

Radio World®

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December 13, 1989

FCC En Banc Airs AM's Ills

by Charles Taylor

Washington DC The problems are many, the remedies—elusive was the general consensus of opinion expressed at the FCC's *en banc* hearing on AM.

Anyone expecting definitive answers to the problems ailing AM radio—technical or otherwise—was likely disappointed after five hours of testimony at the FCC's comprehensive hearing on

AM improvement here 16 November.

While the band's problems—from technical and marketing to receiver design—were spelled out in great detail by the 26 broadcasters and related industry participants who testified, few new solutions of relevance saw light.

The forum's value, however, may become clear when the proposals are incorporated into pending rulemakings that continue to emerge from the mas-

sive docket MM 87-267, aimed at defining AM technical assignment criteria.

In addition to verbal testimony at the hearing, many more participants filed written comments, all of which will be incorporated into the docket for comment and hopefully, action.

The hearing was split into six panels, during which speakers focused on the difficulty of running a business in a spectrum filled with interference, undecided standards and a wait-and-see attitude regarding future improvements.

Complaints about AM's lack of parity with FM ranged from accusations about the Commission's failure to choose an AM stereo standard, to cries for better fidelity AM receivers to a call for a "Big Bang" approach to reducing interference on the band.

Alan Okun of Okun Broadcasting, summarized the feelings of most who spoke: "Action needs to be taken now. We know what we need. We've been on the bench long enough. It's time for AM

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Radio Makers Frown At AM Stereo Bills

by John Gatski

Washington DC Several audio receiver manufacturers are opposed to a radio improvements bill that would mandate AM stereo capability in receivers equipped with FM stereo.

The opposition stems from the Radio Quality Improvements Act of 1989, HR 2714, which would mandate technical requirements designed as cures to help the ailing AM band.

A hearing for HR 2714 was held by the House Telecommunications and Finance Committee in October and was favorably received on Capitol Hill, but no other

action has been taken so far, according to the subcommittee.

Receiver companies said the decision to include certain features on radio receivers should be left up to the manufacturers, not the government.

"Quite honestly, we think that if the government mandates how products should be made, you are taking away consumer rights," Sony Corp. Executive External Affairs VP Bob Dillon said.

Dillon said government interference in selection of receiver features will add to the cost of a receiver for consumers. However, he did not give a cost estimate.

(continued on page 8)



Antenna patterns from the air? See story, p. 20.

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STL Extension Asked

by John Gatski

Washington DC Because time is running out for stations to type notify their STLs by the July 1990 deadline, at least one broadcast group has asked the FCC for an extension.

The FCC, however, said it has not yet decided whether to extend the deadline because individual stations or STL manufacturers have not complained about a lack of time to comply.

Society of Broadcast Engineers attorney Chris Imlay said the organization has filed for an extension on behalf of the thousands of stations that use STLs, many which were made before 1985.

Alerted by NPR

Imlay said SBE became involved after being appraised by National Public Radio about the possibility of stations not being able to receive type notification in time to comply with the deadline.

Also, significant costs for upgrades and unnecessarily forcing stations to conform to rules based on an old STL

technology is not cost effective for stations, Imlay said.

In a filing made before the FCC in November, the SBE said: "It is the position of the SBE that the requested extension or waiver (of the deadline) is necessary to avoid a severe hardship and expense to large numbers of broadcast licensees.

"Further, the requested extension will allow more time for development of digitally-based STL systems, as opposed to forcing licensees to prematurely invest in older analogue STL systems."

According to NAB Science and Technology VP Michael Rau, the NAB soon may announce its position on the fast approaching deadline, which has confused manufacturers and stations.

"We have not decided precisely what we plan to do about the issue," Rau said. "It's definitely an option to try and get an extension of time."

FCC Engineering Policy Branch Chief Jim McNally said the SBE's is the only request that has been made for an extension

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NEWS BRIEFS

TV Station Uses KYW Newsradio

Philadelphia PA When independent WPHL-TV begins local news broadcasts in January, the station will rely on all-news KYW Newsradio 1060 for its coverage.

WPHL will rewrite and broadcast three, 60 second news updates nightly. In exchange for providing the news material, WPHL will air the radio station's promo spots.

About the agreement, WPHL

Station Manager Steve Mosko said, "I believe these synergistic arrangements will be the norm, not the exception."

NAB Receives Presidential Award

Washington DC The NAB and the Broadcast Industry Productivity Council were selected to receive a 1989 Presidential Award for Private Sector Initiatives.

The award recognizes their "Work Works" program

designed to help out-of-school and at-risk youths get job training and skills.

"Work Works" is a cooperative, and almost totally volunteer project co-sponsored by the National Alliance of Business.

RAC on AM Interference

Washington DC The FCC Radio Advisory Committee has recommended that the Commission, at a minimum, should not permit greater interference to Class I skywave service areas than that permitted under current rules.

But the committee said it was unable to reach a consensus concerning adjacent channel

protection to skywave service of Class I stations because of concern over freezing the ability of other existing stations to modify facilities and questions regarding methods of calculation including the determination of existing interference.

The report was submitted to the FCC as part of its *en banc* meeting on AM. (See separate story.)

AP on New Digital System

Washington DC Associated Press Network News will be delivered on a new digital audio transmission system, "T-1 Audio Delivery" (TAD), according to AP.

The TAD system will be provided at no extra charge to AP Network News affiliates and is expected to significantly improve the technical quality of programming.

Analog transmission will continue on Westar IV and Space-net 3, Transponder 1, for the several years it will take to complete the new system. Conversion is scheduled to begin at the end of 1989.

TAD technology will allow remote control of hardware equipment, much like the selectivity features of AP's high-speed broadcast wires. For instance, one audio card will be capable of receiving a 7.5 or 15 kHz signal and can be programmed to add or change audio network signals without having a technician visit the station.

NAB Announces '90 Chairs

Washington DC The NAB has announced its chairmen of the 1989-90 committees.

Among those on radio-related committees are: AM Improvement, Art Suberbielle, president/GM KANE-AM, New Iberia, LA; AM Receiver Manufacturer Liaison Task Force; Ted Snider, president, Snider Corp., Little Rock, AR; Congressional Relations, (co-chairs) John F. Dille III, president, Federated Media, Elkhart, IN, and Patricia Smullin, president, California/Oregon Broadcasting, Medford, OR.

Others include Engineering Advisory, Milford K. Smith Jr., VP engineering, Greater Media Inc., East Brunswick, NJ; Engineering Conference, Don Lockett, director of engineering, National Public Radio, Washington, DC; FM Transmission, John Marino, VP engineering, NewCity Communications, Bridgeport, CT, and Group Radio, Michael Osterhout, president/CEO, Edens Broadcasting, Tampa, FL.

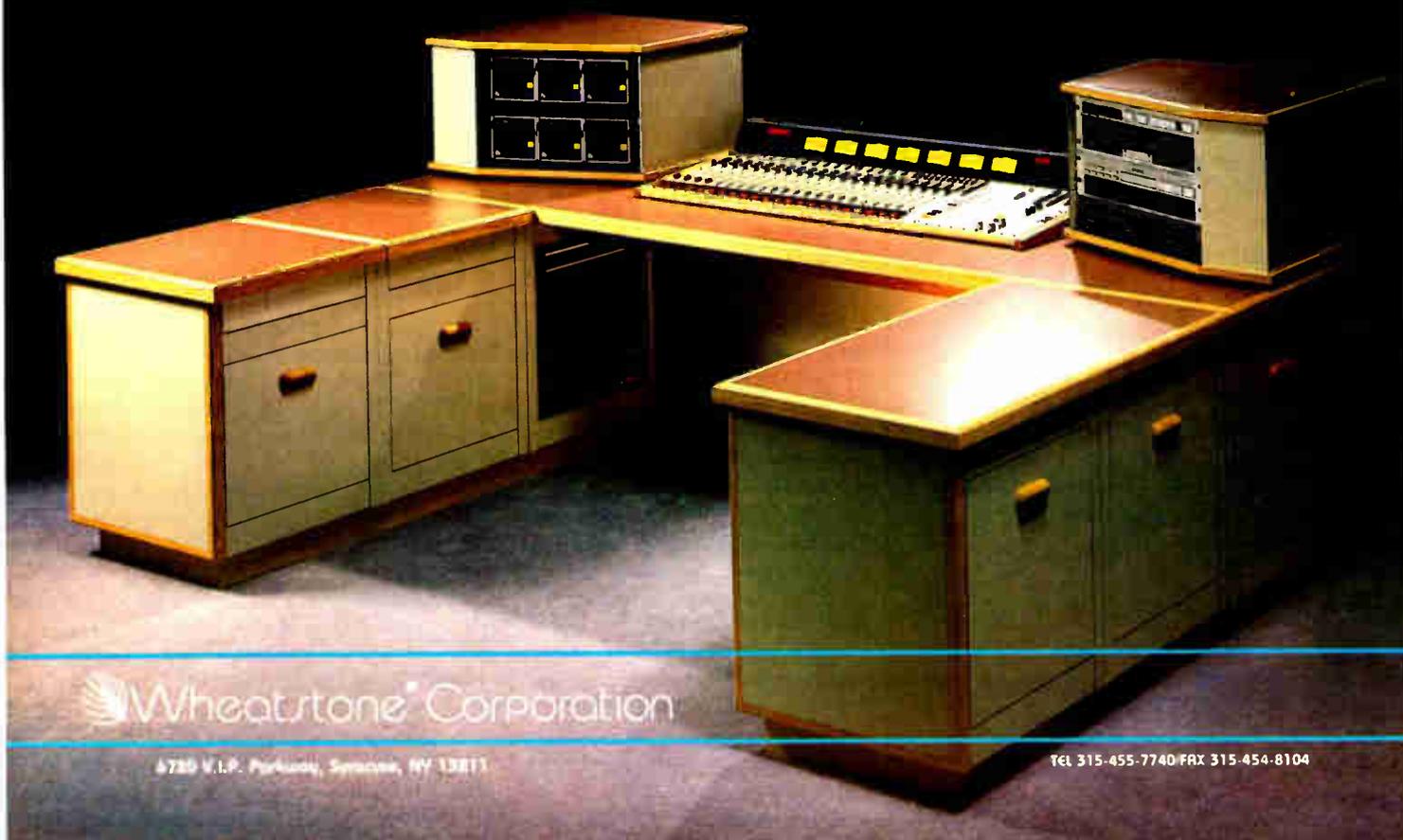
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Composite Group Seeks Goals

NAB Tries To Prevent Press Coverage As NRSC Group Convenes

by Judith Gross

Washington DC Whether or not it would be possible to develop and generate widespread acceptance of a composite "mask" to mitigate the effects of heavy processing of FM signals is the question currently before the NRSC working group on composite studies.

The group, part of the NRSC's FM subgroup, met here in mid-November to try to define the scope of its work. Unlike a previous meeting held in April in St. Louis, notice of the recent meeting was sent to the entire NRSC mailing list, according to the NAB.

Special invitations

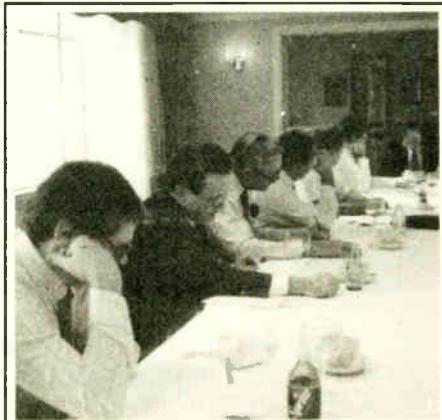
In addition, manufacturers of processing gear, including Eric Small of Modulation Sciences, Frank Foti of Cutting Edge Technologies, Robert Orban of Orban Associates and Greg Ogonowski of Modulation Index were specifically asked to participate.

Chuck Adams of CRL, also present, had attended the April working group meeting.

Foti and Small were present, although

Small noted he was present "as an observer only" in light of a dispute over a paper critical of composite clipping the committee had accepted from Adams at its previous meeting. Small has said he is exploring the possibility of legal action stemming from the committee's actions.

At the start of the meeting, NAB Legal Counsel Valerie Schulte attempted to interfere with press coverage by prohibit-



The NRSC subgroup ponders future directions.

ing a tape recording by RW, although past subgroups and full NRSC meetings have been recorded without incident by press and other participants.

Schulte claimed the prohibition against recording is "NAB policy" although none of the committee notices



Composite working group Chairman Ed Anthony (center, left), NAB Legal Counsel Valerie Schulte and MSI VP Engineering Eric Small

state such regulations. She also indicated members of the press were present "as guests of NAB" and as such could be ejected from the meetings.

However, after a private conference with committee chairman Ed Anthony and NAB Science & Technology staff, Schulte said press coverage and recording could continue pending referral of the matter "to the full NRSC."

Is it broke?

Anthony outlined the group's initial objective as stated by John Marino, who was not present, as "investigating the effects of overall processing techniques on an RF transmission system."

Anthony added that the group had expressed interest in attempting to head off the narrowing of the bandwidth of FM

receivers, which one receiver manufacturer has claimed is a result of over-modulation and aggressive processing.

Discussion about the current trends in processing focused on the use of clipping, with scattered talk about over-modulation and stations which purposely boost their modulation above legal limits in order to boost ratings.

"Radio stations are choosing in a competitive environment to transmit an affected sound," noted Foti, who has been a consultant to such power stations as New York's Z-100 and LA's Pirate Radio, which have used a certain processed "sound" to achieve high ratings.

EIA consultant Eb Tingley, among others, asked if the effects of processing hurt only the station itself or if they caused occupied bandwidth problems.

Since little data is currently available on the effects of processing on occupied bandwidth, the group asked Foti to begin further studies and report back to the committee at a later date.

Composite mask

The idea of a composite "mask" to protect a station's SCA and pilot from the effects of heavy processing came from

(continued on page 17)

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Please Don't Kill the Messenger

by Judith Gross

Falls Church VA Well, they've done it again.

Hate to keep carping on this, but what is NAB afraid of, trying to stop us poor, humble journalists from bringing news of NRSC committees to the folks who will be most affected by their actions?

This time it was NAB legal counsel Valerie Schulte, trying to prevent tape recording and threatening ejection of your ole pal from the working group on composite studies.

What are you guys hiding, anyway?

It was a roomful of competitors in the processing game, true. Eric Small was there as "an observer." But there was no mention of anything sticky, legal-wise. It was just your ordinary, six hour, overheated room, what-are-we-attempting-to-accomplish-here meeting.



Not a nasty jibe in sight. So let's lay off the press, OK? Let's not shoot the messenger. Maybe Shakespeare knew more than we thought when he opined that we ought to lose all the lawyers. (Actually he said "shoot" but I'm being kind for a change.)

☆☆☆

And exactly what are these committees trying to accomplish? Composite working group chairman Ed Anthony said it best in his question during the meeting. "What's the consensus here, is it broke, on its way to being broke, or are we just wasting our time?"

Sure, it was different with the AM NRSC standard. Most everyone agrees

that AM is in some kind of trouble. So AMers decided to play good guys and pull back their occupied bandwidth and put a ceiling on preemphasis.

But is FM broke?

All we got is one paper from one car receiver manufacturer intimating that modulation and processing can be factors in receiver design. Ford's Rick Zerod said maybe they will cause narrowing of the bandwidth in FM receivers.

So the sky is falling, huh?

Yeah, and maybe car buyers will do what some of us did when we negotiated for a new car and tell 'em to yank the radio. You need to pay \$200-\$500 for a radio that doesn't even let you get AM in stereo? I didn't.

Let's just say a lot of scenarios are possible with this one, maybe some not even thought of yet.

Hey, if I were an overseas aftermarket receiver manufacturer, I'd be jumping for joy. Go ahead, Detroit. Now muck up the radio receivers. You already blew it with economy cars.

☆☆☆

And you well-intentioned folks crying gloom and doom, saying that people will stop listening to the radio and only play CDs if stations keep processing, well let's agree to disagree, OK?

You can't get weather, news, the bulletin about that accident on the freeway up ahead and sometimes not even the latest music from the CD you bought last week. Not to mention the most important items of all: Mets games and the football scores.

When was the last time a car cassette player gave you the point spread?

☆☆☆

Is it just me, or do the NRSC committees seem to be going through an identity crisis?

Sit through enough of those six-hour deals in DC and you start to wonder

where it's all heading. I say bring back the champagne Charlie Morgan had at the NRSC meeting in Las Vegas. Maybe we won't notice the overheated room.

Why did the FCC *en banc* meeting on AM's problems sound like a lot of folks patting themselves on the back for how they've already helped AM?



"Banc-ing" on solutions for AM.

I suppose we were all gathered there just for our health?

FCC Chairman Al Sikes had really done his homework before the meeting. His questions were right on.

So now minorities, public stations and daytimers all want a piece of the expanded AM band pie. Maybe there's enough room for all of you.

If I were the Black Media Coalition, I would most definitely want their counsel David Honig speaking on my behalf. Eloquence on the 8th floor of 1919 M Street is not all that common.

☆☆☆

Hope the esteemed Commissioners got the message about AM stereo loud and clear. Yeah, you goofed. We need a standard. But if you aren't up to that, just require stereo from everyone.

I know that idea hasn't exactly caught fire among many impoverished stations. But hey, if we're going to require radio makers to put in AM stereo, fair is fair.

Had a nice chat with Russ Gentner and Gentner's east coast rep Walt Lowery, in town for a visit. The company is zooming ahead with all kinds of new goodies, some of which I'm sworn to

secrecy about.

But they did show me the new SPH-5 analog hybrid designed with many of the same features as the Digital Hybrid II. It'll be available in about two weeks.

And what's Gentner doing up the road? Hint, hint. Think processing. And think digital.

And by the by, Gentner also got a patent for its voice remote control unit, the VRC-2000. Russ says the company plans to enforce the patent rights through legal measures to protect the technologies which went into its development.

☆☆☆

Lots of stations do lots of neighborly things which go unmentioned. But I have to tell you about WAEB, the Allentown FM doing those multipath tests.

The station held a Radiothon and raised \$132,000 for Camelot for Children, a home for chronically and terminally ill youngsters set to open next year.

As CE Harry Simons told me, there's gotta be more for these kids than just sending them to Disneyland. Yeah.

Oh and let's hear it once more for FCC Chairman Sikes. He made good on his promise to staff. They got rid of the rotary dial phones.

But will it speed up the Class A upgrades?

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Underground storage

Dear RW:

I read your recent article on testing of underground storage tanks (USTs) with some interest. I called the EPA at the numbers indicated and received some further information which seems to contradict some of the information printed in your paper.

I quote now from the Federal Register, Vol 53, No 185, Friday September 23, 1988, Part II (Environmental Protection Agency 40 CFR Parts 280 and 281 Underground Storage Tanks; Technical Requirements and State Program Approval; Final Rules).

On page 37109, I quote, "UST systems that store fuel solely for use by emergency power generators are deferred from the release detection requirements under Subtitle D. All other regulatory requirements apply to these tanks."

On page 37113, regarding UST systems associated with emergency generators, it further states, "In today's rule, EPA is deferring Subpart D requirements for UST systems associated with emergency power generators. Such tanks are common in the telephone industry and electric utility industry. These tanks often store diesel fuel which serves as a source of backup power in remote locations (for example, at telephone switching locations). This is a deferral of the release detection requirements only; owners and operators of these systems must comply

with all other subparts of this rule.

"Several commenters argued that these tanks should not be regulated at all for the following reasons: they are generally small in size (typically under 500 gallons); most are less than five years old; they are often at unmanned stations in remote locations; they contain diesel fuel, which is less mobile than gasoline due to its higher viscosity; and many are filled only annually.

"The Agency does not agree that these reasons merit an exclusion from the UST regulations. The requirement that these tanks be monitored each month is unworkable, however, because they are often located in remote areas and are visited infrequently. Therefore, EPA is deferring Subpart D requirements for these tanks to allow time to develop workable release detection requirements for these tank systems."

Ed Mielke, Engineer
WJR Radio
Detroit, MI

No mandatory stereo

Dear RW:

I have to strongly disagree with your suggestion that all AM and FM stations be required to adopt stereo or "turn their license in."

Our FM operation (Class A) is one of the very few FMs (commercial) which is not broadcasting in stereo. Basically, we don't believe the programming we're most proud of and serve the public best with has to be in stereo.

For instance, local news, local weather, local information (lost and found, date-book, classifieds, farm report), local remotes, pro, high school and college sports play-by-play, talk shows, and more are not enhanced significantly in stereo. Yes, we air music, but that's very secondary in our format.

Please also consider this: it's 6:00 AM and our typical listener is waking to a clock radio. Stereo needed? Nah. How about frying that bacon with the kitchen transistor on. Stereo needed? Hardly. Dad's shaving and showering in the bathroom. Can you imagine one speaker poised on the back of the toilet with the other hanging from the shower curtain rod? I don't think so. And at the office, the receptionist quietly keeps a pocket radio by her side. She can hardly hear the radio, not to mention hear it in stereo.

I'd have a fit if the FCC took away my license for not going stereo. I think my community would have a fit, too.

Frederic C. Hirsch, GM
WDME AM/FM
Dover-Foxcroft, MA

Why protect clear channels?

Dear RW:

As an avid radio listener, and, as more than that, a fan of radio and a post-graduate student in the Department of Broadcasting at the University of Tennessee, I wish to convey my displeasure over the way in which the 50,000 W AM clear-channels continue to insist on the

The SBE's filing asking the FCC to extend the July 1990 deadline for type-approved STLs appears, at first blush, a well-intentioned effort on behalf of stations' technical staffs.

But the evolving situation with the rule requiring FCC approval renders such a move unnecessary.

For one thing stations have already had five years to plan for the new rule, which grew out of the need to provide more STL frequencies.

Secondly, all STL manufacturers have been quick to respond with policies addressing the requirement, by applying for or obtaining type-approval and by offering upgrades to equipment already in the field.

Stations with STLs which meet the requirement will receive certification from manufacturers. And while those whose equipment needs to be upgraded will have to pay for some of the modifications, there will still be a cost savings over the price of a new STL.

No Need For STL Extension

But many engineers see the new rule as an opportunity to persuade management to upgrade existing equipment—or purchase new gear. Some of these stations are already contemplating switching STL frequencies or buying new units and the approaching deadline will help foster their decisions.

Unfortunately, it sometimes takes the clout of an FCC rule to get management to budget for new equipment.

FCC staff has said the Commission is not inclined to grant an extension unless there is strong support for it from a majority of stations. The SBE is not speaking on behalf of such a majority in seeking the extension.

And it's puzzling that a group which purports to represent engineers, which should stand in favor of better technical operations, would propose action which would benefit managers more concerned with the bottomline than with the performance of their technical plants.

In the end, SBE's request could hinder the good efforts of the very stations they are trying to help.

—RW

antiquated rule prohibiting nighttime drop in AM stations on their frequency.

I realize that AM clear channels were needed during the infancy of radio because of the lack of local service. I, further realize that AM clear channels continue to provide a window to the world for many radio listeners, particularly those of us who are sports fans, who catch our favorite team's broadcasts on an AM-clear channel.

Nevertheless, with the advancement in radio technology, I can see no reason why daytime only stations on the clear channel band cannot be allowed to broadcast at reduced power within five to ten miles of their transmitter site at night.

A perfect example on point is radio station WTNN, licensed to Farragut, Tennessee, a suburb of Knoxville. I frequently commute to Knoxville, and I enjoy listening to the only station within a 200 mile radius of my home which plays the "Breeze" format which I enjoy. This station also carries the local high school football and basketball games, which I enjoy very much also. Nevertheless, they are constrained to carry these games on a tape-delay basis, even though, I would guess, they are doing this as a service to the community, because they have no nighttime authorization.

The clear channel which takes up this band is WMAQ Chicago. WMAQ is an

all-news format, and it is all Illinois news at that. The only time I ever listen to WMAQ is to catch an occasional Chicago White Sox game, but, frequently, I find that WMAQ is drowned out by interference from Cuban and Central American stations occupying that band.

I do not know why WMAQ Chicago is so afraid of WTNN Farragut, when WMAQ Chicago does not serve the Farragut/Knoxville metropolitan area. WTNN Farragut serves the local interests; after all, isn't that why radio was established—as a public service? I cannot see why WMAQ needs a 700 mile monopoly on its frequency, when those of us living in the fringe areas of the band cannot pick up the station anyway.

With the concerns over the alleged demise of AM radio, it would seem only natural that the FCC would allow stations such as the one alluded to previously to drop in at night on reduced power. These stations could provide a lot of things to their local communities that the 50,000 watt powerhouses could not. Furthermore, I do not see where stations such WMAQ, or any of the other 50,000 watt giants, would lose advertising revenue if a station a few hundred miles away decided to broadcast at night to a radius of five to ten miles within their transmitter site.

Francis X. Santore Jr.
Santore & Santore, Attorneys at Law
Greenville, TN

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Next Issue RW
Dec. 27, 1989

Before we changed the rules of the processing wars, we made sure we were following the FCC's.

ModMinder's revolutionary digital modulation measurement technology has caused plenty of excitement and considerable comment. Not to mention the occasional unfounded rumor.

This excerpt from an Opinion of Counsel prepared for Modulation Sciences by the respected FCC law firm of Bechtel, Borsari, Cole & Paxson in Washington D.C. should clarify the picture. The Opinion is based on consultation with a Professional Engineer, and on exhaustive research covering FCC Rules and Reports and Orders as well as case law. After all of that, attorney Harry Cole's Opinion is this:

"I understand that... [the ModMinder™] has been designed and manufactured to satisfy the FCC-defined standards for type approval in effect prior to the 1983 deregulation. It is my opinion that, assuming that [the ModMinder] does in fact meet these standards, and thus permits monitoring of a station's modulation consistently with the last rules in effect for such equipment prior to the elimination of the modulation monitor requirement in 1983, then correct installation, regular maintenance, and proper operation of [the ModMinder] should be sufficient to assure compliance with the Commission's modulation requirements."

Harry F. Cole, Esq.

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World Radio History

AM Hearing Reveals Problems Are Many, Solutions Are Elusive

(continued from page 1)

broadcasters to get back in the game." NAB Joint Board Chairman Lowry Mays said broadcasters aren't looking for a quick fix from government. "We are asking that industry and government work together to tackle these technical issues..." he said. "When 1991 comes, let us have met the AM improve-

ment challenge and watch as a new AM band grows and prospers."

ness or putting our money into CD or money market accounts that pay a 9% return?" Abel said.

The view was supported in testimony

"It (AM) must be able to sound just like FM to survive."

from communications broker Richard Blackburn. "AM is viewed as noncompetitive and not a factor in the marketplace," he said. "Prices are going down. It must be able to sound just like FM to survive."

One much-needed improvement,



Commissioner Andrew Barrett reviews a document submitted to the FCC.

agreed most panelists, is AM stereo. The FCC was scorned by some for adopting a marketplace stance in the early 1980s for the selection of a stereo standard,



A near-capacity audience listens with rapt attention to the proceedings.

which they argued had stalled the technology from flourishing.

A strong recommendation was that all receivers sold in the US that are equipped with FM stereo also be capable of AM stereo, as required in HR 2714, The Radio Quality Improvements Act of



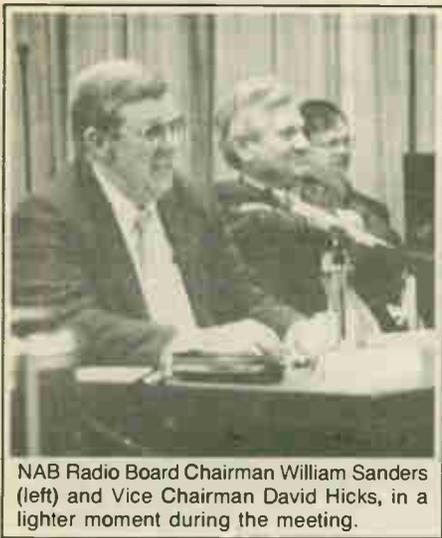
Commissioner Sherrie Marshall

1989, currently before Congress.

In response to support for the idea that all FM stereo radios be equipped with AM stereo, Sikes questioned whether AM broadcasters would be as eager to support a mandatory requirement that they broadcast a stereo signal.

"AM broadcasters should have to keep

(continued on page 8)



NAB Radio Board Chairman William Sanders (left) and Vice Chairman David Hicks, in a lighter moment during the meeting.

ment challenge and watch as a new AM band grows and prospers."

Demonstrating how challenging that goal may be, NAB Executive Operations VP John Abel presented a stark financial portrait of AM. According to his data, the average fulltime AM today yields an annual loss of \$3973 against \$246,579 in revenues. Station values, judging AM sales over the past few years, have depreciated an average of 4% annually, he said.

"Many AM broadcasters are asking themselves: With a financial picture like this, are we better off running this busi-



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Opposition to AM Stereo Bill

(continued from page 1)

He said Sony has not seen a great demand for AM stereo receivers, although the company still makes an auto receiver with AM stereo.

Congress not best designers

Tom Friel, executive VP of the Electronic Industries Association's Consumer Electronics Group, said most receiver manufacturers are reluctant to have the government require what features should be included in their products.

"When Congress starts being a technical advisor in our products, we don't think that is a good thing," Friel said. "We don't think that Congress is necessarily the best design shop."

In testimony before the FCC's AM *en banc* hearing in November, Panasonic Audio Information Systems Division As-

Dillon said government interference in selection of receiver features will add to the cost. . .

sistant Director Robert Finger said receiver features are and should be the result of the market forces.

"We believe that consumers should decide on the selection and availability of the audio product features such as AM, FM, mono and stereo," he said.

Same as UHF/VHF

Proponents of the bill believe mandating AM stereo on FM stereo receivers is no different than a 1962 law that required TV manufacturers to include UHF tuning along with VHF.

The EIA, however, said the analogy does not hold up.

"You are talking about two different things," Friel said. "That argument can't be accepted on its technological or conceptual merits."

According to Friel, UHF was a brand new feature that needed a "boost" whereas AM stereo has been around several years and customers already know it is out there.

At the *en banc* hearing, FCC Chairman Al Sikes alluded to a potential unfairness of requiring AM stereo capability on receivers by the manufacturers, but not requiring stations to broadcast a stereo signal.

Mandatory AM stereo

At one point, Sikes asked a station owner whether all AM stations should be required to convert to stereo if re-

ceiver manufacturers are required to include the capability as a standard feature.

The broadcaster said he believed it would be a good idea, but acknowledged that it would not be cheap for stations.

Although they oppose mandatory AM stereo as a receiver feature, manufacturers and the EIA favor the FCC setting an AM stereo standard.

"We do believe the FCC should select an AM stereo standard," EIA General Counsel Gary Shapiro said.

Industry analysts believe the sluggish acceptance of AM stereo can be at-

tributed to the FCC declining to set an AM stereo standard.

Receiver manufacturers said the selection of a standard would do more to help AM stereo than requiring companies to add the feature on the receiver.

Less than 20% of AM stations broadcast in AM stereo. C-QUAM, developed and produced by Motorola is considered the AM stereo *de facto* standard, with a majority of stations on the air using that system.

For information, contact Tom Friel at the EIA, 202-457-4914, Bob Dillon at Sony 201-930-6050 or Robert Finger at Panasonic, 201-348-7843.

FCC Addresses AM's Problems

(continued from page 7)

up with the latest facilities, just like McDonalds franchises are required to offer Chicken McNuggets," said Art Suberbielle, president and GM of KANE-AM in New Iberia, LA, and a member of the NAB Radio Board and chairman of NAB's AM Improvement Committee.

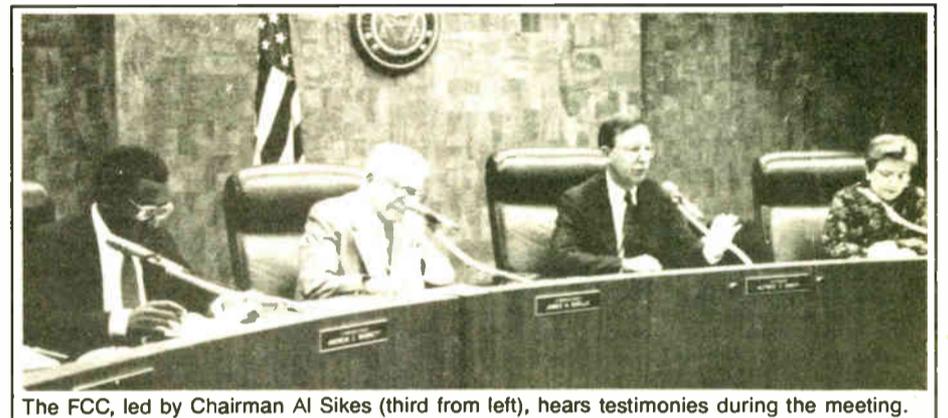
Suberbielle added that he was speaking for himself only, since the NAB



NAB's John Abel (left) and Lowry Mays

board has stopped short of endorsing a mandatory stereo requirement.

Comments from AM station owners magnified other dilemmas that challenge



The FCC, led by Chairman Al Sikes (third from left), hears testimonies during the meeting.

business.

Arlen Diamond with KSMU and a professor at Southern Methodist University presented a study on listener perceptions of AM, which showed a negative slant toward even good quality sound if it were associated with AM.

Diamond supported continuous dialing on receivers, comparing it to modern televisions. "Consumers see numbers on the TV go up from two and up the dial. They don't even know VHF and UHF. Why continue to assimilate the way AM and FM stations are broadcast?"

Richard Harris with Group W Radio offered a list of hard hitting improve-

ments that would pave AM's way toward recovery. His ideas included allowing companies to own more than one AM in a market (a move the FCC has taken by easing restrictions), eradicate the simulcasting of FM programming over AM and offer tax breaks for AM owners.

A separate panel at the hearing focused on the expanded AM band, with minority interests, public broadcasters and daytimers expressing interest in the new allocations (see related story, this issue).

All testimony from the *en banc* meeting will be available for reply comments through 18 December.



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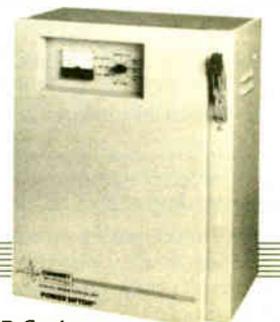
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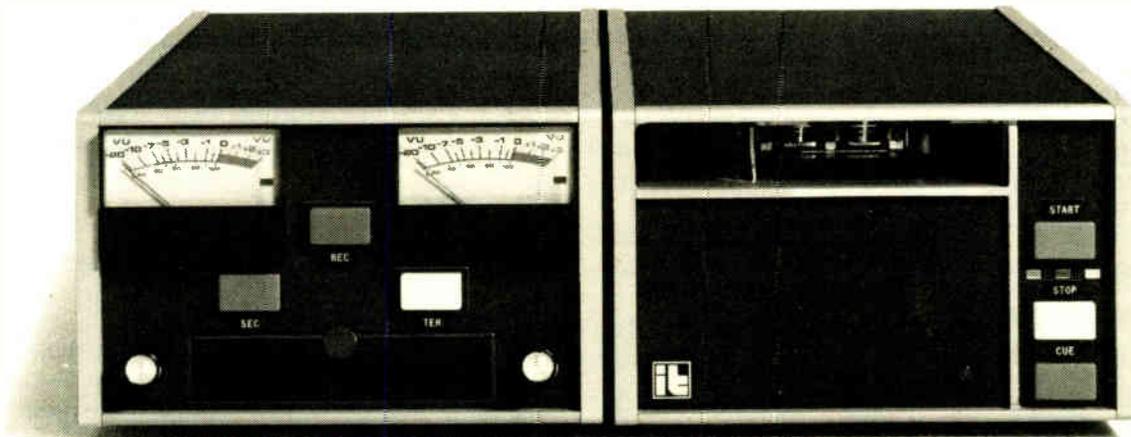
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Sikes Airs Views on AM's Lot

by Alan Carter and Charles Taylor

Washington DC When all is said and done, FCC Chairman Alfred Sikes believes the fate of AM radio rests in the hands of AM broadcasters themselves.

"I think a lot of what happens over the coming years with AM is going to depend on what broadcasters do, whether they make investments in their studios, control rooms, transmitters," Sikes said. "It's going to depend on whether they make investments in programming, talent."

The notion that the FCC is going to bring AM to parity with FM in one broad swoop by changing rules here and there is not exactly realistic, he suggested in an interview with RW just prior to the *en banc* hearing on AM.



FCC Chairman Al Sikes

Maintaining integrity

But Sikes continued that the Commission is charged with maintaining the integrity of the spectrum and must study a wide range of issues: from man-made interference to complaints that the FCC packed the dial with too many stations.

AM is among the high-profile

issues—along with indecency—that Sikes has taken the FCC into since assuming office three months ago. He came to the Commission from the National Telecommunications and Information Administration (NTIA), where he was director.

Considering specific proposals for AM, Sikes said he personally believes

stations should broadcast in stereo. But he maintained that the FCC should not require AMs to convert.

"We didn't require FM stations to go stereo," Sikes said. "I think they (AM broadcasters) have to decide what the asset means to them."

AM broadcasters "serious" about the business will make investments across the board, Sikes continued. "An investment I hope to see them make is the stereo investment. But there might well be stations that have formats that are quite comfortable with a monaural transmission and I'm not going to require them to go stereo."

Stereo receivers

Sikes said some responsibility for AM's fate belongs to receiver manufacturers. AM stereo receivers sound better, he said.

Angeles and New York unless stations complained to the Commission.

"I think that somebody who tweaks a signal to the point that it becomes an annoyance to the listener is simply hurting himself," Sikes said. "But it becomes an FCC issue when he tweaks it so that it interferes with a competitor or others on the dial."

In the future

Looking ahead, Sikes said calls for spectrum studies throughout the industry and on Capitol Hill bring attention to the "importance" of spectrum and the "difficulty" of dealing with its limited quantity.

But, he continued, "I think it's safe to say you're going to see an accelerated effort in this area aimed at reducing interference, capturing spectrum that can be reclaimed and moving more

AM broadcasters "serious" about the business will make investments across the board . . .

But again, Sikes backed off supporting a requirement that manufacturers put AM stereo on all radios that have FM stereo, as suggested by legislation proposed in Congress.

"The problem is simply this: Every time the government orders manufacturers to do particular things, it results in costs for the consumers."

The bottom line for AM, from Sikes' perspective, is to get the band "to a position equal to what the laws of physics will allow. Clearly, AM is not there."

In other areas, Sikes said the FCC would not initiate investigations into the modulation/processing wars in Los

quickly on allocations and trying to put a premium on spectrum pioneering."

With many recent rulemakings at the FCC focusing on spectrum issues, thus requiring extensive paper work, Sikes said the staff is aware of the potential log jam and the disadvantage it places on radio broadcasters. He said he is waiting for proposals from new Mass Media Chief Roy Stewart and Audio Services Division Chief Larry Eads.

"As a broadcaster, I saw ideas and assets on ice as I had to wait in line," Sikes said. "As a public official, I view that one of the first responsibilities of this organization is to serve the public quickly, completely and courteously."



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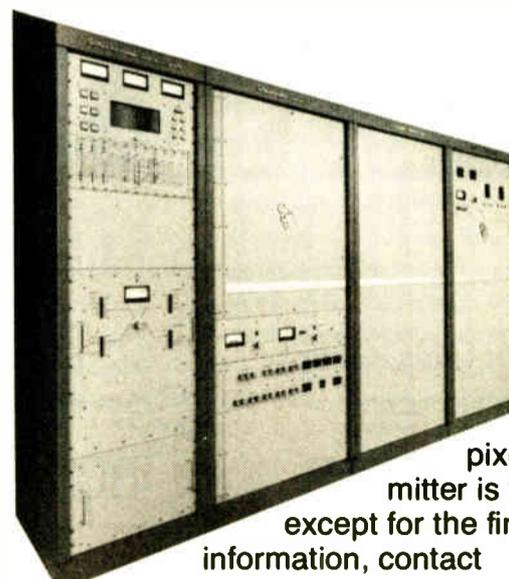
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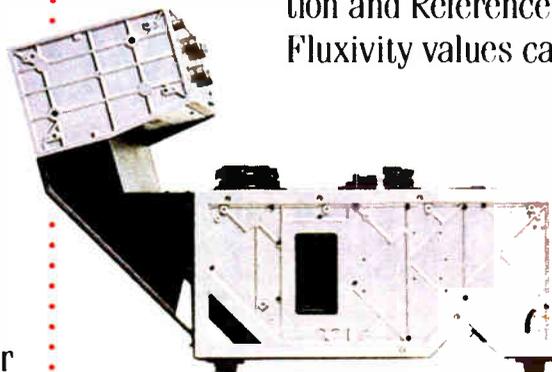
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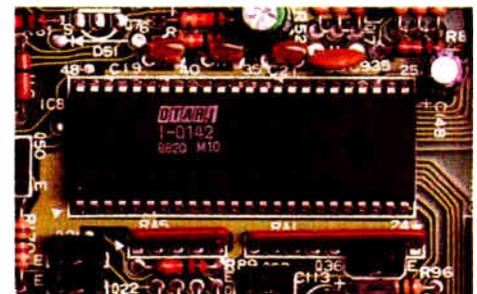


Three cue locations and a zero memory can be accessed via the MX-55NM's built-in locator.

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Shannon's Audio Is the Wind in The Sails of LA's Pirate Radio

by Charles Taylor

Los Angeles CA Punch in 100.3 as you drive down the 405 freeway and something hits you in the face.

"It's like a sledgehammer leaping out of the dashboard at you in the car," said Scott Shannon, who conceived the frequency's Pirate Radio format. "I was looking for a neck-snapping sound."

Shannon has plenty of company. In the past nine months since KQLZ-FM raised the Pirate flag here in one of the nation's most aggressive radio markets, ratings have flown from 13th to fourth.

A lot of the success has to do with powerhouse promotion. Obviously, the mix of top 40 rock and album cuts play a part. But to Shannon, Pirate's audio signature is as important to the formula.

"As competitive as broadcasting is today in the major markets, it's important that you isolate every facet of your operation and then constantly work to make it better and different from the competition," Shannon said. "A unique audio personality is as essential as a unique DJ or a promotional or music personality."

From last to first

The ideal is not new for Shannon, who gained prominence in 1984 when he took New York's WHTZ (Z-100) from



last to first in the ratings in less than three months, using his now-famous "Morning Zoo" format, along with heavy audio processing. His mission there was much the same as it is in LA—to bring together all the elements it takes to be the best.

Pirate Radio set sail 17 March after radio programming conglomerate Westwood One purchased the station in 1988 and felt it couldn't make money from the frequency's then light rock format as KIQQ.

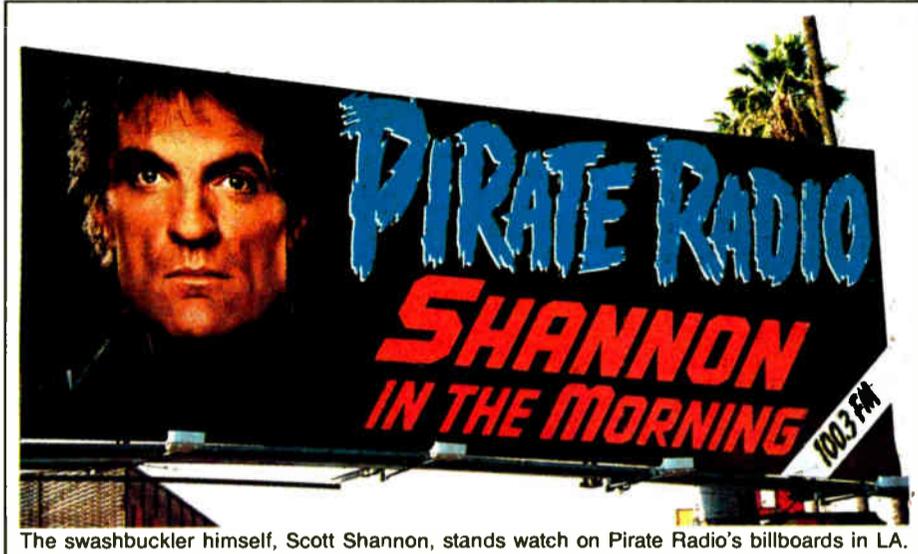
Shannon was brought in by Westwood's CEO Norm Pattiz in January to conquer the market by overseeing the creation of the hybrid Pirate format.

But ultimately, Shannon concedes that his talent is programming and that much of the sound of a station he works with is devised by engineering staffs that collaborate with him: "I try to stick with people who know Scott Shannon and have worked with me before."

Patterned after Z-100

The Pirate sound was tailored in part by Frank Foti, president of audio consulting firm Cutting Edge Technologies, who also helped Shannon design the sound for Z-100. "He was the architect there and patterned this one after the Z-100 sound."

Aside from the competitive theories,



The swashbuckler himself, Scott Shannon, stands watch on Pirate Radio's billboards in LA.

the station's carefully orchestrated audio chain is designed as a weapon to battle the station's less-than-ideal signal strength.

"We're not in the top three as far as signals (strength) go," Shannon said, "so rather than have a powerful signal, we have to have a powerful sound. Thus, we pay a lot of attention to the overall sound of the radio station, the equalization, the compression and all the elements that are important to the sound."

Every goofy claim

It's also essential for the station to keep its unique sound a quantum leap ahead of the competition. "We have to know what new equipment is being developed and look into every goofy claim and every little new invention or box that someone comes up with. You've got to stay on top of it constantly and make it a priority," he said.

Shannon added that other stations in the market have made moves to close in

on Pirate Radio's sound. In New York, he said, it took Z-100's CHR competitors seven, nine and 12 months to react with more dramatic processing and a push toward peak modulation. In Los Angeles, he said the chase has been much faster: "They all want a piece of the Pirate," he said.

"The Emmis station, Power 106 (KPWR), reacted very quickly to our changes. They were already close to maximizing their potential, but they added reverb before I arrived—something I always do—and then added a little more compression and did some things to make it louder."

KIIS FM (102.7), another CHR super power, also made some "obvious" changes, Shannon said, about 90 days after Pirate debuted.

And then there is the new kid on the airwaves, KKBT (92.3), which abandoned its classical format in September for "Rock with a Beat." In an earlier interview, Greg Ogonowski, a Los Angeles

engineering consultant who designed KKBT's sound, said he has armed the station for Los Angeles' loudness war.

Maxed-out processing

A number in the industry have warned that the maxed-out processing in LA will result not in being the strongest voice in the market, but instead in blasting listeners to more reserved stations.

Shannon scoffed at the claims.

"I remember reading a comment where one gentleman said that Pirate Radio's audio sound was very irritating and that listeners wouldn't be able to take it very long. I laughed that he was naive enough to think that people sit around



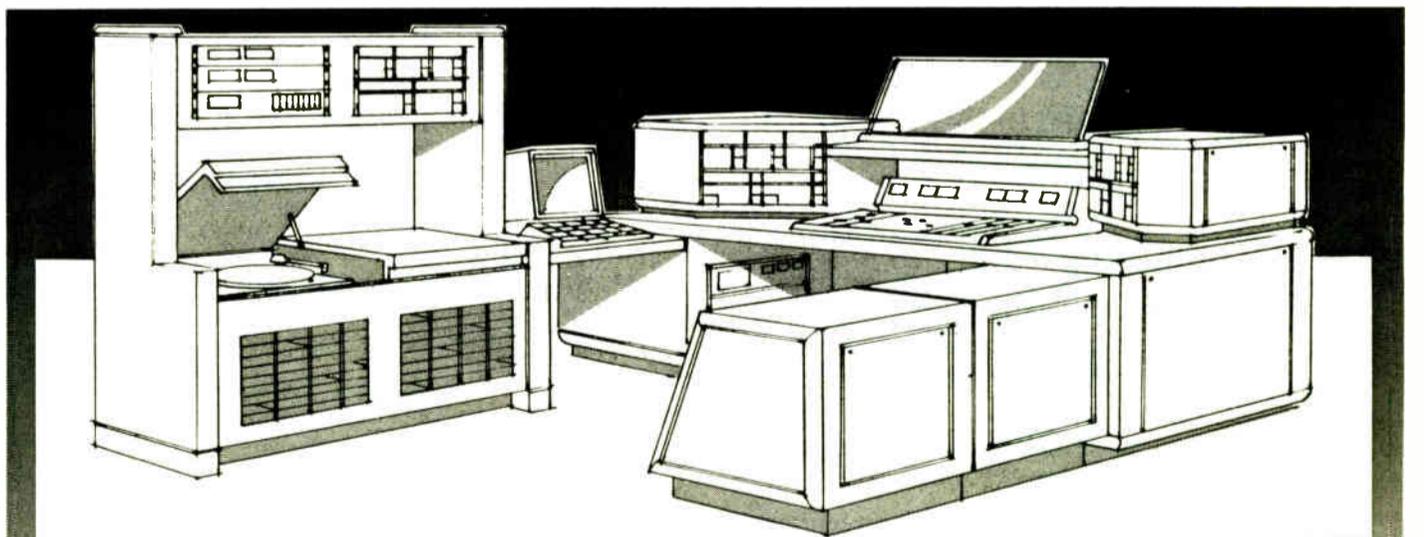
and listen for quality like that," he said. "They're not thinking of it. It's subconscious."

"And now, after a couple Arbitrons, we have one of the longest time spent listening averages of anyone in the market, especially with contemporary music."

But despite Pirate's rapid and impressive climb into the top five, Shannon has no intention of sitting easy.

"The job isn't done yet," he said. "Many people think that they've done a spectacular job getting us top five in LA and #1 with 18 to 35 year olds, but we're really just getting off the ground."

"We won't predetermine the altitude or destination of the project."



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KJOI Purchase Breaks Record

by Frank Beacham

Los Angeles CA Revving the economic engines ever harder in America's most turbo-charged radio market, Viacom Broadcasting has bought LA's KJOI in the richest single radio station purchase deal in history, according to industry observers.

In a transaction valued at \$101.5 million, Command Communications of New York signed an agreement to sell radio stations KJOI-FM, Los Angeles, and KSYF-FM/KHOW-AM, Denver, to Viacom. Though Viacom refuses to reveal the individual purchase prices, a

spokesperson for the seller placed the KJOI portion of the deal between \$85 and \$90 million.

It was the highest price ever paid for a single radio station, said Ann-Mary Diana of The Sillerman Companies. The firm's president, Robert F.X. Sillerman, is a principal investor in Command Communications.

The previous sale record also was for KJOI, which was purchased by Command for \$79 million only 16 months ago.

The deal marks Viacom's entry into the nation's most lucrative radio market. No management or format changes will be made at the station, said Bill Figenshu,

president the Viacom Broadcasting radio division.

KJOI recently switched to a "Touch 98.7" soft-hits format that mixes light jazz and vocals. The station was rated fifth in Arbitron's summer radio rankings in the LA market. The new format places it in competition with soft music-programmed KOST, which got the first-place position in summer rankings in the LA market.

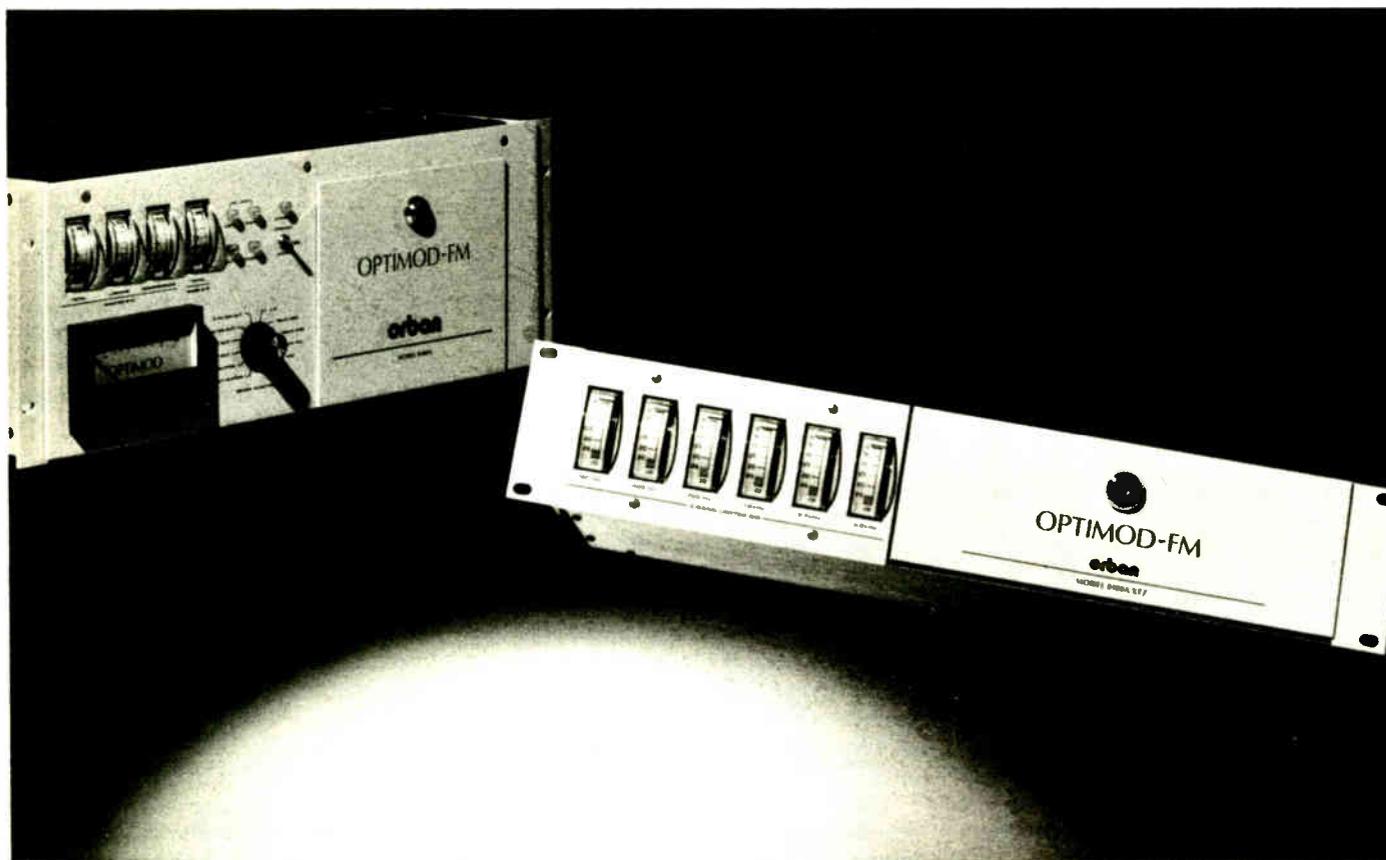
The purchase is "the latest strategic move in Viacom's aggressive pursuit of properties in major radio markets around the country," said Henry S. Schleiff, chairman and CEO of Viacom's

Broadcasting and Entertainment Groups.

In another Southern California station purchase, Westwood One announced it will purchase KJQY-FM, San Diego, as part of a three-part transaction involving Group W, Command Communications and Westwood One. The deal has Westwood One selling its 50% controlling interest in WNEW-AM, New York, to Command Communications for \$15.3 million in cash. The station was purchased in April, 1989, for \$11 million.

The terms

According to the terms of the deal, Westwood One will pay the \$15.3 million to Group W and \$4 million worth of Westwood One common stock priced at \$10.75 per share (372,093 shares) to Com-



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mand Communications to be held for a period of three years. Command recently acquired an option to acquire KJQY-FM from Group W, which will be transferred to Westwood One.

As part of the WNEW-AM transaction, Command has agreed to continue its affiliation with the NBC and Mutual Radio Networks, which are owned by Westwood One. Additionally, the station will continue to program Westwood One-produced talk programming for at least the next two years. The programming includes The Larry King Show and The Bruce Williams Show.



The history-making KJOI sale comes in an extraordinary year in the nation's richest radio market. The Southern California Broadcasters Association has predicted a record-breaking \$399 million in ad sales during 1989. Such an ad climate has fueled record-breaking prices for LA stations.

KFAC, the city's only commercial classical station, changed its format to popular music in September after being sold for \$55 million earlier in the year.

The KFAC change followed another significant Los Angeles station sale in 1989. KIQQ, a soft rock station, was sold to Westwood One in March for \$56 million and turned into a new and highly successful high-energy rock programming concept called "Pirate Radio."

A piece of the pie

The KJOI sale was brokered by American Radio Brokers of Washington, DC. Managing partner Bill Steding, who represented Command, did not respond to requests from Radio World for information regarding the sale.

But Roy Rowan, vice president of the Beverly Hills office of broker Blackburn & Co., called the KJOI sale a unique sit-

(continued on next page)

DigiMod Gives KIIS Its Sound Signature

by Alan Carter

Los Angeles CA This morning, the oscilloscope shows that KIIS-FM is modulating to the limit. To the ears of several of the station's engineers standing around, it sounds louder and clearer than any competitor on the dial.

That's exactly what Paul Donahue wants to hear.

KIIS is Gannett's flagship station, a property here in one of the US's most competitive radio cities. As engineering VP for Gannett Radio, Donahue is concerned about the audio with which the CHR station does battle.

If Donahue needs to be reminded

ing station after station.

"We've been lucky in coming up with techniques that work for us very well," Donahue said.

He doesn't know, or understand, why radio these days has to be "loud," except that is what general managers and pro-



gram directors want. So he does it, with few qualms and no hesitation.

But how he manipulates the sound is something on which he will not compromise.

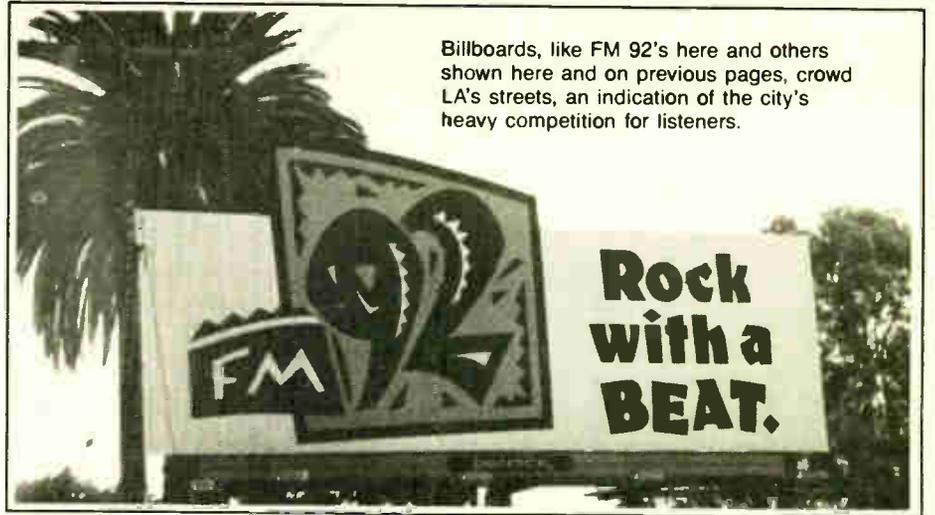
"There are two trade-offs to loudness," Donahue said. "One is distortion, the other is dynamics."

Listeners will put up with only so much distortion, he maintained. "That is a subjective evaluation, and we try to not go beyond that tolerance level."

Dynamics, which he called a psychoacoustic effect, also is subjective. "We



of what he is up against, all he has to do is look out the window of his 11th floor office in the Motown Building on Sunset Boulevard and see the billboards plastered everywhere promot-



Billboards, like FM 92's here and others shown here and on previous pages, crowd LA's streets, an indication of the city's heavy competition for listeners.

have several 'Golden Ears'—a term you'll hear broadcasters use—around the station who evaluate our audio. It might even be an engineer's wife at home.

"If you're going to walk a thin line in modulating and processing—and stations in LA do—you have to work within reason."

The audio chain at KIIS and six other Gannett stations includes proprietary circuitry that Donahue through his engineering design firm, California Digital, developed and markets under the trademark DigiMod 2000. The DigiMod is another in a series of audio processing techniques stations use as they customize their sound.

As he explained, the circuit cards modify an Orban Optimod 8100 when used with a preprocessing multi-band compressor. It allows a station to control the "sound signature" and develop a "distinct stationality," he said.

What that means is engineering can adjust the audio from a transparent to very aggressive sound depending on what best suits the format.

The DigiMod was in the works for two years before Donahue put it on the market in September. He called it a bridge between the analog world of today's radio and the digital world of tomorrow's radio, turning a standard Optimod into a multi-band digitally controlled processor when using CDs and DAT.

When Donahue first tested the DigiMod at some stations, programmers complained the sound was too transparent or too good.

"You could say it sounded like your CD players were connected directly into the transmitter," Donahue said. "We had to make it sound more like radio, more aggressive."

For information on the DigiMod, contact California Digital at 805-523-2310.

Viacom Buy Tops Charts

(continued from previous page)

uation and not a continuing trend in ever higher station prices. "I think Viacom wanted to be in Los Angeles and they knew they were going to have pay a huge sum of money, which they did," said Rowan.

"Can they service the debt out of the radio station?" Rowan asked. "The answer is—to my knowledge without seeing the figures, but I have a general idea what they are—no, they won't be able to service that debt out of the operation of the station."

Rowan speculated that the nearly \$400

million in predicted ad sales in the LA market is a powerful reason for a company such as Viacom to pay such an extraordinary price for a single station. That opinion was shared by Vic Biondi, executive director of the California Broadcasters Association.

"You can't consider a sale like this out of context," said Biondi. "The Los Angeles market has had a marvelous two years. It has grown and it continues to grow. And quite frankly, if Viacom saw the potential, you have to respect their decision. I have to assume they think it is realistic."

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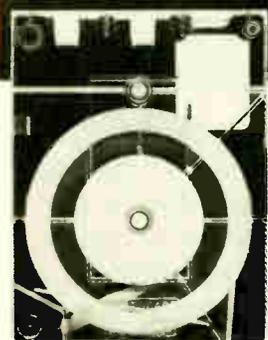
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Injunction Stymies Florida AM

by Paul Rebmann

Orlando FL Construction was halted at the new tower site of WWNZ-AM 1 November when the Greater Orlando Aviation Authority (GOAA) obtained a temporary injunction from a Lake County judge.

The WWNZ towers would make a nearby site for a planned general aviation airport unusable, according to the administrative appeal filed by the aviation authority.

WWNZ CE Dave Murray said the station is increasing power to 50 kW with different directional patterns for day and nighttime operations. The new tower array will consist of one 374' and five 363' towers. All six towers will be used with both patterns. The station currently operates at 5 kW non-directional day and 1 kW directional at night.

The new tower site is in Southeast Orange County only 1.3 miles from the planned airport site according to Murray.

Steve Richey, a Lake County attorney who obtained the zoning changes for the radio station and Murray both said the aviation authority did not file comments opposing the towers during the Federal Aviation Administration (FAA) approval process.

GOAA Engineering Director Dick Bonner declined to comment on the situation to **Radio World**.

WWNZ obtained an FCC construction

permit, an FAA permit for the towers, county building permits and proper zoning for the site, according to Murray.

He said the radio station received a notice from the Florida Department of Transportation (FDOT) in August informing WWNZ that a permit needed to be filed with it before the towers could be erected. "This was the first we found out about the planned airport," Murray said.

Richey quoted from the Florida statutes that "permits from the DOT will be required only within an airport hazard

area where federal standards are exceeded." There are no provisions in the statutes covering planned airports unless the area has been zoned specifically for airport use.

The proposed airport site in conflict with the WWNZ towers is one of three selected as possible sites in West Orange County by a consulting firm. A recent DOT study showed that Orlando will need two more general aviation airports by the year 2000 and that one needs to be in the west portion of the county and the other in the east.

Murray said the temporary injunction is in effect until a hearing is held on the matter with the Lake County Board of Zoning Adjustment. He explained that the injunction prevents any construction at the site, not only tower erection.

There is one tower foundation in the ground, but no guy anchors, and about 300' of tower has been offloaded on the site, according to Murray. He said that the original completion date for the project was 1 May, but added that did not seem probable in light of the dispute.

A hearing date had not been scheduled.

For information call WWNZ at 407-299-7400 or the aviation authority at 407-826-2001.

Paul Rebmann is CE for WLKF-AM/WEZY-FM in Lakeland, FL.

ETTA May Help Broadcasters

by Benn Kobb

Washington DC Broadcasters facing STL congestion may spell relief E-T-T-A, if Reps. John Dingell (D-MI) and Edward Markey (D-MA) succeed in their efforts to find more bandwidth for the burgeoning telecommunications industry.

Dingell and Markey's Emerging Telecommunications Technologies Act (HR 2965), would transfer as much as 200 MHz of unused and underused government spectrum to the FCC to the possible benefit of radio, HDTV, mobile system operators and other as-yet-unknown communications services.

The first hearing on ETTA was held 2

November and according to Markey, who chairs the House Telecommunications and Finance Subcommittee, Congress had not held hearings on spectrum allocations since 1959.

At the hearing, congressmen, telecommunications consultants and FCC Chairman Alfred Sikes proclaimed their support for the legislation. The sole holdout was the Bush Administration, in the form of Executive Branch telecommunications advisor Janice Obuchowski. She heads the National Telecommunications and Information Administration (NTIA) that regulates federal radio usage.

"The federal government holds approximately forty percent of the radio spectrum in this country," according to Dingell. He said that the government's holding of spectrum is "inhibiting economic growth and innovation, causing us to lag behind other countries in development of technology."

Sikes said that it is no longer clear whether we can continue to look toward advances in technology alone to resolve all of our radio frequency management challenges. He said some engineers believe broadcasting has reached the theoretical limits of spectrum efficiency.

Others believe there still are significant improvements possible, he said, although they recognize the challenges of mandating the use of new, often more costly technology where there is a significant, installed user base.

"In all likelihood," Sikes said, "we will have to both move toward new generations of equipment—at a significant cost—and find more spectrum." He said that although he supports many of ETTA's goals, the FCC does not have sufficient information to be able to state categorically that there is 200 MHz of spectrum available to be transferred.

Sikes advocated what he called the "forcing action" of the legislation to pressure government and non-government spectrum users to become more efficient in their use of frequencies.

NTIA's Obuchowski said the Bush administration could not support ETTA in its present form. She urged the subcommittee to wait until the NTIA completes studies aimed at quantifying government and private sector spectrum use.

Additional hearings are expected in the first few months of 1990, at which the subcommittee will receive testimony from private sector witnesses.

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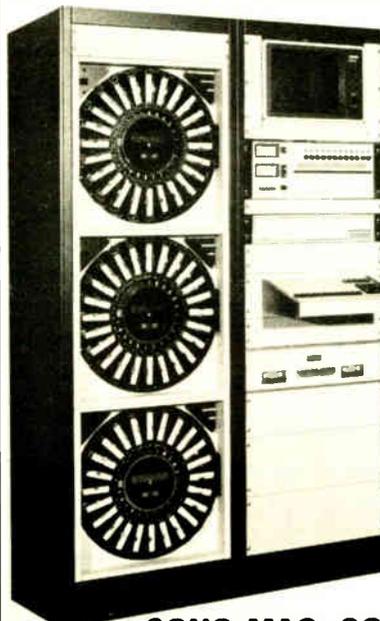
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Working Group Eyes Processing

(continued from page 3)
the Adams paper.

Adams noted, however that "I don't personally feel we want to tell a station what to do to itself."

Foti noted that the Dividend, a filter developed by his company and used with clipping, accomplishes half of what a composite mask would be designed to do in that it protects the SCA frequencies.

But he noted that filtering alone does not necessarily protect the pilot and that clipping causes "energy to fill in around the pilot." He explained that this could cause problems in receivers with new circuits which cause blending back to mono upon detecting such energy around the pilot.

NAB VP of Science & Technology Michael Rau asked if a composite mask could co-exist with a station's use of a clipper.

Adams said it would be "difficult and pricey" and that the stereo separation could be affected.

The consensus of the group was that more research would be needed to develop a mask. Adams offered to submit a "test plan" for further studies to the NRSC mailing list for approval.

Even as the working group pondered

the possibility of a composite mask, members wondered about the ability of the engineering community to generate widespread acceptance among program directors and general managers.

Education or standard-setting

"There already is a standard and it's already abused," noted FM subgroup chairman Wes Whiddon, referring to limits on overmodulation. "If another standard is developed, what's to prevent it from being abused?"

WAEB CE Harry Simons noted that "as a committee we carry more credibility than individuals" and that "education

would be a good place to start."

"At least 95% of the PDs I know personally don't know what happens when you process," Simons added.

Foti suggested that engineers need to "sell" PDs on the idea of a cleaner signal and that "through the process of education we can share some things and come up with a consensus to educate others."

Several members raised the possibility of a demonstration of the effects of processing, similar to one set up by the NAB to demonstrate the NRSC processing standard for AM.

But NAB staff engineer Stan Salek

noted that variations in processing setups would make such a demo difficult to evaluate and Rau noted that NAB didn't set up an NRSC AM demo until a standard had been developed.

Tingley said that getting broadcasters to help themselves and educating them on the effects of modulation and processing might boil down to getting an FCC ruling in favor of a mask, similar to the NRSC AM standard. But he noted that such action would be "far down the road."

In the end, the working group decided to wait for the completion of further studies to decide on future directions. The group's next meeting was set for 15 February, 1990 to allow time for the Foti and Adams studies.

For more information contact NAB at 202-429-5346 or EIA at 202-457-4900.

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Annandale VA "Digital" was the buzzword of the '80s. As we move into the next decade, it will be more important than ever to understand the workings of digital circuits.

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The course introduces students to the theory of digital electronic operation. It will cover identification of digital circuits, testing number systems, logic gates and related terminology. Interfacing with other devices and displays will also be covered.

The course will begin in the 10 January 1990 issue of *Radio World* and continue for a total of 12 installments. NOVA will offer 1.3 CEUs (continuing education units) for those who complete the course. An examination will be mailed for those who register for the program.

Cost of the program is \$20 for RW readers payable to North Virginia Community College, Director of Continuing Education, Annandale Campus, 8333 Little River Turnpike, Annandale, VA 22003. The course number is BCST 91401N. To register, look for the coupon in the 27 December issue of RW. For more information contact Ed Montgomery at 703-971-6850 during work hours. Please do not call the college.

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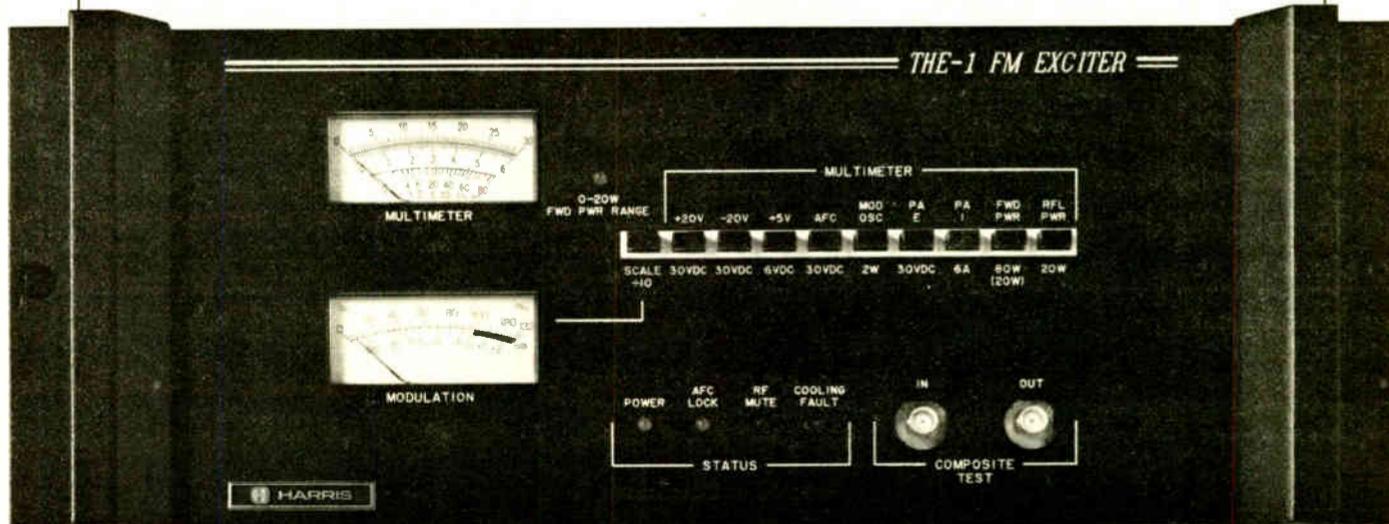
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TRADE UP TO THE-1 FM EXCITER.

STL Owners Face Upgrades, Replacement

Washington DC In order to be legal by the July 1990 deadline, stations with STLs that do not meet FCC type notification specifications have two choices:

They can shell out as much as \$3000 for an upgrade, or they can trade the old units in on new ones, which cost \$3000 to \$12,000 depending on the model.

It appears that stations with STLs that meet the specifications will have little trouble getting type notified because most manufacturers have agreed to undertake the process.

Stations with units that do not meet the specifications, however, will have to decide whether to upgrade their STL or buy a new one.

In addition, a filing by the SBE is asking the FCC to consider delaying the requirement to ease the burdens on stations (see related story, this issue).

Factory upgrades

TFT Inc. is offering upgrade services and a trade-in policy for those units that do not meet the specifications.

Moseley Associates is offering upgrades for some pre-1985 models, but had not decided if it will accept trade-ins on newer models.

All Marti Electronics STLs already meet the specifications and are type notified or are in the process of being type notified, according to the company.

The STL-10 was FCC approved in 1986 (FCC ID number: BEN9EZSTL-10/950). Although the Marti STL-8 met the specifications when it first was produced in 1970, approval was not necessary then.

However, Marti has applied for type notification of the STL-8, under the 1985 rule mandating approval by 1 July 1990, according to Marti.

Marti also previously received FCC approval for several of its other models. The MW-500 Aural Broadcast Microwave Booster (FCC ID: BEN9EZMW-500); and RPU models RPT-30/150 (FCC ID: BEN9EZRPT30-150); RPT-30/450 (FCC ID: BEN9EZRPT30-450); RPT-15/150 (FCC ID: BEN9EZRPT15-150); RPT-

15/450 (FCC ID: BEN9EZRPT15-450); RPT-2/150 (FCC ID: BEN9EZRPT2-150); RPT-2/450 (FCC ID: BEN9EZRPT2-450); RPT-25 and RPT-40.

In order to be type notified, STLs in the 944-952 MHz band must meet acceptable spurious emission levels and a .005 frequency tolerance. The factory must fill out FCC form 731, submit a statement that the model meets the specs along with a \$100 fee per model.

If a manufacturer type notifies a model, all units sold are considered type accepted. The factory will be supplied with FCC type notification stickers for stations to affix on the STL to show proof of type notification.

Station with units that cannot be type notified without an upgrade will have to pay for the upgrade and the \$100 FCC processing fee, according to STL companies.

STLs modification

TFT Marketing Director Jesse Maxenchs said there are about 500 Model 7700s made from 1978-85 that cannot be type notified unless they are modified to meet frequency emission levels. The later model Model 7700s, 8300s and 8600s meet the FCC requirements and are type notified.

Maxenchs said TFT will try to accommodate the owners of the older 7700s. "We will permit trade-ins on that equipment or make the units certifiable," Maxenchs said.

He estimated it will cost \$1200 to \$1500 to make the modifications if a station decides they want to keep using the old STL.

Maxenchs said trade-in allowances will vary according to the condition of the old STLs.

According to RF Specialities of Texas, a new TFT 8300 will cost a station about \$9500 while the 8600, designed more for urban crowded areas, is priced at \$3425.

Moseley Sales Manager Dave Chancey said the company will upgrade pre-1975 to 1985 PCL 505s that do not meet the specifications, but it conceded that won't

be cheap for some models.

He said the early PCL 505s, which can be identified by the horizontal heat sink fins, will cost \$3000 to upgrade.

Could cost stations

The 1975 to 1985 PCL 505 upgrades "won't be \$3000," but will cost stations, depending on which model they have, he said.

Chancey emphasized that Moseley will not offer any upgrades for its model PCL-401s, 101s or 303s, which do not meet the FCC specifications.

He said there may be some independent shops that will offer such a service.

The company has already filed for type notification for its post-1985 era PCL-505s that already meet the FCC specifications.

New Moseley STL models cost from \$4500 for the PCL 6010 to \$10,700 for the PCL 6065.

Stations with Moseley PCL 505s should contact the company to receive a questionnaire they can fill out and return so the company can best determine

what upgrades are needed, Chancey suggested.

Another variable also has been thrown into the STL mix, according to Chancey.

He said the FCC plans to tighten the frequency tolerance limit from .005 to .0025, and if that is indeed the case, some of the PCL 505s will not meet the specification when the new change is made.

Tightening tolerances

FCC Engineering Policy Branch Chief Jim McNally confirmed that the Commission will eventually tighten the .005 frequency tolerance, which "dates back to the equipment of the 1960s." He did not know what the new frequency would be.

But, McNally noted, "We will get around to it when we have the time. We do not want to further muddy the waters."

For information about STLs contact TFT at 408-727-7272, Moseley Associates at 805-968-9621 or Jim McNally at the FCC at 202-632-9660.

SBE Asks for STL Type Notification Extension

(continued from page 1)
sion so far.

He said the Commission will carefully consider SBE's request, but individual stations and STL manufacturer complaints would have significant impact on a decision to extend the deadline.

No decisions yet

"We're thinking about it, but we haven't made up our minds," McNally said.

Although there was some initial confusion about the type notification procedures, McNally said manufacturers have indicated to him they are working to type notify STLs by the 1 July deadline and

there may not be a need for an extension.

McNally said, however, there is precedent for granting an extension, if the industry convinced the Commission one is necessary.

In August, several aircraft owners and pilots groups successfully lobbied the FCC to extend a deadline from January 1990 to January 1992 for compliance with a stricter frequency tolerance for VHF radios in general aviation aircraft.

If such pressure was brought on by the radio industry for an extension of the STL deadline, the Commission would consider the request, McNally said.

Industry pressure

"If the (STL) manufacturers argued that extension of the deadline is a good idea, then that would carry some weight," he said.

Many stations and manufacturers have been confused about the type notification procedure because they are not sure who is responsible for the certification and they are uncertain about whether older STLs will meet the specifications.

The Commission began requiring type notification in 1985, but gave stations with pre-1985 units five years to type notify them.

For those that are not yet type notified, FCC officials said the notification process will work better if the manufacturer certifies each model, which would apply to all units sold.

It then would be up to the station to contact the manufacturer to find out if their STL was type notified and how to receive proof of certification.

Manufacturers are currently establishing policy for type notification and upgrades (see related story this issue).

For information about an extension on the STL deadline, contact NAB Science & Technology at 202-429-5346, Chris Im-lay for SBE, 202-296-9100 or Jim McNally at the FCC, 202-632-9660.

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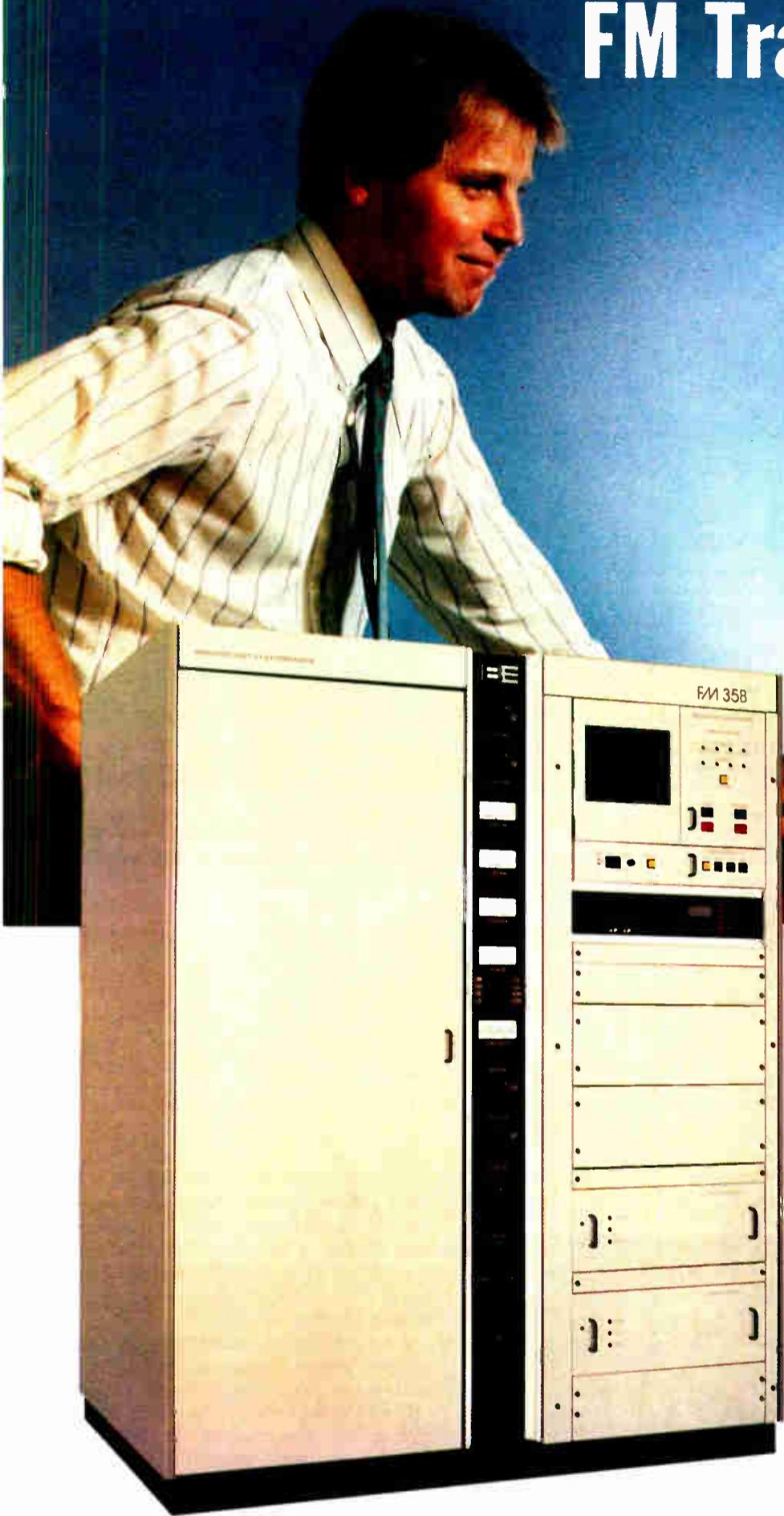
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Circle 38 On Reader Service Card
World Radio History

Data Collection Goes Sky-High

New Company Uses a Wing-Mounted System To Get Real-Time Data

by Charles Taylor

Miami FL Tom Becker admits he was baffled.

In 1980, when his low power WDNA-FM here was launched, its service area was nestled along a narrow strip of islands along the Florida coast, forcing a directional pattern of only 20° of a 360° circular signal area.

How could he know if his signal was being effectively directed up the strip, or whether a good bit of energy was unknowingly being dumped into the Atlantic Ocean?

"We somehow wanted to maximize the service area of this little station," Becker said. "We wondered if there were some way we could at least get an idea of whether I was sending a huge lobe over some useless area."

Near exact accuracy at low cost

Six years and mounds of trial and error later, Becker and partner Ralph Chambers—both broadcast engineers—indeed believe they have found a way to identify a station's coverage area with a high level of accuracy at low cost.

The pair's Air System Technologies Inc., formed earlier this year, provides broadcasters with computerized analysis of real-world coverage data, including contours and power output levels for AM, FM and TV antenna transmission systems. The data is collected using an airplane with a uniquely designed wing-mounted cross-polarized array and Becker's own software program.

Becker, a former software designer and business programmer, and Chambers, a commercial pilot, developed the process bit by bit. First, Becker built an ana-

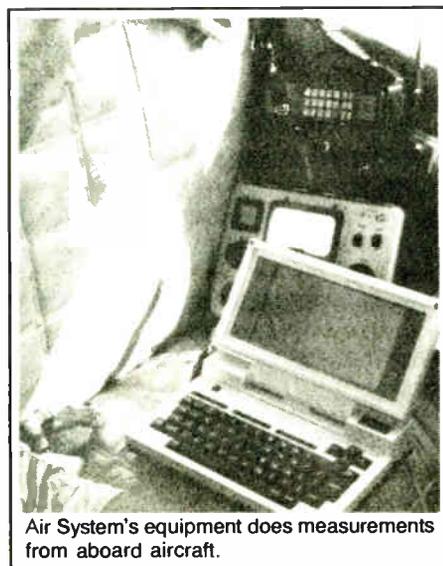
log/digital converter for a lap top, which is used to take measurements of an antenna array in the air, providing real time data.

"We started out crudely with a chart recorder trying a bunch of antenna ideas and getting all sorts of unsatisfactory results," Becker said. But when they perfected the wing mount antenna—and achieved FAA approval—they felt success was approaching.

Horizontal and vertical data

"The antenna allows us to simultaneously collect horizontal and vertical data, and they are essentially at the same point in space, which is important if you're trying to determine the circular polarization of a signal," Becker said.

When measurements are taken, an on-



Air System's equipment does measurements from aboard aircraft.

board computer is fed continuous data depicting the measured field strength of an antenna system, factoring in the test aircraft position, direction, altitude, speed and wind correction angle.

The process, according to Chambers, normally takes 12 minutes.

The results, Becker said, provide two-



Ralph Chambers (left) and Tom Becker, of Air System Technologies

fold service: "At the engineering level, from some engineers' postures, I think it's as benign as an intellectual curiosity about where their signal is going. But from the manager and owner's perspective, it's a matter of dollars and cents. If they can recognize that what comes off their antenna and where it goes is very directly associated with the accounting department, it becomes important."

Air System Technologies has played a major role in an ongoing study in Allentown, PA, to discover the effects of multipath on FM radio reception. Sponsored by Harry Simons, CE at WAEB there, the tests come out of the National Radio Systems Committee's desire to find out more about what causes the distortion and how it might be alleviated.

WAEB's signal was tested by the company using a data acquisition system and LORAN C navigation from the airplane. Information was gathered in a circular pattern from the station's transmitter and included a polar plot of the main an-

tenna pattern horizontal and vertical polarizations as installed on the pole at the top of the station's tower; and a polar plot of WAEB's auxiliary antenna mounted on the side of the tower.

The readings were taken from several loops flown at a three mile radius from the antenna. Some consultants have suggested that at that distance, some of the Air System Technologies' readings would incorporate reflected ground signal.

WAEB's plans currently call for a new round of readings from loops with a smaller radius.

Variety of other utilizations

A variety of other utilizations for the company's capabilities are in the works, Becker said. For one, stations trying to target their signal toward a particular demographic segment within their coverage area could use Air System's services to legally manipulate a directional pattern.

"Let's say that Hot Rock 98.7 wants to hit the 13 to 25 (age) monied audience market," Becker explained. "With demographic data, we know where those people are and we can suitably program the computer so it gives us a meter that peaks the average signal in that market."

"And because the measurements are taken in real time, you can have guys on the antenna to loosen bolts and swing it around until the signal is maximized for the format," Becker said. "This I see as a tool for sales. We can sit down with customers and tell them exactly the performance of their radio station."

And thanks to an AM loop antenna apparatus Chambers designed that allows easy mounting on the wing tip of the plane, Air System is able to measure AM directional patterns in areas that often are inaccessible from the ground.

"The most popular way to do AM measurements is from the ground, but it's not always possible, such as in areas like the Florida Everglades," Chambers said. "With a helicopter, such a test would cost between \$375 and \$600 an hour. We can do a reading for a lot less in just 12 minutes."

A typical job costs about \$3000 plus expenses, depending on travel distance and other variables. Discounts are offered for multiple towers within a station group. The company is currently based in two locations—its headquarters in Miami and a new office in Dallas. A third office on the West Coast is planned in the future.

Also in the future is the actual purchase of a plane. Currently, the company leases a Piper Cherokee Warrior. To serve customers in different areas of the country, "the plan has been to have contacts in a couple central locations with friendly owners," Becker said.

A lot of growth is planned, he added, but for now, the two plan to concentrate on establishing credibility for what has taken them by surprise with its potential.

"I had a specific need and came up with an intriguing way to solve this at relatively small expense," Becker said. "At that time I had never intended this to be a business."

For information on Air System Technologies, call 305-598-5153 in Miami or 214-244-5353 in Dallas.

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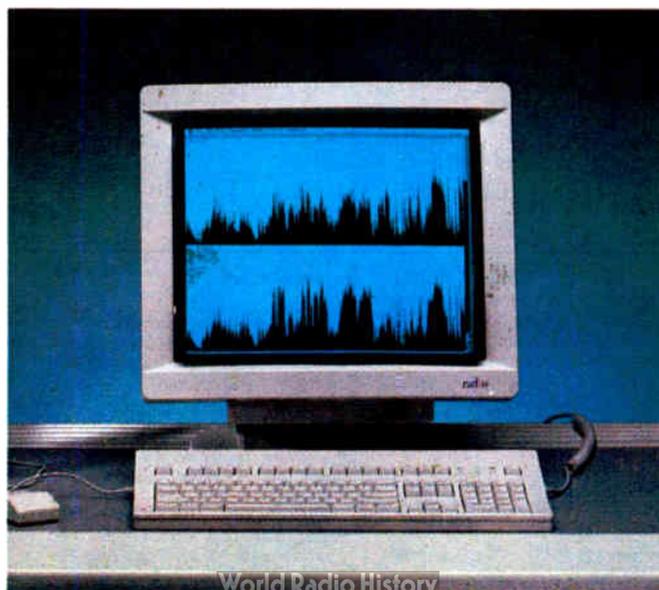
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Circle 49 On Reader Service Card

CART MACHINES

Want to Sell

ATC PB-150 tube mdl, seems complete, gd for parts, etc, \$100/BO. J Sigmon, WBZK, POB 398, York SC 29745. 803-684-2421.

ITC Omega Series (2) playback desks, program cards need minor repair, otherwise excel cond, \$800 ea pls shpg. D Kelley, KISZ, POB 740, Cortez CO 81321. 303-565-1212.

BG Engineering BGE-1T new 10 minute digital up timer for retrofit into Spotmaster/ITC cart decks, BO: new semiconductors, IC's, lamps, motors, switches, rack ears, accessories for PDII, Delta, RP, SP, 3D, WP, Series 99 cart decks, BO B Royster, KQM, 1019 Cordova, San Diego CA 92107. 619-223-3413.

Telex MC-PR III RP audio, excel cond, \$995. L Chatman, IVA, 424 Commerce Ln Ste 1, Berlin NJ 08009. 609-768-5006.

Automated Broadcast Controls w(4) Otari ARS-1000DC reproducers, (2) 24 cart Carousels, 80 event sequence controller & audio controller, w/manuals, gd cond, \$10,000 pls shpg. B Herrera, KCRF, 100 Fisher, Trinidad CO 81082. 719-846-3355.

Sentry complete automation system including (5) Revex PR-99 stereo PB machines; In-stacart; (2) IGM Carousels; (2) Audicord stereo cart machines; PC compatible computer w/software & interfaces, excel cond. B Ferguson, WMMJ, 400 H St NE, Washington DC 20002. 202-675-4800.

BE 2000 R/P, 2 decks, one has new motor, manual, \$700/both; (3) Ampex 602 R-R decks for parts, BO. B Oostenburg, KCKY, POB 6, Coolidge AZ 85228. 602-963-9290.

UMC Beaucart RP stereo record w/spare parts, manual, 3 tones, \$1125. B Carr, WFED, 1201 Fremont Pk, Toledo OH 43469. 419-837-9696.

ATC Criterion Series mono R/P, gd cond, \$300. B McKittrick, 331 Mulberry, Catashuqua PA 18032. 215-264-5295.

SMC 510 single cart player (2), \$150 ea/BO. J McDonald, 303-669-3442.

Telex MC-PRIII R/P, like new, \$950. L Chatman, IVA, 424 Commerce Ste 1, Berlin NJ 08009.

Rapid-Q ROM-2 R/P mono, fair cond, \$200 or trade. D Kohn, KESM, 200 Radio La, El-dorado Springs MO 64744.

Fidelipac Zenith & height gages for head alignment, never used, \$50. D Bailey, 3422 Beech, Rowlett TX 75088. 214-475-9796.

BE 5302B mono, triple decker, gd cond, \$1300. E Trevino, KBOR, Box 3407, Brownsville TX 78523. 512-541-6348.

3M/ITC Delta I stereo, gd cond, presently working. E Trevino, KBOR, Box 3407, Brownsville TX 78523. 512-541-6348, Fax 512-542-4109.

SMC 792 mono, gd cond, \$900. E Trevino, KBOR, Box 3407, Brownsville TX 78523. 512-541-6348, Fax 512-542-4109.

3M/ITC Delta I stereo, gd cond. E Trevino, KBOR, Box 3407, Brownsville TX 78523. 512-541-6348.

BE cart tape winder, almost new, w/timer, both in original packing, \$425. G Cahill, Invisible Inc, POB 5786, Hudson FL 34674. 813-725-5003.

BE/Spotmaster TP-1A cart winder, without timer, \$100, will throw in 100 plus cards for \$150; (3) record amps, mono, for RCA RT-27BA-27 series cart machines, \$40 ea. F Vobbe, Great Northern Bldg Co, POB 5031, Lima OH 45802. FidoNet 1:23416.

Want to Buy

ITC 3D mono w/WRA record amp, triple deck. C Waltman, KNEW, 66 Jack London Sq, Oakland CA 94607. 415-836-0910.

Parts & manuals for RCA 7 Series; record amp for RCA 7 Series; parts & record amp for Harris Criterion ATC Series. C Gill, POB 371, Indianapolis IN 46206. 317-923-2800.

Rapid cue R/P mono or stereo, any model, schematics & operative units, must work, need several, may be interested in units for parts. N Williams, WTJZ, 553 Michigan, Hampton VA 23669. 804-723-1270.

Eraser splice finder. KDKB, POB 6184, Kingman AZ 86402. 602-753-KDKB.

Tapecaster P & RP 700, any cond from junk to excel, call or write w/descriptions & lowest prices, complete or parts only. T Crockett, Hot Tracks, Box 10501, Blacksburg VA 24060. 703-953-0222.

Stereo record in gd working cond, used carts 40 sec, 70 sec, 100 sec, 2.5 min. A Moll, KLXQ, 128 Memory Trail, San Antonio TX 78232. 512-496-0677.

CASSETTE & REEL-TO-REEL RECORDERS

Want to Sell

Tandberg 74B 4 trk, 3 speed, portable case w/opt plastic lid, service & user's manuals, no mics, mint, BO pls shpg; VM 700 portable 1950's consumer unit, fair cond, BO pls shpg. S Delahoyde, Box 33063, Phoenix AZ 85067. 602-937-9088.

Tascam 38 1/2" 8 trk, low hrs, excel cond, \$1875; Tascam 40-4 4 trk w/dtr, low hrs, \$925. K Flory, The Production Co, Box 1027, Siloam Springs AR 72761. 501-524-4626.

Scully 280-14SP, mono 14", fair cond, \$250; Kahn Symetra-peak SP 58-1A, gd cond, \$50; SMC 282 time announce, gd cond, BO; CBS Audiomax 4450 stereo, gd cond, \$200; CBS Volumax 4100, mono, excel cond, \$200. J Thomas, WLEW, Bad Axe MI. 517-269-9931.

Scully 280B 2 trk stereo in factory roll-around cabinet, manuals, new heads, spare capstan motor & other parts, excel cond, \$1000 pls shpg. B Mountjoy, WIDD, 610-1/2 Hattie, Elizabethton TN 37644. 615-543-5849.

Stancil Hoffman CRM-7 logger Young, WJON, POB 220, St Cloux Crown motor, capstan, Dale Hl bi-directional, Crown player, new athon 702-7 & 702-10 portable bi-directional, auto reverse, call prices. E Davison, 135 N Illinois, IL 62702. 217-787-0800.

Ampex AG-440C 1/2" 4 trk in around cabinet, manuals, heads I tie wear, spare set of R/P electro spare parts, vgc, \$1000 pls shpg. WIDD, 610-1/2 Hattie, Eliza 37644. 615-543-5849.

Technics 1520 isolated loop R control in fair cond, \$500. R San POB 83111, Lincoln NE 68501. 41

Scully 270-2 (2) 14" stereo reproducers, 3.75-7.5 ips; also (6 capstan motors, BO; Ampex 35 only w/Schaler electr, excel cond, heads, parts, relays for 350 & BO; PR&E Multisync MDA motible speed amp for Ampex & Scully B Royster, KQM, 1019 Cordova, S 92107. 619-223-3413.

Telefunken M15A 24/32 trk 15K & varispd, \$25K; Telefunken M15/ \$4K; Tascam 80-8 w/dtr rack Nakamichi 550, BO. R Rhodes, NNY 10101. 212-245-5045.

Pioneer CT-F2121 stereo (2), ic need minor repair, \$60 ea or \$10C mon, WBZK, POB 398, York SC 684-4241.

ITC 850 Series, gd cond, BO. D 1 901 E Pike Blvd, Weslaco TX 785 1548.

IBM System 34 computer w/ drive, 6 yrs old, excel cond, use bine traffic system, \$3500 pls sh WJJKL, 3342 Perry, Camillus NY

Otari 8 SD 1/2" 8 trk w/calibrati tremely clean & reliable +4 or - tions, \$2500/BO. M Mantell, 1st I 15 Perkins, Brockton MA 024C 1844.

Revex B77 excel cond, \$1000/BO J-Con Ltd, 200 E Rackquet Club, Springs CA 92262. 619-323-43

Teac X-2000R 10.5" 1/4 trk, 7.5-3 bi-directional 6-head system, aut motor transport, very low hrs, \$1000. G Curry, Int'l Minist Peachtree Corners Circle Ste 2E GA 30092. 404-449-6766.

Revex A-77 15/7.5 ips w/Dolby B \$450/BO; Revex B-77, 15/7.5 ips, \$1250/BO. B Henry, KLLK, 12 W lts CA 95490. 707-459-1250.

Otari MX5050-4, 14" 4 trk, lapped, \$950. B Petrucci, Rouse: E Old Hickory, Madison TN 371 8516.

Ampex 1200 24 trk matched | mods, great shape, heads have b many spares, \$30K/pr, will cons breaking set. D Hewitt, Remote I 334, Lahaska PA 18931. 215-79-

Ampex 601 tape transport, as \$30; (3) Rotron 115 V Whisper far ment cooling, \$10 ea or \$25/ea Welch Media, POB 1455, Monck 29461. 803-761-7585.

Recordex 330II cassette duplic ter & 3 slaves, 16X duplication s matic rewind, erase heads, long-li ord heads, LED level meters, \$700 ry, Int'l Ministries, 4725 Peachtr Circle Ste 250, Norcross GA 300: 6766.

Sony/MCI JH-110B-2 R-R consok (2), light use, new heads & pinchr capable, (2) technical manuals & control, \$2800/ea. B Kohtz, KBAY San Jose CA 95150. 408-370-7377.

Otari 5050B2 7.5 & 1.5 ips 2 trk, less than 1 yr old, excel cond w/manual, \$950/firm. S Mahaffey, Mahaf Prod, 3592 N Delsea Ste 12, Vineland NJ 08360. 609-692-3439.

Otari ARS-1000 in excel cond, (4), \$700 ea. C Kneer, KCNA, 139 SE J St, Grants Pass OR 97526. 503-474-7564.

Scully 1/2 trk tape heads (28) play; (12) mo-no Magnacord Presto, play; (16) Magnacord stereo lapped Presto, play, sacrifice price. Call 616-782-9258.

Ampex AG 440B 2 trk, 7.5-15 ips in Ruslang console (2), \$700; Ampex 351-2 2 trk 7.1-15 ips w/inovonics 360 electronics in Ruslang console (2), \$400; Ampex 351 FT 7.5-15 ips in Ruslang console, \$250; Ampex 351 electr (4), \$100. B Reider, WGU, 1223 Central Pkwy, Cincinnati OH 45214. 513-556-4444.

Scully 280B 4 trk 1/2" in factory roll-around cabinet, manuals, new heads, spare capstan motor & other parts, excel cond, \$1200 pls shpg. B Mountjoy, WIDD, 610-1/2 Hattie, Elizabethton TN 37644. 615-543-5849.

Ampex 350 FT w/inovonics electr in roll around walnut floor cabinets (2), \$800 ea; Scully 280B 4 trk 1/2" recorder, gd cond, in

Revex tape recorders, top-shape factory rebuilds. New heads, etc. Accessories. A77, \$850; B77 (1/4 trk 7.5 ips), \$1000; G36 (tube mdl) 1/4 trk 7.5 ips, \$500. Send phone number & address to: JM Technical Arts, POB 8156, Hermitage TN 37076.

Ampex AG-440A-I, gd cond, \$450; Ampex AG-602-2-p, new, \$775; Ampex PR-10-2-p, very gd cond, \$850; many others, call Martin at 219-322-7090.

Want to Buy

Sony TC 788-4 4 trk in gd cond & w/maintenance manual. C Fuller, Voices, POB 153, LaGrange IL 60525. 312-579-9578.

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Circle 43 On Reader Service Card

Scully 280-1 (2), ea in Ruslang roll-around cabinets w/overbridge, \$3000/pr; (4) Scully 270-2 stereo PB, late mdl, manual, \$3K/ea; Ampex AG440B electr chassis, as-is, \$100; Telex 4-chnl, slow-speed logger system, current mdl, \$2000/ea; Tape-A-Thon Programmer III, current mdl, \$5000. E Stoiz, KWOD, 1425 River Park, Sacramento CA 95815. 916-929-5000.

Scully 255 reproducer, 1/2 trk, stereo, BO. KDKB, POB 6184, Kingman AZ 86402. 602-753-KDKB.

Ampex 350, 7.5-15 ips, FT, cabinet mounted, \$400; Teac A1200, complete, cond unknown, \$100/BO. J McDonald, 303-669-3442.

High speed cassette duplicator mono or stereo to record 10 at one time in working cond, need not be Elabrite. R Sweatte, KOKR, 600 Bdy Ste 220, Kansas City MO 64105. 816-421-1065.

ATR1000 taperecorders for parts. Circuit cards, heads, motors, machine parts, or electronic parts. Call 818-907-5161.

MCI/Sony capstan & reel motors, any cond., recdg heads, most mtgs, machines, new, used. Relapped then sold. Amp Services, 224 Datura St No 614, W Palm Beach FL 33401. 813-826-0801, in FL 305-659-4805.

CONSOLES

Want to Sell

Autogram AC-8/IC-10 spare parts, lamps, switches & bridging input transformers, BO. B Royster, KQM, 1019 Cordova, San Diego CA 92107. 619-223-3413.

Numark DM 1550 4 chnl DJ mixer, 2 phono inputs, 2 line inputs, 2 mic inputs, 6 band graphic EQ, always in road case, excel cond, \$150. B Fisher, KPOK, Box 477, Bowman ND 58623. 701-523-3883.

AC-8/IC-10 spare parts, lamps, idging input transformers, BO. M, 1019 Cordova, San Diego CA 3-3413.

1550 4 chnl DJ mixer, 2 phono inputs, 2 mic inputs, 6 band ways in road case, excel cond, r, KPOK, Box 477, Bowman ND 23-3883.

h Systems 8 16 input, 8 subs, 3 effect sends, +4 or -10 level cond, \$3000/BO. M Mantell, 1st 15 Perkins, Brockton MA 02401.

Executive 10 chnl stereo solid-in clean, vgc w/manuals, \$1000 Acumjoy, WIDD, 610-1/2 Hattie, TN 37644. 615-543-5849.

d cond, BO; Cetec 2000 8 pot, r supply, gd cond, BO. D Wolfe, Pike Blvd, Weslaco TX 78596.

Grandson 18 input console, neck 33X16 rodg console 3-band patch bay plus 24 tr harness, Freeman, Pranava Prod, 1227 ay, Los Angeles CA 90069. 213-

o 80 complete w/pwr supply, iders new, woris fine, 3 mic in-, includes book, \$800. C Ben-40 Domino Ln, Philadelphia PA 13-8900.

10 chnl, all plug-in amps, digi-complete set of spare PC boards, wn. WPRS, POB 367, Paris IL 35-6336.

I5 8 chnl stereo, excel cond, all tras, \$5500. R Trumbo, KNLF, incy CA 95971. 916-283-4144.

AC-6 6 chnl 23 input stereo, in-cludes ESE built-in timer, shpg. D Kelley, KISZ, POB 740, 1321. 303-565-1212.

12x8x8, lots of extra features, t cond, \$2900. K Flory, The o, Box 1027, Siloam Spring AR 4-4626.

see A/B 20x16 w/(8) 9-band uli patch bay, producers desk, rich, Box 869, Greenville CA 34-6929.

1112, 12x4x2, \$1500. C Green, rogramming. 800-937-2100.

12 in, stereo out & mono & mon-1, \$500. D Bailey, 3422 Beech, 5088. 214-475-9796.

, modified to 7 inputs, complete & manuals, gd cond, BO; Kel-emote broadcast console w(2) proof speakers, gd cond, BO. J , POB 1070, Sunbury PA 17801.

7500 stereo console parts, P&G in preamps, etc. J.C. Aegerter, W Center, Milwaukee WI 53210.

w/4 pots; (2) Ramko solid state; 2 tube type w/6 pots; AT1 8 chnl supply, call for details. Adolph,

1L 16x8 monitor mix console, 9 EQ pads, solos, etc, \$950. B use St Prod, 804 E Old Hickory, 37115. 615-868-8516.

20 20 chnl, mint cond, 6 mos Miller, Airborne Audio, 11647 W nexa KS 66214. 913-492-8822.

5000, 24 inputs, 4 outputs, 3 band, 5 frequency EQ, Duncan spare modules & case, \$2300. ouse St Prod, 804 E Old Hick-TN 37115. 615-868-8516.

Midas Pro Custom Recording, 16x8, Remix switch-over, (8) Pro 5, (8) Pro 3 modules, peak meter, clock/timer, flight case, \$10,500. H Al-rich, Box 869, Greenville CA 95947. 916-284-6929.

Harris Micromac 16 input mainframe, man-uals, spare pwr supply, \$10,000/BO. V Kilion, KRVN, POB 880, Lexington NE 68850. 308-324-6717.

RCA BC8A dual mono console, clean shape, \$500 plus crating & shipping. J Kreines, DeMot/Kreines Films, 5330 Kennedy, Millbrook AL 36054. 205-285-6179.

Allen & Heath Systems 8 16 input, 8 subs, 16 monitors, 3 effect sends, +4 or -10 level options, excel cond, \$3000/BO. M Mantell, 1st Impressions, 15 Perkins, Brockton MA 02401. 508-580-1844.

Gates/Harris Executive 10 chnl stereo solid-state console in clean, vgc w/manuals, \$1000 pls shpg. B Mountjoy, WIDD, 610-1/2 Hattie, Elizabethton TN 37644. 615-543-5849.

RCA 8 pot, gd cond, BO; Cetec 2000 8 pot, 16 input w/pwr supply, gd cond, BO. D Wolfe, KRIX, 901 E Pike Blvd, Weslaco TX 78596. 512-968-1548.

Audtronics Grandson 18 input console, \$3800/BO; Speck 33X16 rodg console 3-band sweep EQ, patch bay plus 24 tr harness, \$3795/BO. G Freeman, Pranava Prod, 1227 Sierra Alta Way, Los Angeles CA 90069. 213-457-8390.

Gates Stereo 80 complete w/pwr supply, most rotary faders new, woris fine, 3 mic in-put 4 line input, includes book, \$800. C Ben-ner, WUSL, 440 Domino Ln, Philadelphia PA 19128. 215-483-8900.

ORF Omega 10 chnl, all plug-in amps, digi-tal switches, complete set of spare PC boards, \$4500. B Brown, WPRS, POB 367, Paris IL 61944. 217-465-6336.

Ramko DC8M5 8 chnl stereo, excel cond, all manuals & extras, \$5500. R Trumbo, KNLF, POB 117, Quincy CA 95971. 916-283-4144.

Autogram AC-6 6 chnl 23 input stereo, in excel cond, includes ESE built-in timer, \$4200/BO pls shpg. D Kelley, KISZ, POB 740, Cortez CO 81321. 303-565-1212.

Tascam M-50 12x8x8, lots of extra features, low hrs, mint cond, \$2900. K Flory, The Production Co, Box 1027, Siloam Spring AR 72761. 501-524-4626.

Sphere Eclipse A/B 20x16 w/(8) 9-band graphic EQ, full patch bay, producers desk, \$6000. H Alrich, Box 869, Greenville CA 95947. 916-284-6929.

Ramsa WR 8112, 12x4x2, \$1500. C Green, Century 21 Programming. 800-937-2100.

EV EVT 5212 12 in, stereo out & mono & mon-itor, mint cond, \$500. D Bailey, 3422 Beech, Rowlett TX 75088. 214-475-9796.

RCA BC5A (2), modified to 7 inputs, complete w/spare parts & manuals, gd cond, BO; Kel-don KD20A remote broadcast console w(2) TTs, (2) waterproof speakers, gd cond, BO. J Keller, WKOK, POB 1070, Sunbury PA 17801. 717-286-5838.

McCurdy SS-7500 stereo console parts, P&G taders, plug in preamps, etc. J.C. Aegerter, Satcom, 5431 W Center, Milwaukee WI 53210. 414-445-2300.

BE 4BEM 50 w/4 pots; (2) Ramko solid state; Collins 212 F-2 tube type w/6 pots; AT1 8 chnl stereo w/pwr supply, call for details. Adolph, 915-949-2112.

Interface 104L 16x8 monitor mix console, 9 freq, 3 band EQ pads, solos, etc, \$950. B Petrucci, Rouse St Prod, 804 E Old Hickory, Madison TN 37115. 615-868-8516.

Tascam M-520 20 chnl, mint cond, 6 mos old, \$4250. D Miller, Airborne Audio, 11647 W 83rd Terr, Lenexa KS 66214. 913-492-8822.

Summ Magna 5000, 24 inputs, 4 outputs, 3 aux sends, 3 band, 5 frequency EQ, Duncan faders & (2) spare modules & case, \$2300. B Petrucci, Rouse St Prod, 804 E Old Hick-ory, Madison TN 37115. 615-868-8516.

Midas Pro Custom Recording, 16x8, Remix switch-over, (8) Pro 5, (8) Pro 3 modules, peak meter, clock/timer, flight case, \$10,500. H Al-rich, Box 869, Greenville CA 95947. 916-284-6929.

Harris Micromac 16 input mainframe, man-uals, spare pwr supply, \$10,000/BO. V Kilion, KRVN, POB 880, Lexington NE 68850. 308-324-6717.

RCA BC8A dual mono console, clean shape, \$500 plus crating & shipping. J Kreines, DeMot/Kreines Films, 5330 Kennedy, Millbrook AL 36054. 205-285-6179.

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Neumann TLM-170, new, blk finish, \$125

Processing In The Real World

by Frank Foti

Cleveland OH Recently, a lot of noise has been made within the engineering community about "loudness" audio processing.

My experience as the former chief engineer of Z-100 WHTZ (New York), WMMS (Cleveland), consultant to Pirate Radio in Los Angeles and manufacturer of processing equipment with Cutting Edge, has provided me the opportunity to participate in loudness processing issues from several perspectives.

I experience some of the same frustrations as my fellow engineering colleagues with respect to the loudness versus quality tradeoff. However, I also believe that much of the flak this same group is generating towards loudness audio processing is misguided.

The sound we might favor for a station cannot take precedence over the goals or objectives set by programmers and management.

After watching the battle rage now for some months, I feel compelled to offer my two cents' worth, in hopes that the engineering community as a whole can feel more comfortable with this situation and that its presence in the broadcast world will not be blown out of proportion to the point where it becomes an obstacle for future growth and innovation.

Not a recent development

"Loudness" audio processing didn't just appear out of nowhere. Rather, it has been edging along to its current state throughout the last decade. To understand fully its encroachment in the radio industry, we need to first look at how the changing radio environment allowed its emergence.

It should be no great revelation that the business of radio today is very different than when many of us entered the field. In fact much of the change in the industry is a result of that very word: business.

Broadcast properties were once almost exclusively owned by radio enthusiasts, those whose payoff was simply the pleasure of working in a medium they loved. Not so anymore. Wall Street eventually found radio (or

vice versa) and with it came the investors, stockholders, high financing and the lure of profit.

With such high stakes, it has become necessary to lift the debt service factor as quickly as possible in order to turn a profit. Regardless of market or format, radio revenue comes from advertising and—as we all should know by now—advertising rates are only as good as the ratings of the station. Because financial success is directly linked to ratings success, it's no wonder that every method to achieve ratings will be employed.

Which brings me to an interesting point: Although "loudness processing" cannot by itself guarantee performance goals, it is one of many methods used in the mix to garner higher ratings.

Just as high profile promotions, state of the art equipment, or key talent help flesh out the station's desired image, so does its sound. And for every "sound" comes a variety of ways to present it.

Likely candidates

Let's talk for a minute about the likely candidates to utilize "loudness" processing. It has been my experience that stations try to present their programming in the same fashion that their listeners will control their own audio selections within the privacy of their home or car.

Hence, Contemporary Hit, Urban and Rock stations will place more importance on the same loud, driving sound as the listener who slaps a CD in the compact disc player and cranks up the volume, while classical or beautiful music stations prefer a lower key approach featuring a higher range of melody.

We as technicians realize that every increase to buy loudness is a tradeoff against quality; our trained ears find this very discouraging. It is important, however, to realize that the sound we might favor for a station cannot take precedence over the goals or objectives set by programmers and management to present the station in a certain way to its audience.

Loudness and driving sound are an attention-getting mechanism in most cases and are perceived to be a valuable asset to attaining better ratings. Therefore, if program directors and management believe that loudness gives them a definite advantage over the competition and is in line with the programming content being delivered, we as engineers must acknowledge that.

It is this perception of programmers and management that plays a vital role in determining the use of processing. We know that the more processing used, the less quality the station's sound will have. But if program directors and general

managers believe that having a louder sound is more important than having quality sound, then in a sense, so be it.

Help or hindrance?

So far, no definitive studies have been done to determine whether loudness processing actually "helps" or "hurts" ratings. Nonetheless, as long as manage-

We have to "sell" the benefits of better sounding radio, just like you have to "sell" your manager on why you need a specific piece of gear.

ment and programmers think of it as a ratings tool, it will exist.

I realize that much can be said of the relationship between time spent listening versus loudness processing. But most programmers also know of the same set of circumstances. After all, it is their job to get the listeners, and to keep them.

Those in the engineering community who are disgusted by the importance be-

ing placed on loudness processing should realize that its so-called "advocates" are not really turning their backs on quality sound presentation, but rather are fulfilling a demand from the marketplace.

Like the automobile manufacturers who responded to the need for small fuel-efficient cars, these engineers and audio processing manufacturers are answering the segment of the marketplace that demands such sound. You must realize this!

Some stations adopt a very aggressive method of presence in the marketplace—format, promotions, sales techniques... the whole ball of wax is usually quite assertive. These are the stations that also create the demand for a sound highlighting loudness over quality. As long as there are stations that choose to operate in this manner (and there always will be), there will be a call for processing that can make them louder than their competition.

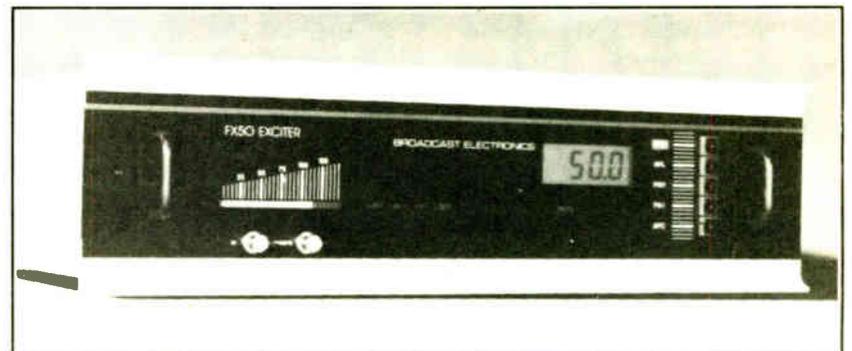
Picking up speed

The debate over loudness processing seems to have gained momentum with the emergence of Pirate Radio, KQLZ Los Angeles.

Pirate Radio, like Scott Shannon's previous radio environment Z-100, chooses to deliver itself with the subtlety

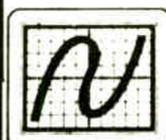
(continued on page 25)

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FCC Inspection by Moonlight

By Harold Hallikainen

San Luis Obispo CA The October installment of *Insight on Rules* has generated several phone calls, which is good, because I hope these columns provoke discussion.

Several chief operators called to get a copy of the violation notice issued to a station for having untrained operators (hoping to convince management they need trained operators). Another suggested I was out of touch with reality, since the FCC does not enforce its rules. He argued that stations are at a competi-

tive disadvantage if they follow the rules, because no one else does.

We had quite a discussion. I suggested he put his thoughts together into a letter to the editor of *RW*. I hope to see it in *RW* soon!

This does, however, bring up an interesting point regarding the purpose of laws or rules. Supposedly we are all better off by following the rules. It is to our advantage to follow the rules, regardless of how severely they are enforced. An individual may end up better off by not following the rules, but the rest of us suffer.

If we all don't follow the rules, we all

end up worse off. Some rules may seem arbitrary, but instead of ignoring them, let's try to make our best judgement of their intent, or perhaps petition for a rule change.

This month we'll look at the results of another 1988 FCC inspection. Several violations were found, resulting in a \$3100 fine.

EBS test receipt logging

The station was fined \$300 for not logging receipt of an EBS test as required by 73.1820. The FCC inspection was about three weeks after the missed test, so the

DCO log review should have caught the missed test. The station argued that other stations in the market also did not receive the test. Further, they sent the monitor to be reconditioned. There was nothing wrong with it.

It appears that there may have been something wrong with the EBS generator at the originating station or perhaps an untrained operator forgot to run the tones. In any case, the DCO should determine the cause of a missed EBS test and log the corrective action taken [73.1870(c)(4)].

In another violation, the inspector found the base current ratio for one of the towers was 13.5% from that licensed. Phase indications were 9° and 12° from that licensed. In addition, the inspector found field strength measurements to be over the licensed maximum. This resulted in a \$1500 fine.

The station's response was quite interesting. Apparently the inspection took place from 10:15 PM to 3:45 AM. The station argued that "a reading at the inspection hour . . . was not realistic."

I could find no justification for this statement. It would appear that way past sunset there may be skywave interfer-

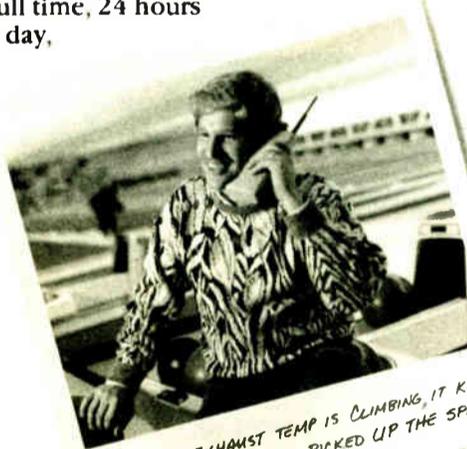
Remote Control Systems

How to get an engineer to babysit your transmitter 24 hours a day, 7 days a week, and like it.

Babysitting the transmitter is no one's idea of a good time. Somehow, nothing seems to go sour from nine-to-five. You get "beeped" or called at the most inopportune moments. They're in a panic and you've got to jump in the car, race to the site and start problem solving. What a nuisance.

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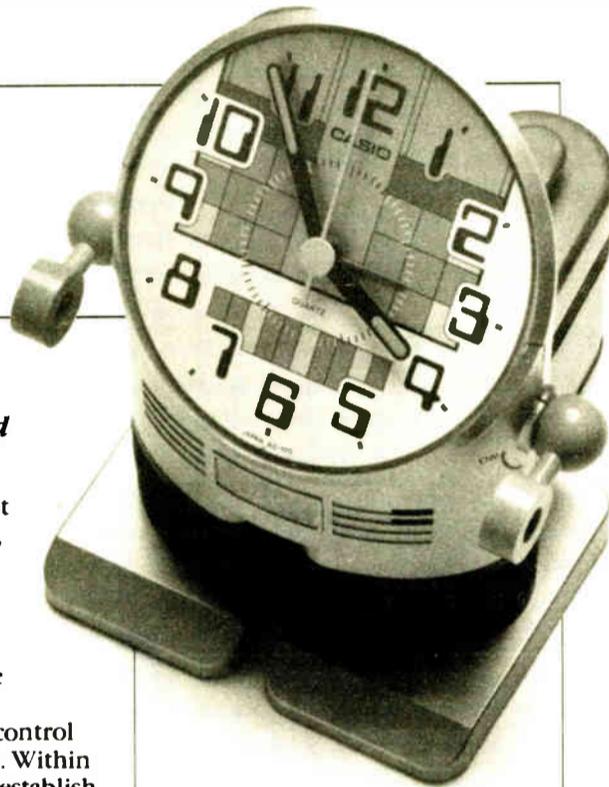
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BOTTOM OF THE 9TH VRC CALLED TO TELL ME IT SWITCHED TO STANDBY, I HIT A TWO RUN DOUBLE!

INSIGHT ON RULES

ence resulting in an unreliable reading, but I'd think such interference would be very evident on the field strength meter.

The station's consultant responded that one of the monitor point descriptions on the last proof was misleading. If the inspector went to the wrong point, the field strength reading would be expected to be high. Of course, I'd expect an inspector to use the monitor point description on the license instead of one in a proof. If the description on the license is inaccurate, 73.158(b) requires the station to file a request for a corrected station license.

Varying readings

The consultant also said that the antenna monitor gave different readings when operated "locally" and when operated by the remote control. If the array is tuned according to the antenna monitor, it "went to hell." If tuned according to the remote control, the base current ratios and monitor point readings were correct.

The Notice of Apparent Liability said the base current ratio was out, not the antenna monitor currents. In any case, this does remind us that 73.62(a) requires both the base current ratios and the antenna monitor current ratios to be maintained within 5% (or less, if specified on the license).

In 1976, the FCC removed the requirement that DA base currents be logged several times a week if the station had an approved sampling system and monitor. An occasional check of base currents is still desirable to ensure compliance with 73.62(a).

Finally, remote control equipment should not adversely affect the operation of transmitter meters and monitors. Although not specifically stated in the remote control rules, 73.1550(a)(7) places such a requirement on extension meters.

Incomplete public inspection file

The station was fined \$300 for missing several items from the public inspection file. The station responded that the miss-

(continued on page 26)

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Underlying Truth in the Loudness Wars

(continued from page 23)

of a freight train. With an operating philosophy that grabs the listener by the throat and runs at full speed, Pirate Radio wanted a sound that matched.

As the audio consultant responsible for that job, I did my best to give them what they wanted, filling their request. My technical background allowed me to create a sound that I feel minimized distortion, yet achieved the goals of presenting the sound of Pirate Radio in line with the image that Scott Shannon and the management there had determined would be effective. They wanted it louder than anybody else in Los Angeles.

Engineers must learn to avoid attitudes about quality sound that deny the station a sound in line with its overall presentation objective. All departments must at one time or another defer their preferences to the requests of management or programming.

Talk to salespeople sometime and you'll often hear them gripe about how they could sell more advertising if programming was different, or less lenient, etc . . . Quite frankly, they are probably right on the mark most of the time—they

Crying amongst the engineering community about the merits or detriments of loudness audio processing will serve no positive purpose.

undoubtedly know their clients better than anyone else at the station.

Yet, they must work to accomplish their sales goals within the confines of the station policy. They can, and should approach station management with their concerns, in order to develop what may be the best compromise for both parties. It is no different with engineers.

Your personal preference regarding the sound of the station may not agree with the ideas management and programmers have. Your technical judgement tells you to go for quality. But as we have seen and will continue to see, quality does not hold the same level of importance for everyone. So, your challenge becomes to create the best sound possible that still delivers it loudly.

Be prepared

This article may appear, on the surface, to be supportive of programming, and management only—it is not. My intent here is to illustrate the "real world" picture of what is going on today within the aggressive confines of our industry.

Your thoughts and opinions do count, but they can only count when presented in a supportive and educational manner.

I perceive the "quest" of today's engineering posture as trying to find a way to highlight quality rather than quantity—quantity here being dBs of loudness. This can be accomplished. But

for that to happen a few concepts need to be considered and addressed.

Probably the most important issue is education. We as an engineering community need to assemble concrete data that is based on research and that details the benefits of better sound for radio.

Once assembled, an education process for programmers and management

Stop blaming engineers and audio processing manufacturers who have responded to the requests from radio stations to achieve a certain sound.

must be established. This process must be communicated to them on their level, not ours. This is probably one of the areas where the engineering community makes its biggest mistakes. We must get the word out, through the trade press, conventions, and seminars.

Also, the word must be presented to programmers and management just like any other new "hot" idea that is designed to make your station #1—with pizzazz! That's right, we have to "sell" the benefits of better sounding radio, just like you have to "sell" your manager on why you need a specific piece of gear.

In addition, the equipment manufacturers, our company included, need to assist in research and educational efforts. I realize that because audio processing is a subjective pursuit, we cannot all agree on theory, design, and method.

But through the open forum of "professional controversy" we can offer the broadcaster a choice of useful information, not the embarrassing name-calling that has transpired over the past few months.

Finally, once we have presented our case to management, we then need them to listen to the information presented and understand it. They can only benefit from it. Maybe, if a situation like this were ever to arise, a better "understanding" between management and engineering could be achieved that would give both parties a better insight about the role that audio processing plays in competitive radio.

Change starts with a forum

The key to bringing the loudness processing issue to a point where its role in a station's sound changes begins with expanding the forum to include those who are essentially responsible for creating the need for it: management and programmers.

Crying amongst the engineering community about the merits or detriments of loudness audio processing will serve no positive purpose. Stop blaming engineers and audio processing manufacturers who have responded to the requests from radio stations to achieve

(continued on page 26)

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Learning from FCC Citations

(continued from page 24)

ing items were in a locked office and offered to call the office owner to gain access.

Again, the inspection apparently went from 10:15 PM to 3:45 AM, so it might be reasonable to have the public inspection file locked away. However, nine months after the inspection, the FCC had not reduced the fine.

The station also was fined \$1000 for having an inadequate tower fence. It appears that the property had a fence instead of individual tower fences, as authorized by 73.49. However, the gate was missing. The station decided to add

individual tower fences.

The station was cited but not fined for not having an EBS checklist at the normal duty position (73.908).

Equipment performance

The station was also cited but not fined for not having the report of the 1987 equipment performance measurements [73.1590(a)(6)]. I believe that this is one of many stations under the impression that "proofs were eliminated."

As mentioned in previous articles, the Commission eliminated the audio portion of equipment performance measurements, but they actually increased the RF portion of the measurement requirements from a demonstration that harmonics were not causing harmful interference (as evidenced by tests with a communications receiver) to actually requiring a demonstration of compliance with 73.44.

If we all don't follow the rules, we all end up worse off.

This requires measurements of harmonics and other spurious emissions plus measurements of occupied bandwidth. The Commission's recent adoption of NRSC-2 exempts stations utilizing NRSC-1 from compliance with 73.1590(a)(6) for five years through presumed compliance with 73.44. However, compliance with 73.44 is still required.

It is interesting to note that several stations cited for missing equipment performance measurements submitted incomplete measurements to the FCC in their response. These measurements typically showed lack of harmful interference as determined with a communications receiver or demonstrated compliance with har-

monic suppression requirements.

None of the reports I've seen submitted in response to violation notices included the required measurements. However, the FCC did not request additional information from these stations.

Other violations

The station was also cited for violation of 73.1860(b) and (c), because no operator instructions were posted and the operator was not familiar with operation of the remote control. *Train those operators!*

In another instance, the station was cited for operating at 68% of licensed power (violation of 73.1560(a)) and hav-

ing a base current whose full scale reading was more than three times the minimum normal indication [73.1215(b)(2)].

Finally, in the April Notice of Apparent Liability, the FCC required the station to conduct a partial proof of performance on the DA. In December, the station advised the FCC that the consultant had been paid for the work in June and had still not performed the work.

In its response, the FCC said the "difficulty in accomplishing the task of performing the partial proof as required is between station management . . . and the consulting engineer." The FCC also ordered the station to pay the \$3100 fine.

■ ■ ■

Harold Hallikainen is president of Hallikainen & Friends, a broadcast equipment design, manufacture, sales and installation firm. He can be reached at 805-541-0200.

"Loud" Processing

(continued from page 25)
a certain sound.

Engineers are not responsible for perpetuating this sound. Rather good engineers and smart businessmen within the industry respond to the needs that programmers and management create.

Furthermore, stop hitting the panic button with regards to loudness audio processing overtaking the broadcast industry. It just doesn't make sense for certain formats to beat their listeners over the head with loudness.

Look at research on how different audiences listen to stations differently. Beautiful music stations have a much longer level of time spent listening. Contemporary Hit stations will be punched in and out of much more frequently.

Think! Listener fatigue will be much more important for the format whose listeners stay with it for hours on end than for the format whose audience may tune in every couple of minutes.

"Loudness" processing is not going to eat away at the entire broadcast industry. The volleying that goes on when one station achieves a certain level of loud-

ness is almost always among stations sharing the same listener base.

In both New York and Los Angeles the "loudness wars" were perpetuated when one station established a good competitive sound and then the competition reacted to the change. Then in an effort to remain louder, the first station would react to changes made by the second station. It is this vicious cycle that eventually "pollutes" the sound of the market.

Maybe from some of the thoughts presented here we can circumvent the effects of the above scenario.

In closing, I ask that you think about your own environment and situation. How you can work to improve, and understand it. Not just sonically, but within the domain of education, communication and the competitive arena as well. You will be better for it, your station should be better for it and most of all, your listeners will thank you for it!

■ ■ ■

Frank Foti is an audio consultant and president of Cutting Edge Technologies, a manufacturer of processing gear. He can be reached at 216-241-3343.

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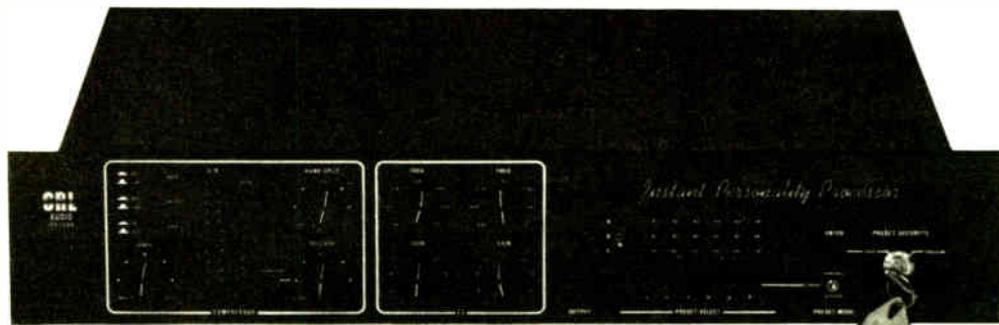
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Advances in I/O Technologies

by Mel Lambert

Studio City CA As we rapidly come to terms with the new vocabulary of digital, it is sometimes too easy to overlook the trees for the forest.

Although I should be the first to acknowledge that storage capacity, track assignments and user interface are extremely important factors when mulling through the sales literature, there are some additional, more basic, parameters that are most definitely worthy of our attention.

An analog console or tape machine is hobbled by inadequate input or output headroom, defective signal-to-noise ratio, and restricted bandwidth. Similarly, the ultimate performance of workstations, digital processors and recorders is strongly affected by the I/O topographies.

DIGITAL DOMAIN

In a nutshell: If the analog audio is corrupted and otherwise less than sonically perfect after passing through the A-to-D process, and is further degraded during the D-to-A stage prior to the AM/FM transmitter, your listening audience is going to be less than impressed with your programming, let alone your technical standards.

Even if your current involvement with things digital is restricted to a PCM STL link, either permanently installed or

The majority of digital systems incorporate . . . a "successive approximation" . . . converter.

used for the occasional high-quality music remote, or to simplify networked feeds, your program audio is going to pass through at least one complementary A-to-D-to-A process.

Just the facts

It's a fact of life that all digital systems contain circuits which convert a continuously variable input signal into a series of discrete 12-, 14-, 16-, or 18-bit binary words during a time period equal to the reciprocal of the sampling frequency.

In basic terms, for conventional PCM systems the input signal is first filtered to remove all components whose frequency is half the selected sampling frequency (the so-called Nyquist Limit), and then compared with a fixed-value reference to produce a digital word equal to the closest approximation of the signal amplitude.

(A 16-bit system, for example, can produce a unique output for 256x256 or 65,536 input levels; a 14-bit system, on the other hand, will accommodate 16,382 discrete levels.)

Conventional 16-bit systems, however, have problems solving the last or sixteenth bit of data; in fact, varying amounts of a special dither signal are added during the analog-to-digital conversion process to reduce the effects of

this last-bit sampling anomaly.

The majority of digital recorders, workstations and processors are currently restricted to 16-bit operation—primarily because of the cheaper availability of 16-bit microprocessors and DSP chips from the computer industry. Still, there are now available a number of 18- and even 20-bit analog-to-digital converters.

Some of the more innovative designers—and those now innovating their second- and third-generation systems—are using higher-precision A-to-D circuits to produce an 18/20-bit sample word, and then purposely truncat-

ing the value to a highly accurate 16-bit word for recording on tape or for processing within a multifunction workstation.

It cannot be denied that this enhanced degree of sampling precision can often be heard in more exacting classical music sessions, or where the digitized signal will be subjected to a series of signal manipulations. In these situations, specifying a digital recorder with higher-precision A-to-D chips may very well offer sonic advantages.

The majority of digital systems incorporate what is often referred to as a "suc-

cessive approximation" analog-to-digital converter. As the name eloquently suggests, this device performs a series of comparisons during the sampling period and quantizes the input level into a digital word.

As the signal level decreases, however, such an A-to-D loses accuracy. In addition, most converters need to be accurately calibrated and surrounded with high-stability components to prevent drift during normal operation.

Another vital component in all digital systems is the anti-aliasing filter. Given

(continued on page 30)



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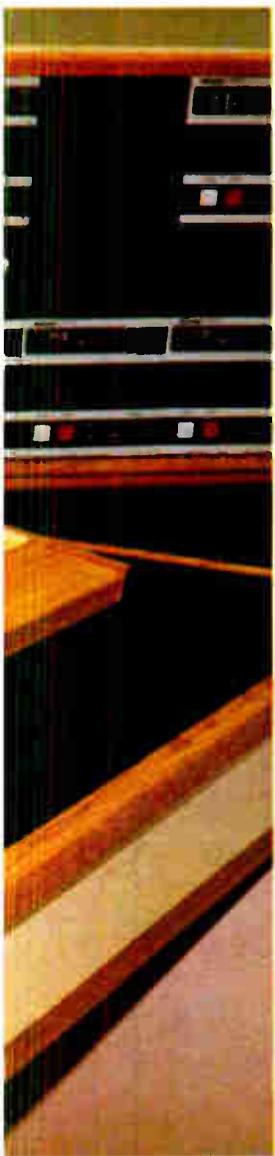
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NEW NEW NEW

Developments in Digital I/Os

(continued from page 27)

the job we ask of these higher-order filters, designing such filters is not exactly trivial. As with all filter designs, we can expect some amount of HF ringing, plus non-phase linearity and small to medium amounts of group delay. (It goes without saying that many man-hours have been spent on our behalf developing sonically transparent anti-aliasing filters.)

Given some of the design headaches faced by digital designers who elect to follow the conventional filter and ADC converter topologies, it's hardly surprising that we are also seeing systems being innovated that incorporate alternate approaches.

The MASH solution

One of the more interesting of these potential solutions is MASH analog-to-digital conversion, or "Multi-Stage Noise Shaping," a technology developed by NTT Labs in Japan. This solution is now finding its way into a number of systems, particularly DAT recorders. In essence, MASH utilizes a 64-times oversampling digital filter to achieve high precision A-to-D conversion even at very low signal levels.

MASH is an advanced "delta-sigma" ADC system that's fundamentally different from conventional (successive approximation) systems. Instead of directly converting each sample into a 16-bit value, which means that the difference between the resulting staircase of digitized values and the continuous wave-

form is therefore large, MASH uses a sampling rate of around 3 MHz ($64 \times 48 = 3.072$ MHz; $64 \times 44.1 = 2.822$ kHz).

Rather than attempt to determine the absolute value of each sample, MASH simply determines whether the current sample is higher or lower than the previous one. In this way, quantization can use just a single bit, a "1" or a "0," to indicate a rise or a drop in the sampled signal voltage.

... MASH uses three of these one-bit quantization circuits with an added circuit to obtain 16-bit precision.

But a delta-sigma system with only single-bit resolution would need to be run at an unreasonably fast clock rate to obtain the desired level of performance. To get around this drawback, MASH uses three of these one-bit quantization circuits with an added circuit to obtain 16-bit precision.

Lower quantization noise

As well as eliminating a number of the precise adjustments required by successive approximation designs, MASH also reduces quantization noise and avoids the distortion that occurs in conventional systems at low signal levels. MASH allows the use of a relatively gentle (third-order) analog anti-aliasing input filter, thereby avoiding the phase distortion of

steep filters.

Also, the 64-times oversampling rate is so fast that no external sample and hold circuit is needed. (If you wonder where the name MASH comes from, single-bit quantization circuits are described as "shaping" the quantization noise to minimize its effects, thereby further improving the audio performance.)

As an added bonus, CMOS construction allows a MASH-based A-to-D converter to be run from an unbalanced 5

V power supply, thereby reducing power consumption for the ADC and analog filter to a total of under 200 mW, compared to approximately 1 watt required by conventional designs.

MASH would therefore seem to offer a three-fold benefit: high sound quality, compact dimensions and low power consumption. (All of which might explain why MASH technology is proving very attractive for portable DAT machines where, for obvious reasons, power drain has to be kept to an absolute minimum.)

So fast are developments in digital circuitry, it is hardly surprising that radical enhancements in circuit design can take place during the lifetime of a digital recorder, processor or workstation. In

this case, one alternative to making the entire system obsolete might be to explore the possible use of external digital input and output stages.

Just as we have seen a blossoming industry in add-on mic preamplifiers to replace the often less than pristine designs found in some lower priced consoles, in the not so distant future we might very well elect to upgrade system performance by dumping our existing A-to-D and D-to-A subsystems and replacing them with some of the more innovative designs now coming to market.

The promise of fiber

Another topic for potential investigation—and one I'll cover in greater detail in a subsequent column—is the use of fiber-optic links to carry multichannel digital audio around a larger production facility.

Already we are seeing digital processors with two-channel optical I/O based on conventional CP-340 Type II/SP DIF interfaces. It cannot be long before the first digital consoles and tape machines appear with 56-channel MADi (Multichannel Audio Digital Interface) ports.

As well as simplifying the connection of complex digital systems, optical links can be run over long distances at relatively modest costs and are immune to the majority of EMI problems that can plague both analog and digital trunking schemes.

■ ■ ■

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

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A Guide to Digital Cable Radio

by Douglas Conn

New York NY The digitizing of consumer entertainment product is clearly the wave of the future. Both the audio and video media are undergoing a transition from analog to digital as new generations of technologies and distribution networks are introduced.

Remarkably, little attention has been paid to a new cable service, digital cable radio (DCR), which will be introduced in late 1989 and early 1990. DCR's potential lies in its ability to bring digital audio signals to a mass audience.

While it does not appear to be a revolutionary new application, nor will it soon overtake the popularity of broadcast analog radio, this new form of home audio delivery may have far reaching implications for at least three major industries: radio broadcasting, cable television and recording.

Digital inroads

As of late 1988, digital music signals were in about 12% of US homes in the form of CDs. Digital cable radio is a digital audio signal which is transmitted via satellite to local cable system headends and then piped into subscribers' homes where it is transformed to analog by a cable converter box and played through an ordinary home receiver.

DCR programming will consist of new packaged channels, digitally retransmitted radio broadcast stations, and digital simulcasts of program channels. The quality is said to be comparable to a CD because the digital signal travels locally over shielded coaxial cable lines, minimizing electrical interference.

But that is not the only dissimilarity between DCR and broadcast radio. The new DCR programming has virtually no disc jockeys and it is basically commercial free, leaving DCR programmers to collect their revenues directly from subscribers rather than advertisers.

Moreover, DCR channels will offer packaged music in specific sub-formats (ie. classic jazz, dixieland jazz, big band sound, new age, etc.). And DCR can be packaged on a pay-per-listen basic, similar to cable's pay-per-view, only here the subscriber pays to receive an album, live concert or pre-recorded music special at a specific time of the day.

Thus, DCR, with its many permutations of program offerings, is distinctly different from analog broadcast radio and may one day become a potent competitor.

Cable not new to radio

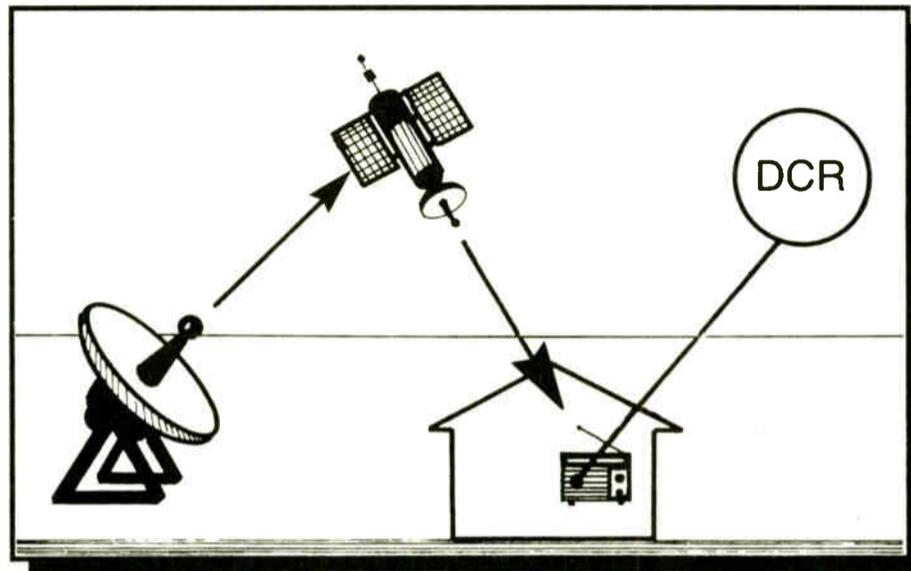
Cable radio is not by any means a new idea. In Switzerland, private wire radio was introduced in the 1930s to bring radio to mountainous Swiss terrain. Today, a typical Swiss cable system provides about a dozen television channels and up to 18 stereo radio channels.

In the US, non-digital cable radio has been available for some time and as an industry has just under 10 million subscribers, or 11% of total TV homes and 14% of total cable TV homes passed.

However, DCR's distinction lies in the superior digital quality of its signals. But, as the record industry has always known, consumers also want the ability to listen to pre-recorded music on their own schedule. The introduction of digital audio tape

(DAT) will enhance this prospect.

As DAT players gain acceptance in the US, home taping via DCR will make it doubly convenient to acquire digital quality music. With this in mind, it is en-



tirely possible that DCR will ride on the crest of DAT's popularity or stumble in the wake of its failure.

Competition for broadcast radio?

Concerns have been raised that, in some areas, cable radio stations, like cable video channels, will begin to flourish and their numbers will eventually keep broadcast radio stations off of cable systems or relegate them to less desirable slots on the dial.

This would be especially worrisome if listeners who subscribe to cable (60% of US TV homes) set up their home receivers so that they only have convenient access to radio through DCR.

These concerns though, are probably unfounded. Portability and mobility outside the home will always be important for radio listeners, insuring the longevity of broadcast radio.

Additionally, some digital radio receivers, such as Jerrold's, are extensible to 98 channels, leaving slots for the retransmission of broadcast stations. Also, an A/B switch could be employed to allow the listener to easily switch from cable to broadcast radio.

The cable television industry has much to gain from DCR. The additional fixed cost of new headend technology is minimal and the cable operator utilizes excess capacity to generate new revenues.

DCR may also enhance the profile of cable service offerings and, through digital audio simulcasts, may act to increase the value of current video services; however, the value added of digitizing the audio portion of premium or basic video channels, such as music channels, is unknown.

In the least, by digitizing audio signals, cable operators are helping to boost their image, both as purveyors of new technologies and as innovative service providers.

No copycode disputes

Finally, the recording industry should be taking a long, hard look at DCR, since its basic distribution methods are potentially greatly affected.

Pay-per-listen by itself may be successful but perhaps not until DAT is widely accepted and consumers can shift the times they choose to listen to program-

ing through home recording.

Pay-per-listen and its eventual sophisticated step-brother, listen-on-demand/CD home jukebox, will allow consumers to listen or record digital mu-

which prohibits the making of copies of copies will help to discourage rampant copyright violation.

DCR may even help bridge the gap between those who want to purchase music and those who are apt to record. The artist, record company and publisher will each be compensated at the point of purchase, accurately and quickly, and the number of real consumer outlets to purchase recordings (ie. record stores plus DCR jukeboxes) will increase.

It will take some time for DCR to be accepted. First, the technology must be installed by the cable television industry. Then, the programming component of the industry must itself begin to take form and diversify; whether from entirely new entrants or established radio programmers, who perhaps may develop national superstations.

Finally and most importantly, consumers must recognize the improvement in sound quality and new radio formats and adapt to the notion of digital tape recording via cable television lines.

Digital cable radio may be the technology which accelerates the rate at which digital audio signals reach a mass audience.

■ ■ ■

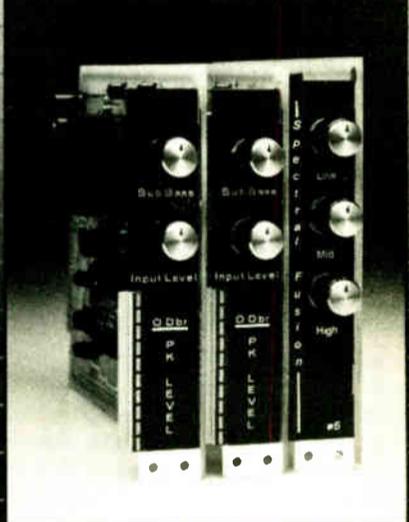
Douglas Conn is Associate Director at the Center for Telecommunications and Information Studies at Columbia Business School. He can be reached at 212-854-4222.

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A New Look at the Ufer Ground System

by Chris Scott

Bowling Green KY The Ufer ground system—it seems to be the lost art. None of the contractors or architects, and very few of the engineers I've had contact with have ever heard of it . . . a cheap earthing system that consistently stomps rods into the ground.

Before I describe this proven concept, let me make it clear that I take no credit for its design.

An idea is born

During World War II, a retired vice president of Underwriters Laboratories, Herbert G. Ufer, developed the system for the US Army. Igloo-shaped bomb storage vaults were being built at this time and posed possible static and lightning problems. Ground conductivity was poor and to be effective, ground rods would have to be driven several hundred feet.

After much research and testing, Ufer advised the Army to make connection to the steel reinforcing bars (re-bar) that would be in the concrete foundation anyway. He had determined that concrete was more conductive than all but the best soil and that this improved semiconductor characteristic would enhance surface area contact with the surrounding soil.

The wire ties would be extra secure and attention would be directed to bonding or welding the lattice-type network together.

The Army adopted the idea and built the vaults as specified. After construction, ground resistance tests were made on these installations. No measurement exceeded five ohms. This value was considered extremely low for the local soil conductivity. Later tests confirmed stability.

Ufer went on to develop the concept of concrete-encased grounding electrodes. Many of his findings are detailed in IEEE Transactions paper #63-1505. His system has since been used by the mili-

In 16 months, the management has requested no maintenance of the site . . .

tary, utility companies and other industries throughout the country. Why not broadcast stations?

Construction

After reading an obscure 1967 paper citing actual tests and comparisons to conventional systems written by Wismer

and Becker Engineers, I elected to give it a try.

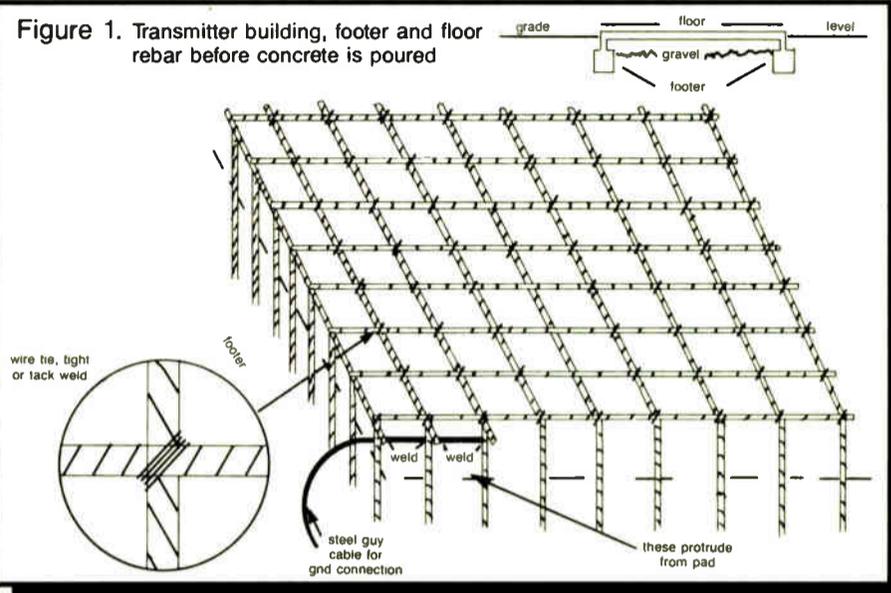
I installed a cheap, convenient version of the Ufer ground system at WHHT, a new Class A FM station I was consulting with in Glasgow, KY.

The transmitter was located on a three-hundred foot knoll where just one hun-

tightening more than usual. Tack-welding them together was preferable but the equipment was not readily available at the time.

I later made the ground connection to several bars that were intentionally extended slightly out of the foundation. Standard copper strap connections were

Figure 1. Transmitter building, footer and floor rebar before concrete is poured



dred feet of tower would provide 400' above average terrain. A two-bay ERI antenna would be mounted at the top. This location was a natural for signal . . . and lightning.

One 70' tower was already on site for two-way radio service. The land owner warned us that this tower was frequently struck and equipment had been repeatedly damaged despite increased transient voltage precautions. Indeed, during July construction, masonry workers left the site after "a bolt sent fireballs rolling down (the existing) tower."

With a CMOS controlled transmitter and a talking remote control selected for installation, I knew that any transient overvoltage protection devices I would install would need a clear path to ground to divert strike energy away from the equipment.

I asked the concrete engineer to use additional wire ties connecting the re-bar together and to double-wrap them,

used along with MOV/L-C filter transient protection (see Figure 1 for a diagram of the construction).

Minimal downtime

In 16 months, the management has requested no maintenance of the site and has maintained 24 hour per day operation with zero downtime except due to AC power failure.

With equipment so susceptible to transients, this kind of performance is very unusual in this region, especially on this hill.

I am convinced that the low cost, combined with the proven performance of the Ufer ground is the ideal system for new installations. Western Kentucky University will be using this system for all new transmitter sites.

Chris Scott is CE of Public Radio and Television for Western Kentucky University. He can be reached at 502-745-2153.

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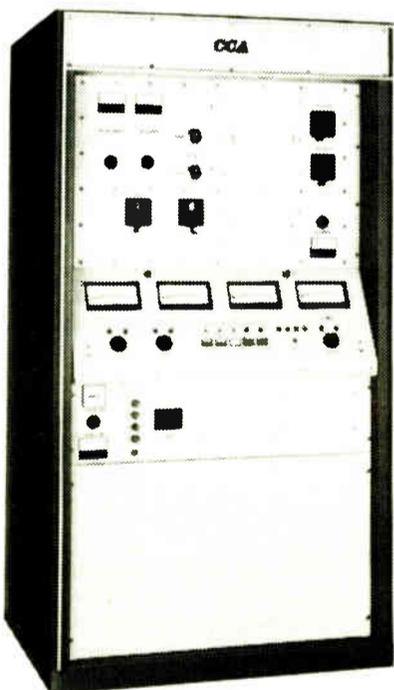
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Where Does Time Come From?

For Radio, at Least, the Answer is Easy: From Ft. Collins, Colorado

by Dee McVicker

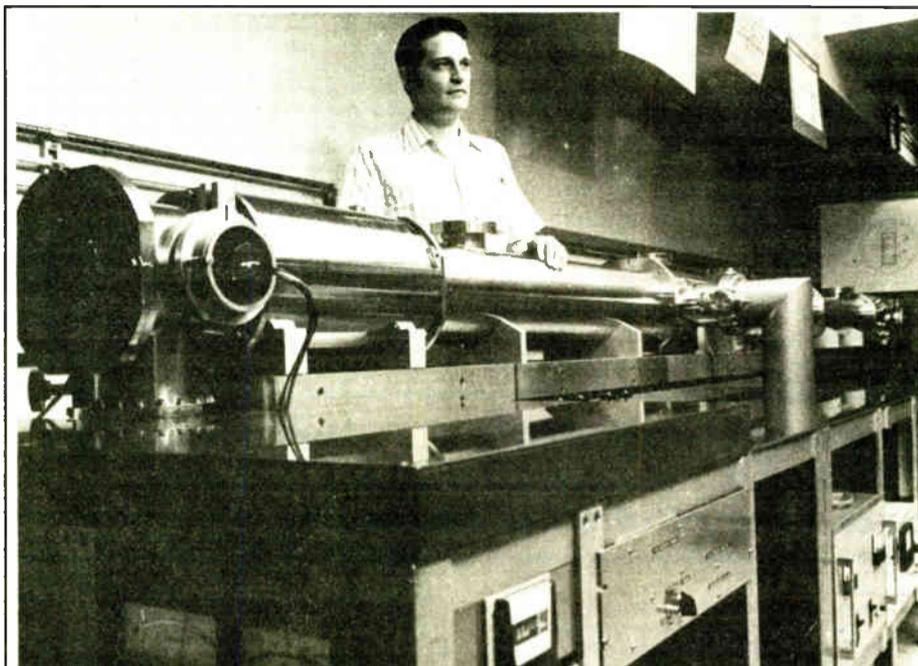
Ft Collins CO Time, wouldn't you know it, comes from radio. We're not talking about the kind of time that radio sales-types sell and the kind that everyone at the station makes such a fuss over. We're talking about where time comes from, which is WWV in Fort Collins, CO, among other places.

Engineers, of course, know this because it's prudent to time-calibrate transmitter frequencies every 40 days or so. Call it a waste of time, but the advent of broadcasting did, after all, spearhead our compulsion for timekeeping.

OFFBEAT RADIO

In a rhetorical sense, time originated alongside the first radio station. That would be KDKA in Pittsburgh, and the year was 1923.

That year or soon after, The National Institute of Standards and Technology (NIST), then called the National Bureau



NIST Physicist David Glaze is pictured with the NBS-6, the sixth generation of atomic frequency standards.
Photos: NIST, Boulder Laboratories, U.S. Dept. of Commerce

of Standards, was given the task of timestamping frequencies of up-and-coming radio. Ironically, it was feared that the few AM stations of this day would interfere with each other if not for a sophisticated method of referencing frequencies!

Shortwave station WWV went on the air for this purpose, broadcasting time

by what is now considered an archaic clock—the rotation of the earth.

The measurement of time has since changed to reflect our atomic age; WWV now calibrates transmitters to the movement of a Cesium atom.

The resonance frequency of the

Cesium atom, said Roger Beehler, manager of time and frequency broadcast services at NIST, is 9 GHz—nine billion cycles per second. Not only does Cesium resonate at an extremely high frequency, it also appears to be oblivious to the natural world as we know it.

Atomic frequency

Said Beehler, "Unlike the rotating earth, which slows down and speeds up depending on the core of the earth, depending on tidal forces and all sorts of big external events, the frequency that is associated with the (Cesium) atom does not change, as far as we know, with any external event."

Of course, in order for us to actually know what time it is, we have to be able to "hear" the nine billion cycles per second that the cesium atom resonates. Beehler explained how this is done: "What we do is basically arrange a system where an electronic oscillator is locked electronically to this resonance frequency."

The element's atomic beam is what provides correction at the oscillator's slightest shift off frequency, and keeps the electronic signal in near-perfect sync with the atom's resonance.

This strange source material is then
(continued on page 34)

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Keeping Time with Accuracy of Atoms

(continued from page 33)

broadcast on two shortwave stations, a very low frequency station, and a satellite service.

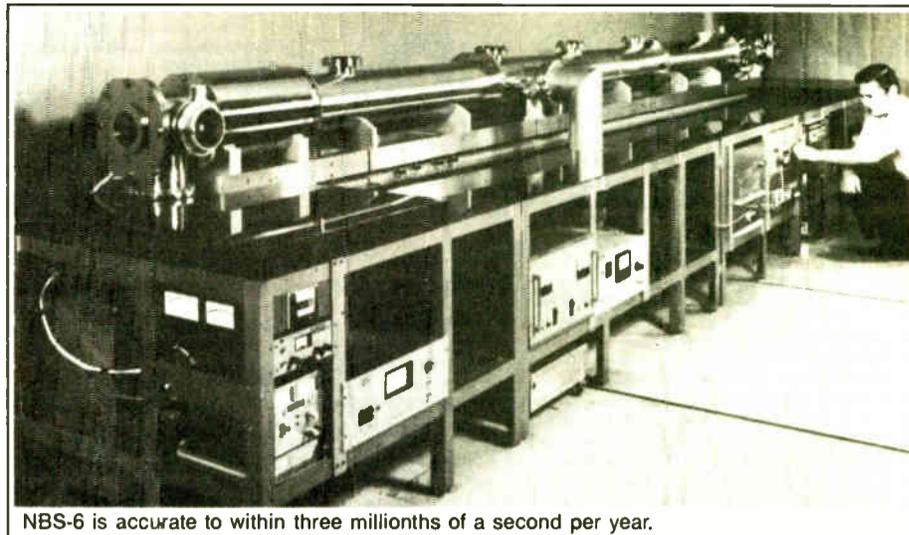
Shortwave station WWV in Colorado—being the first and most popular—covers the world, while shortwave station WWVH in Hawaii predominantly covers the Pacific ocean. Both are powered at 10 kW output and broadcast on 2.5, 5, 10, and 15 MHz, with WWV also on 20 MHz. The transmitters commissioned to keep pace with the atom's motion are predominantly Elcom Bauers for Hawaii station WWVH, and soon to-be-installed CCAs for WWV in Colorado.

At 5 kHz bandwidth, the shortwave

band gives NIST the opportunity to put a voice behind their time signal. Unfortunately, shortwave is not a good timekeeper; it is usually a late arrival because of solar spots, the unpredictable ionosphere layer, and all the other conditions it has to weather. "A thousandth of a second is about the best you can do," said Beehler of the propagation delay.

For a more accurate measure of time

Shortwave station WWV . . . broadcast time by what is now considered an archaic clock—the rotation of the earth.



NBS-6 is accurate to within three millionths of a second per year.



Shortwave station WWV provides its time-keeping standard to the world.

calibration, Beehler suggests WWVB, which is a service transmitted on 60 kHz. Because it has a limited bandwidth, WWVB utilizes a much simpler format than WWV or WWVH.

Stable courier

"All it is," said Beehler, "is a very stable carrier of frequency at 60 kHz, so you can use that as a very precise standard of frequency." By shifting the level of this transmission, the station is then able to send a simple time broadcast in the form of a binary code.

At the beginning of each second, WWVB drops the power 10 dB. Two-tenths, five-tenths or eight-tenths of a second later—depending on the listener's decoder—power is brought back up to its original level. Decoders receive the signal as a binary code that makes up the day, the hour and the minute as well as other relevant information.

Because of the station's range, the station is only received in the continental US, and to some degree in Canada and Mexico. But because WWVB is more accurate by time standards than shortwave by ten to a hundred times, the service is more popular for time intensive applications such as the nation's space program, which utilizes special receivers to pick up the time signal.

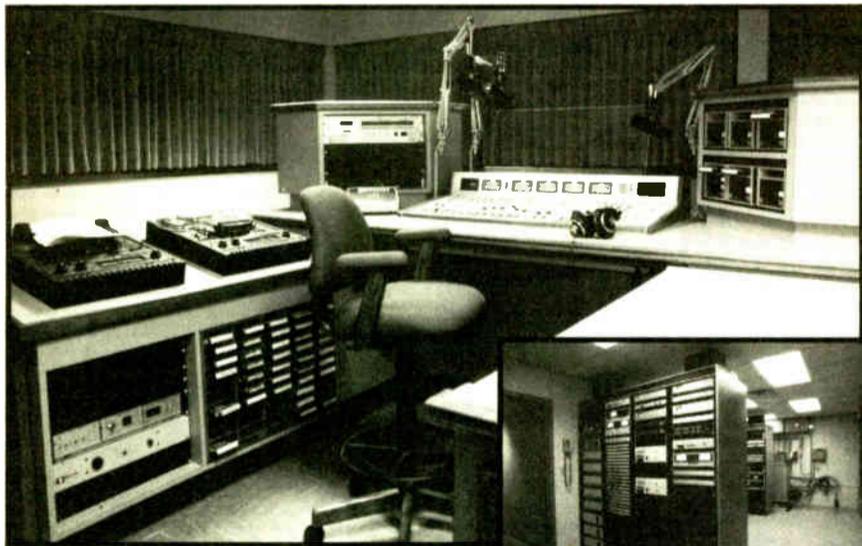
NIST's satellite service, which origi-

(continued on page 36)



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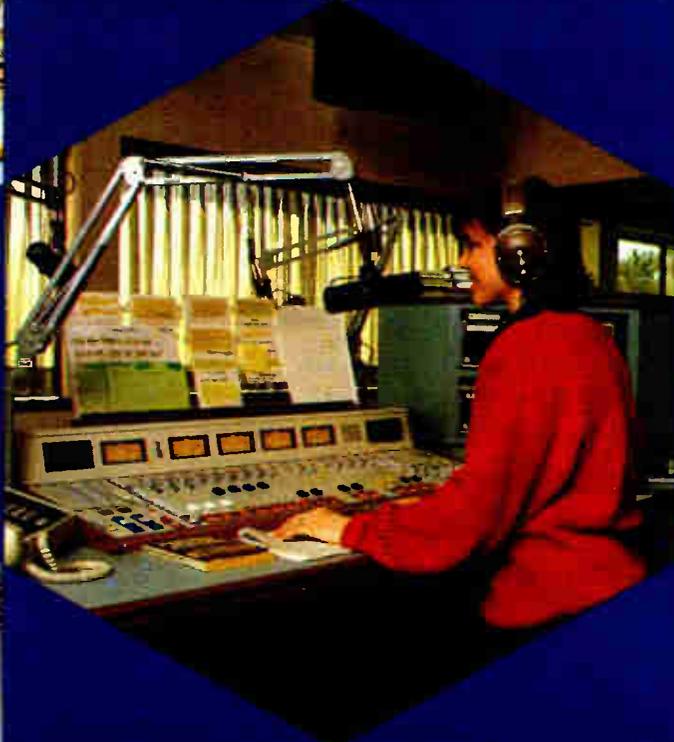
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Accurate Time, Courtesy of the Atom

(continued from page 34)

nates in Wallops Island, VA, also requires a special decoder for its signal. The service is broadcast on a mere 400 Hz bandwidth with a data rate of only 100 Hz.

GOES and NOAA

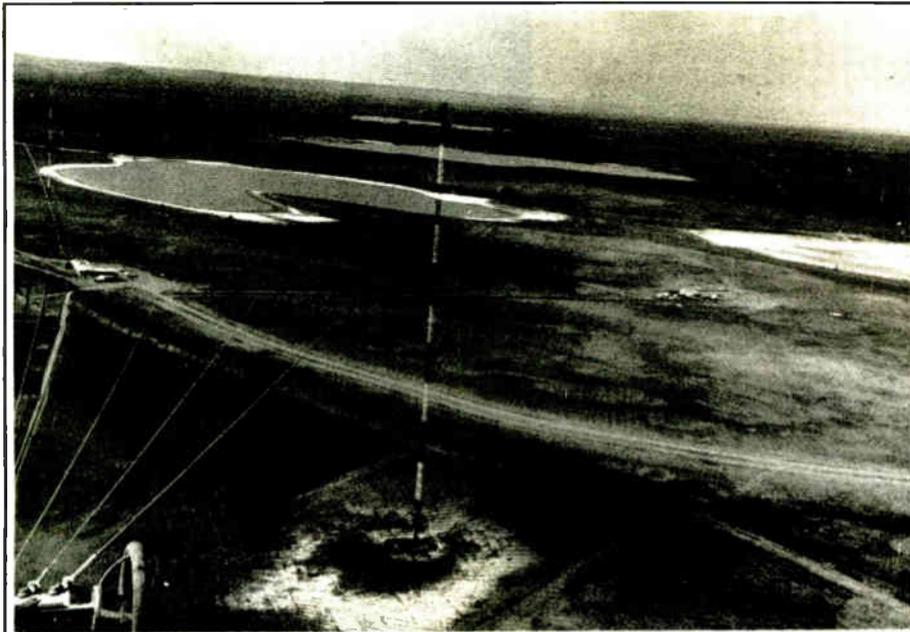
GOES, which is an acronym for Geostationary Operational Environmental Satellite, is put out by satellite organization NOAA, another acronym, which stands for National Oceanic and At-

NIST is exploring the use of satellites for a new service . . .

mospheric Administration.

NOAA is best known for its weather service, but around NIST, this satellite organization is better known for delivering a signal that exceeds the time standard accuracy of other media. "You get a time signal that is accurate to better than one hundred microseconds," said Beehler. "Whatever we transmit in terms of accuracy can be received and used at that same accuracy level."

NIST is exploring the use of satellites for a new service it hopes to have in the works within the next few years. Said Beehler, "We're developing a new time



The antennas here, outside Ft. Collins, CO, transmit the various frequencies of WWV and WWVB.

dissemination system that would send the time signals up through communications satellites. There you would have access to many megahertz of bandwidth."

The tentative plan is to send a series of very sharp pulses via satellite so that listeners can start and stop counters at precise intervals. The technology could yield a time standard accuracy of one ten-millionth of a second, which according to Beehler, "would be one thousand times better than what we can do with

the GOES satellite."

Just about everybody is interested in what NIST and its broadcast stations have to say about a small atom resonating at nine billion cycles per second. The electric power industry, for instance, relies on the reception of time signals to maintain a consistent 60 Hz frequency. Sixty hertz is, after all, what governs the rate of our electric clocks.

But, an even more important time-dependent application for this industry

is the analysis of electrical failure. In recent years especially, with the complexity of electrical networks joining states in particular and the continent in general, time has become key in untangling the rippling effect of an electrical fault.

Sequential event recorders

Thousands of what the industry refers to as sequential event recorders time-mark the events of relays and transformers, for instance, to WWV's time signal or another NIST time signal. When failure occurs, these charted recordings are lined up by their time mark and observed for timing inconsistencies that lead a trail to the source of the problem.

In terms of the largest group of WWV and WWVH listeners, Beehler considers the boaters to be on the top of the list. "They have to navigate typically by celestial navigation," he said, "and record time with that observation."

There are many others who keep time to the beat of WWV and WWVH broadcasts, including schools, factories and the many thousands that access telephone time-of-day services every year. With that kind of listenership, there's no doubt that the Cesium atom holds the record for broadcasting's most popular format.

■ ■ ■

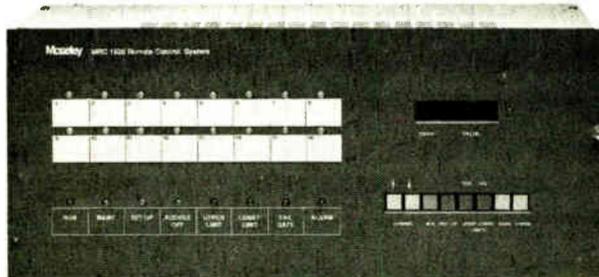
Dee McVicker is a free-lance writer and regular contributor to RW. To inquire about her writing service, call 602-899-8916.

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Harris Technology in Action

“The beacons were blown out of their sockets, but our transmitter barely blinked.”

Robert LaFore knows all about lightning. As Chief Engineer for WQPW-FM “Power 96” in Valdosta, Georgia, he’d better: His 600 foot tower



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WQPW'S 600 FT. TOWER TAKES THEM WHENEVER THERE'S LIGHTNING.

is the tallest object for miles around. “We’ve been hit so hard the tower beacons were blown out of their sockets,” he told us recently, “and so often that the lightning rod looks like someone’s been beating chunks out of it with a sledgehammer. But so far our new Harris HT 20FM transmitter barely blinks at lightning. Occasionally we get a PA Plate Overload message, but that’s it.”

Robert also knows something about Harris reliability: Until they received a power increase to 50,000 Watts last year, WQPW had been on the air with a 3.5 kW Harris transmitter for thirteen years. “That transmitter was very good to us,” Robert reports.

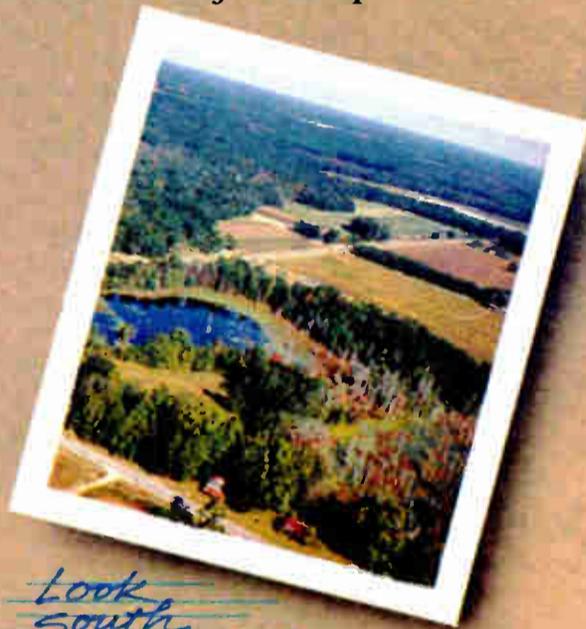
“Still is, in fact—it’s our back-up now. Basically, we shopped around enough to be sure Harris could match or top the competition in both price and features: Things like Automatic Power Control for simple remote operation. Then we ordered a 20 kW HT 20FM transmitter.”

About 45 days later WQPW’s transmitter arrived (meanwhile, Robert supervised construction of a new transmitter building, tower and antenna). “We just took it out of the box and put it right on the air,” he says. “Even the tuning movements were small. The installation went so smoothly, I told the factory ‘You’ve got to do something—this transmitter’s boring.’”

After a number of months of service, WQPW’s HT 20FM remains just as “boring.” Robert has only shut it down for routine monthly maintenance. “Even that is minimal,” he told us. “I vacuum the cabinet out, check tube cooling, make sure nothing’s overheating, and that’s about it. Two or three times a week I do a meter check and log the readings. They hardly ever

change. In fact, we’re still using almost the same tuning numbers we got from the factory. And we’re getting a very noticeable improvement in audio quality from our new Harris THE-1 exciter.”

As you can tell, WQPW is very proud of their new transmitter. We’re just as proud that



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Chief Engineer Robert LaFore

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An Introduction to Sampling Devices

Liven Up Your Station's Production with These Technological Marvels

by Bruce Bartlett

Elkhart IN Buh-Buh-Buh-Buh-Believe me, the stuttering sample effect defines the contemporary sound of many remote DJs and production-music composers. A sample is a memory-chip digital recording of a single note or sound. You can capture any sound you hear and make it part of a DJ production, or part of your station's musical spots. Here's how:

LINE OUT

Using a microphone, you pick up a single note of an instrument, voice, or sound effect—a violin, electric guitar, drum, dog bark, thunder and so on.

The microphone signal goes into a sampling keyboard, which is an electronic musical instrument with a piano keyboard and computer memory circuits. Inside the sampling device, the signal is

converted into digital data and is stored (recorded) in computer memory.

To play the sample, you press a key on the keyboard. You'll hear a note of whatever you recorded. The higher the key you press, the higher the pitch of the reproduced sample.

How sampling works

Let's get into the details of how samples are made. First we need to define the term "computer memory." This is a group of integrated-circuit chips, each containing thousands of solid state switches. Information is stored in binary format (1=switch ON; 0=switch OFF).

Each 1 and 0 is called a bit, which stands for binary digit. Memory stores bits of information. Memory space is limited and is measured in bytes, where 1 byte equals 8 bits.

Suppose you want to sample a live sound, such as a cymbal crash or train whistle. You plug a microphone into a sampler or sampling keyboard. It records the sample as described below (and shown in Figure 1).

The signal from the microphone passes through an analog-to-digital (A/D) converter. This converter measures the voltage of the audio waveform several thousand times a second. Each

Figure 1.

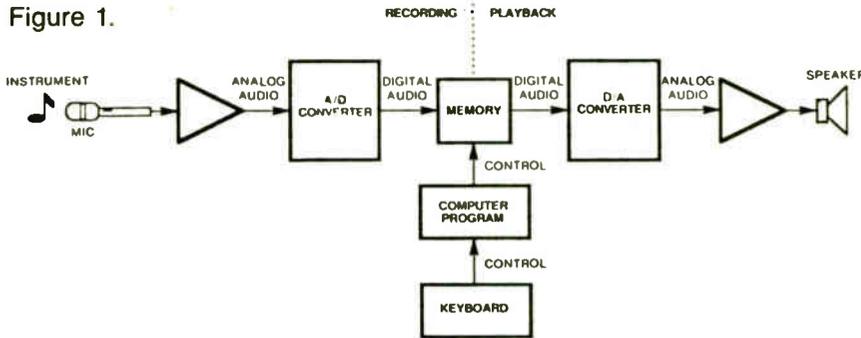
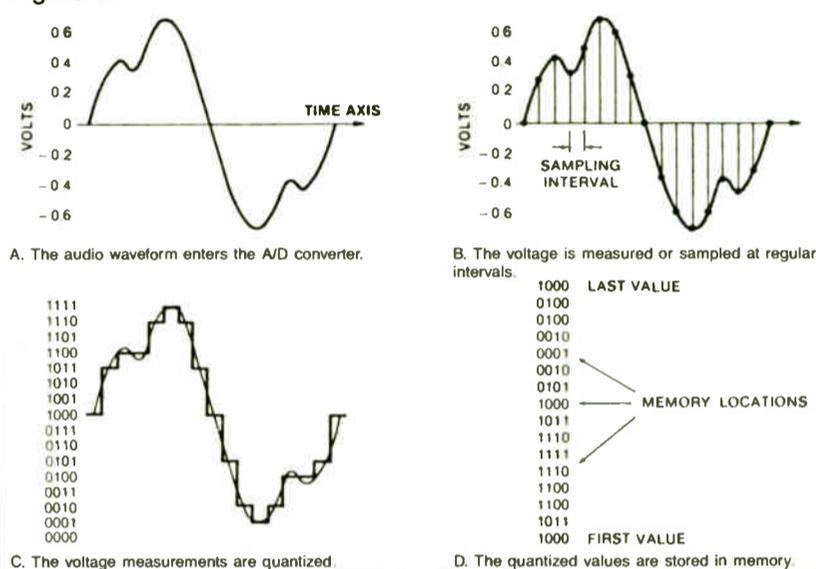


Figure 2.



time the waveform is measured, a binary number (made of 1s and 0s) is generated that represents the voltage of the waveform at the instant it is measured (Figure 2). These binary numbers are stored in RAM (Random Access Memory), making a digital recording.

Later, the sampled sound is played back by pressing keys on the piano-style keyboard (Figure 1). The keypress triggers the sample. Which key you press determines the reproduced pitch of the sample. That is, different keys cause the sample recording to play back at different rates, shifting the pitch of the sample.

However, too much of this pitch shifting can cause an unnatural sound. That's

because the pitch-shifted notes have the same harmonic structure for low and high notes, while notes from a real instrument have different harmonic structures for low and high notes.

Sample sources and hardware

Instead of having the entire keyboard control the pitch of one sample, it's better to record several samples at different frequencies—say one octave apart—and control the pitch of each of these samples within a smaller range. This procedure, called multisampling, is explained in your sampling keyboard instruction manual.

There are many sources of samples. (continued on page 42)

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Power by Series Processing

by John "Q" Shepler

Rockford II Power is the name of the game in high energy audio. To rise above the crowd, you need to fill your allotted bandwidth with as much audio energy as possible. A normal station utilizes a channel. A power station occupies it.

Q-TIPS

Your station can also dominate the dial. But to dominate, you have to pump power into your audio. That's why you bought processing in the first place.

Now, you decide, you need more processing. But, how do you get it? More importantly, how do you get it without destroying your budget or your signal?

The processors you buy today are seldom a single processor. That deceptively simple box in the rack probably has a gain rider, equalizer, parallel compressors, an active limiter and a clipper... all in a line. That isn't one processor, it's a whole chain of processors in series.

Processor chains were what we use to build our stations. You picked one box from each category. Every station had a rack with a different choice of EQ, gain rider, compressor, limiter,

reverb and so on.

Lately, the trend has been to buy single box solutions, or at least a multibox system made by one company. That's great as long as you're the first one on the block with the latest technology. You dominate by default.

Sooner or later, though, your neighbors will get envious and fork over for the same system, or worse... a newer system! Now how are you going to stand out?

Many times, the solution is to add more

ways played this game themselves. Even with the hottest new processing gear, they build unique systems with one of this and one of that. It's constant experimentation and improvement. Like every weapons system, there is always a countermeasure sneaking up on you.

What do you suppose would happen if you took three of your favorite compressors or limiters and hooked them in series? Mucho compresso? You bet!

Would you also believe that this idea

Say each compressor has a decent compression range of 20 dB. Three in a row is 3x20 dB or 60 dB. In other words, you can get 40 dB of normal signal squeeze and still have 20 dB of overdrive for a nighttime screamer.

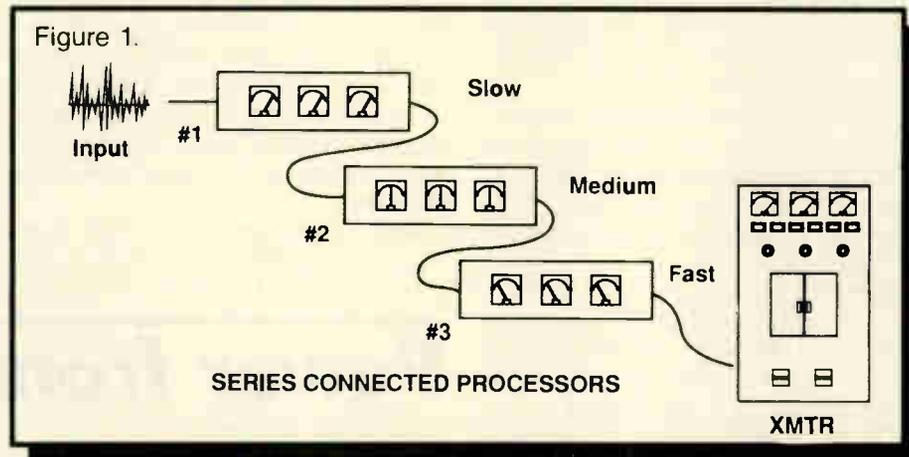
How about response time. Each unit has time constants for attack and release. Since the time constants are acting simultaneously, the response is three times faster. Twenty decibels per second times three is 60 dB per second. Or, do you prefer 600 dB per second?

Figure 1 shows how to set up the units. It is important that the last unit in the chain be the hardest driven. You might think that the first unit in the chain should be doing the work with the later units taking up the slack, but that's not how it works. If the first unit does all the work, the others will never kick in.

So, turn up the level so that the last unit is working half to three-quarters with the first and second loafing. At this point, adjust the second unit's threshold so that it is just starting to work. Finally, drive the system so that with the second at nearly three-quarters of its compression range, the first unit in series kicks in. This unit is one that will absorb the screamers and needle benders.

Notice that the units shown are multiband compressors or limiters. This scheme was invented with wide band

(continued on page 40)



processing. The more savvy manufacturers recognize the rising baselines of competitive processing and periodically add pre-processor chassis, new cards or an additional box to the collection.

Many of the hotter stations have al-

is over 20 years old? The circuits were a little more primitive back then and all of the action was on AM. However, two or three boxes in series made the mod meter stand straight up. Here's what happens:

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For some listeners, waiting for things "you can't say on the radio" is part of the fun. But with today's free-wheeling talk radio formats, controlling what actually goes out on the air is more essential than ever. Now Eventide's BD941 and 942 Broadcast Audio Delays are here to make effective obscenity protection more affordable than ever.

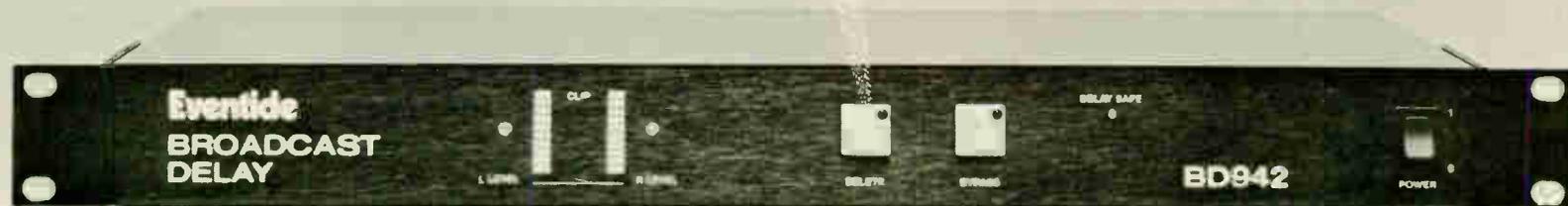
The stereo BD942 and mono BD941 give you six seconds of delay protection (or optionally, three, or even twelve). Yet they cost thousands less than Eventide's industry-standard BD980. You don't get the BD980's elegant *Catch Up* function or its other sophisticated features. But the BD941 and 942 have an easy, convenient and totally reliable system of their own.

OK, you're on the air, and someone's just opened his or her mouth a little too wide. Just hit the *Delete*

button to delete an obscenity, and you're instantly back in real time. The BD941 and 942 delays also have a set of relay contacts that close automatically when *Delete* is pressed. You can use the relay to start a cart or other device to fill the delay period. Then, after the delay period expires, the unit automatically switches back online for full delay protection. What could be simpler?

The full bandwidth audio performance of the BD941 and 942 is everything you'd expect from Eventide, the world leader in talk show delays. All at a price that makes talk cheaper than ever. How much cheaper? Talk to your broadcast distributor, or call Eventide for the good news.

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Singing the Bottom End Blues

by Terry Dalton

Georgetown DE With today's ever-growing competition on the FM dial we all try to find our own little niche. With already overcrowded markets and threatening Docket 80-90 stations hatching out everywhere, we make every attempt to gain our competitive edge.

After establishing a sound programming department and competent air staff, we reveal our hand and enter the "loudness wars." Without getting into high school psychology on why, we simply accept the fact that louder is better and pursue our ultimate goal of pinning those modulation monitors to 100%.

There is no real art to attaining loudness in the pure sense of the word, although, there are those who would like us to think so.

Too often we are enticed by the equipment list that has proven for the other guy. Sadly enough there is only so much that can be done legally to make that transmitter scream without making sacrifices, and sacrifices are always going to be the net outcome of loudness wars.

Sure we can squeeze an extra dB out of the racks to beat the guy down the block, but at what cost? The answer as it usually is in such a case is to find a happy medium: compromise a little, but not too much. Today's multiband limiters

allow us to achieve this.

In order to put things in perspective, we must first analyze the broadband limiter or, more appropriately, the multiband limiter set for linear frequency response.

This device when placed before preemphasis operates nondiscriminately and robs the spectrum equally of transient material as limiting is increased.

The resultant outcome is, of course, a very loud compressed product lacking the depth that brings virgin programming to life. Low frequency intermod also becomes more apparent with increased broadband bass.

When incorporated after preemphasis, limiting occurs at the high end of the spectrum first and follows a 75 microsecond curve downward. As a result, high frequency program material is enhanced as limiting increases.

This method does preserve much of the transient material (depending on the amount of limiting) but produces a "gritty" or piercing high end which may prove distasteful to the listener.

The multiband limiter, when properly adjusted, awards the user the capability of limiting or enhancing that part of the spectrum desired. Program depth is easily maintained through the presence of adjustable band thresholds. Loudness can be tailored throughout the spectrum.

As suggested earlier, when heavy processing is employed, detrimental side effects will result. One of the most apparent with respect to multiband limiting is the loss of bottom end punch.

Heavy limiting in the 30-200 Hz range will result in more bass; however, this enhancement is broadband with a very definite ceiling. Too many of us simply accept this as the answer to increasing our bass. This does not have to be the case.

Keep in mind that because of preemphasis we can boost the bottom end a great deal before absolute limiting must occur. Overall bass will diminish as the threshold in that band is increased. Don't be afraid to back it off. You're taking the first step in the right direction.

Very little loudness is perceived between 30 and 200 Hz. We tend to look toward this band for that open and ex-

citing feeling. So, what's the solution? Try less restriction on the bottom end. Bass punch will follow.

If more punch is desired, add an EQ. A narrowband boost between 100 and 125 Hz should prove very favorable. Keep in mind, however, that many of today's equalizers can provide a very sharp "Q" which will introduce ringing and fatigue in that band.

In summation, if you want it loud with controllable side effects, multiband it and define and attack your problems.

If you are a believer in the volume control on the other end as your loudness device, fantastic! You can take full advantage of the quality built into today's most popular FM processors, with or without multiband limiting.

Terry Dalton is corporate CE of Great Scott Broadcasting. He can be reached at 302-856-2567.

Power from Processing

(continued from page 39)

compressors, but works well with either wide-band or parallel philosophy. Just a few things to watch out for.

First, this scheme will only work if all the boxes get a shot at the audio. Disable any clippers in the boxes. Don't try to run boxes that have both fast and slow processors inside. The faster processing will effectively disable the next slow processor in line.

If you want to have a progressive processing scheme where the limiting action gets tighter as you go down the chain, then put the boxes in order of speed. Slow, then medium, and fastest nearest the transmitter. The composite clipper or other overshoot protection goes right at the transmitter.

Any powerhouse processing scheme is going to be tough to keep under control.

Heavy processing is *not* necessarily synonymous with heavy distortion.

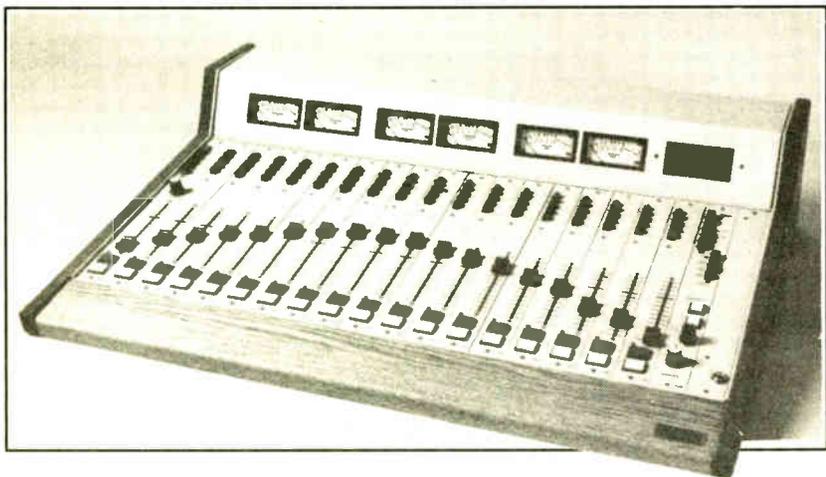
However, the more you try to squeeze out of the audio, the tougher it's going to be to clean out the grunge. A signal that sounds pristine through headphones right off the board may be full of noise and distortion that only becomes apparent after a few squeezes from the processing.

Try this: Adjust the processing for the most your ears can stand. Then go back and work on the raw audio from the tape heads through the board, down the STL and into the audio rack. Flatten the response another couple of dB. Get that 20 dB of headroom instead of only 10 dB. Install amp cards with .05% distortion instead of 0.5%.

Now, see how much more you can crank up the processing. It's a never-ending battle.

John Shepler is an engineering manager, broadcast consultant, writer and regular RW columnist. He can be reached at 815-654-0145.

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What's even more remarkable is that the Bonneville stations are doing all this without any additional processing. Because ModMinder isn't a processor—it's a more accurate, more correct device for measuring modulation. In fact, "The UnProcessor" made such an impression on Jim Stagnitto, WNSR's Director Engineering, that he called it "the

most important product for broadcasters brought out in 1989" in a *Radio World* article published in the issue of August 23rd.

Jim Stagnitto's not alone in his opinion, either. Modulation Sciences has already shipped over 100 ModMinders to stations in all formats, in cities all across the country. So if you don't have one yet, the odds are your competition does.

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Sampling Schemes for the Radio Game

(continued from page 38)

They can be recorded live with a microphone, or can be recorded off records, compact discs, tapes, etc. Recordings of notes can be made first on an analog or digital recorder, then transferred to a sampler or sampling keyboard.

Compact discs are available that contain notes of various instruments to sample. Pre-recorded samples on magnetic disk and plug-in ROM (Read Only Memory) cards are offered for many sampling keyboards.

In general, sample-playing keyboards are more useful than synthesizers. It's easy to make a sample sound like a synthesizer, but it's difficult to make a synthesized note sound like a sample. Some instruments contain samples that are digitally resynthesized so that you can modify them.

Permanent storage of samples

You can store your samples permanently on a RAM cartridge that plugs into a sampling keyboard or on a com-

You can economize on memory space either by keeping the sample time short or the sampling rate low.

An alternative to a sampling keyboard is an external sampler. It is triggered by a separate keyboard or sequencer. Another alternative is a computer running a sampling program.

Sample-playing keyboards play prerecorded samples, but do not record them. This is a practical option because most keyboard users rely on factory or third-party samples and do little sampling of their own.

puter magnetic disk. Once you've sampled many sounds and have built up a library of them, any sample can be loaded into your keyboard and played.

Some keyboards and all drum machines have factory supplied samples stored in permanent memory (ROM or Read Only Memory); these are digital recordings of real instruments stored in memory chips.

Three parameters to consider in sam-

pling are quantization, sampling rate and memory constraints.

Let's explain quantization first. As stated earlier, the audio signal is measured several thousand times a second to generate a string of binary numbers. The longer each binary number is (the more bits it has), the greater the accuracy of

a high sampling rate for fidelity (about 40 kHz); low-frequency sounds (bass, kick drum) can be recorded adequately with a low sampling rate (about 12 kHz).

While most sampling machines have adjustable sample rates, they have fixed quantization.

Memory constraints

As the A/D converter generates binary numbers, they are stored in memory. Each number goes to a separate memory location. Unfortunately, memory space is limited. Once it is filled, part of the recorded note is cut off. This puts constraints on the sample time, sampling rate and quantization. Figure 3 provides an equation that shows how these four factors are related.

If you have a sampler with 8-bit (1-byte) quantization, and you set the sampling rate to 40 kHz and record a 2-second sample, you use up $1 \times 40,000 \times 2$ or 80 kilobytes of memory. Since memory space is limited, you try not to fill it up, because that can cut off the end of a sample.

You can economize on memory space either by keeping the sample time short or the sampling rate low. The higher the sampling rate, the more memory is used, because a high sampling rate generates more binary numbers than a low rate.

The longer the sample time, the more memory is used, because a long sample time generates more binary numbers than a short sample time. Stereo samples use twice as much memory as mono samples.

A one-second sample is enough for the notes of many instruments, but cymbal crashes may require three seconds or more.

Next time: sampling techniques.

■ ■ ■

Bruce Bartlett is a microphone project engineer and technical writer with Crown International. He can be reached at 219-294-8000.

Figure 3.

$$B = Q \times SR \times ST$$

where B = Bytes of memory filled by a sample

Q = Quantization in bytes/sample or bytes/measurement

SR = Sampling rate in samples/second or measurements/second

ST = Sample time in seconds

the measurement.

In other words, short binary numbers provide poor resolution of the waveform's amplitude or voltage; long binary numbers provide good resolution.

The quantization of a sampler is its amplitude resolution, measured in bits. The higher the quantization, the less the distortion and the greater the dynamic range. Commercial samplers range from 8-bit to 16-bit quantization. Quantization of eight bits is good, 12-bit is very good and 16-bit is excellent.

The rate at which the waveform is measured is called the sampling rate, measured in samples/sec. At a sampling rate of 40 kHz, 40,000 measurements are generated for each second of sound.

The higher the sampling rate, the wider the frequency response of the recording. The upper frequency limit is slightly less than half the sampling rate. If the sampling rate is, say, 20 kHz, the sound you sampled will be reproduced up to about 9 kHz.

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A Letter to Radio Management

by George Riggins

Long Beach CA Mr. Station Owner. Yes, you there, the one who thinks that you do not have the money to spend on technical help. The one who has no maintenance, who says that no one will notice that no two audio sources in the studio have the same sound or level. The one who does not listen critically to his own station and thinks that the studio monitor is the only audio system that needs to be checked.

Yes, you there, the person who scans the band on your au-



tomobile receiver and thinks that he knows what the station really offers in audio quality.

You, Mr. Program Director, the one who is of the opinion that loudness is all that matters. As long as the station is the loudest in the area, you are satisfied that you have the sig-

You say there is no technical help to be found in your market? There is technical help at any location for a price.

nal that will capture the hearts and minds of the listeners in your service area.

Have you, Mr. Station Owner, or you, Mr. Program Director, ever bothered to get a decent receiver and speaker system and critically analyze your "off air" signal?

I don't mean just listening to the type of programming that you are putting on the air. I mean the quality of the audio as it pertains to distortion, fuzziness, differences in the levels and audio spectrum as the studio operator switches from a turntable to the cart player, to the satellite feed, to the cassette deck, to a reel-to-reel tape player or the local microphone.

Pay the price

You say your local advertisers will not pay the price for air time that will furnish the funds to provide technical help? You say there is no technical help to be found in your market? There is technical help at any location for a price.

That price is not as bad as you may think at the entry level, or as one progresses toward the more competitive markets. There are many young men and

women who are very interested in the entertainment industry as opposed to other parts of the electronic technical field. Look around and give some young person a chance to learn and progress.

As for paying for the technical help, the difference in the cost of time to the advertiser is not as much as most of us think it is. At the worst for a small

market station, \$10 to \$12 per hour is about what it would take in increased revenue to pay for technical help and add some income to the bottom line.

With the potential eleven or twelve one-minute spots per hour, that is only one dollar per spot. Any reasonable sales person should be able to sell the better quality sound more easily than the garbage being

promoted as good audio.

Notice that no mention has been made regarding the content of the programming. The programming will be determined by your customer orientation. Just make the sound a quality product.

As the wife and I travel around the US we hear many different programming formats. Some we can tolerate, some

make us turn to silence and occasionally we find a station that captures our ears for as long as we can hear the station as we go down the highway.

Ear fatigue

There are times that we would like to listen to the program, but the audio quality is so horrible that the finger finds the (continued on page 44)



The STL/TSL for the 90s is here now. And not a moment too soon.

- Two Way Multi-Channel Communications
- Transparent Digital Audio
- Multiple Signal Path Options

It's time for a new kind of STL. Drastic cost increases are just one sign that the phone company is tired of balanced equalized lines and is ready to pull the Class A plug. Meanwhile, microwave spectrum is scarce—in some areas, channels are unavailable.

QEI's new CATLink Composite Audio Transmission Link is the *digital* STL alternative. It transmits composite and other signals over a single telco T1 data line*. T1 service costs less than Class A, and it's so reliable that the big banks use it for their vital financial data.

CATLink encodes the fully processed *composite* signal and decodes it at your transmitter, so you can run the stereo generator and processing at the studio. At the same time, CATLink configurations can send and receive SCAs, control channels, voice communications, RS232 data, AM audio, transmitter readings, and satellite or remote programs.

With CATLink, you always get full stereo separation: There are none of the phase or amplitude fluctuations that plague dual-channel STLs. Dynamic range is up to 84 dB, and your processed composite signal can use virtually all of it. So the only thing you'll hear is clear, clean, undistorted audio.

Worried about replacing Class A lines, getting a microwave channel, or sight-line infringement? Call QEI toll-free at 800-334-9154 for full info on CATLink, the bidirectional, digital, *easy-wired* STL. And turn the weak link in your signal chain into one of the strongest.

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57 YEARS AGO

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TIMING OF BIG CHAIN

Time is literally money in the broadcasting business, and its value is so great that it is checked to the split second several times daily.

There are ninety-seven clocks in the National Broadcasting studios and offices at 711 Fifth Avenue, New York, and each one gives exactly the same time as every other. They are set from the Naval Observatory clock in Arlington, Virginia, at noon and at 10 p. m.

And three times daily time signals are sent out by the N.B.C. to its associated stations across the country, so that synchronization of programs may be perfect not a second wasted.

In the broadcasting studios and control rooms clock-watching is a very important part of the day's work. Without it, network programs would be an impossibility.

How To Read Arlington Time

Arlington gets its time from the Naval experts who "shoot the sun" at frequent intervals. It is exact to a small fraction of a second. And Arlington sends out its signals by short-wave radio for five minutes twice daily, broadcasting the ticks of the clock.

The second-by-second time broadcast starts five minutes before the hour. The twenty-ninth second of each minute is eliminated so that the listening engineer is warned that thirty is next. From fifty-six to fifty-nine inclusive, the ticks again are eliminated to give warning that num-

ber sixty is next. The ten seconds immediately preceding the hour also are silent, and then the hour is sounded with a gong.

The same system of second-by-second clicks is used to send the signals to the N.B.C. associate stations, except that in this case, instead of short-wave radio, the Morse wires which link the stations are utilized.

Synchronization Essential

The ninety-seven clocks in the N.B.C. Building are checked from the master chronometer immediately after the Arlington signals are received, to guard against any possibility of variation.

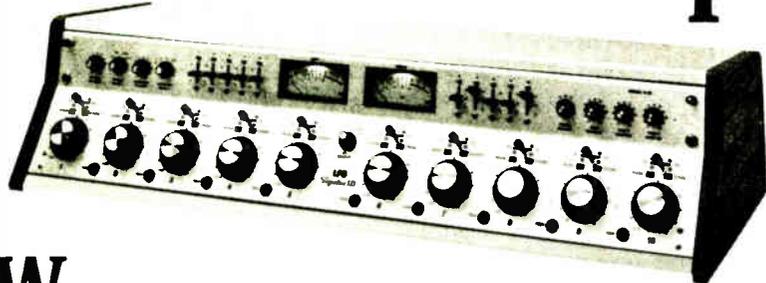
The absolute synchronization of network units is essential, so that one program may not overlap another. For instance, a station in Chicago may be scheduled to pick up a network program starting at 9 p. m. in the N.B.C. studios in New York. Therefore the previous program must be off the air at exactly nine. The same accuracy is required in all the other eighty-four stations on N. B. C. networks.

In addition, time must be allowed for the local station announcements at stated intervals. The N.B.C. chimes are the cue for these. As the chimes end, each station switches off the network and the announcer gives the call letters. The stations remain off exactly fifteen seconds, and then switch back on to the national chain again.

Reprinted from Radio World, January 2, 1932.

Editor's note: The *RW* of today and the *RW* of old, printed for a period of time in the 1920s and 1930s fortuitously share the same name.

It's hard to stop.
It's hard to stop.



What is it about the Signature III that keeps so many leading station groups and consulting engineers coming back for another, and another, and...? Is it this console's unparalleled record of reliability and longevity? The LPB Signature III's easily maintained modular electronics? Its excellent RFI immunity? Or is it designed-for-radio features like the following:

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Chances are, it's all of the above. But whatever the reasons, leading stations and engineers across the country demand Signature III's "unstoppable" performance. In fact, they've made it one of the most popular consoles ever built. If you've been spending too much time inside your console lately, contact your broadcast equipment dealer or call LPB for full information and specifications at (215) 644-1123.

LPB Signature III audio consoles are available in 6,8,10 and 12 channel stereo and 6,8 and 10 channel mono configurations.

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Circle 21 On Reader Service Card

Managers Should
Hear Their Stations

(continued from page 43)

"off" button rather than have the ears put up with the lack of decent sound. There is often no high end or low end to the music or voice. The received signal is often so wide that trying to listen is very fatiguing and hard on the ears.

You there, Mr. General Manager of a larger market station. Have you tried to find a qualified or experienced technical person recently? The market is rather thin, isn't it? There are no entry level positions in the smaller markets and you do not feel that you can justify the expense of training a new hire.

You say you do not have anyone on your staff to do the training? What about helping with the technical curriculum in the local school system, be it at the high school or junior college level?

Do the same things that automobile agencies are doing. Get acquainted with the instructors in the local school system. Help set up a training program, provide a place for "on-the-job-training" experience. Let those so inclined know that there is a future for them in the broadcast entertainment market. You just may be helping to provide for your own future.

Intern programs can be worked out with your local school system. The cost? About one dollar per one minute spot more than you are now charging.

A true story

The president of a small studio equipment manufacturer recently asked a salesman for an international shipping company what he listened to on his auto receiver. The answer went something like this: "I listen to XXX part of the time between calls and to YYYY when I get tired of talk and news."

The latter station is a "Big Band" for-

mat station with very few vocals, news on the hour and very low key studio announcers. No personalities! The Big Band format includes selections from current music, but with the music arranged and presented in the big band style. Without divulging the location of the stations involved, I can say that I have listened to both on many occasions. One is an AM station and the other is

Help set up a training program, provide a place for "on-the-job-training" experience.

an FM outlet.

Be it AM or FM, next to programming, it is the quality of the sound presented that will determine where your listener (customer) will tune. In the absence of decent signals, customer orientation will probably dictate more defection from the RF portion of the auto sound system and more tape sales for use with the audio amplification portion of the system.

Where customer orientation will lead us, to a great extent, will depend on when "good engineering practices" return to radio. "Good engineering practices" will return to radio when technical people are again put in charge of presenting a quality product—sound—to the potential listening audience.

■ ■ ■

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

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ALL FOR \$24,995!

Lazer prewiring with all source cables and connectors. The studio ships to you, pre-tested and ready to plug together in just five hours. Or, you can have Radio Systems engineers assemble it for you on site.

Call us for a quote on your studio, just the way you want it. We'll send you a quote on your exact layout and equipment—at similar savings.

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Circle 72 On Reader Service Card

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AMPLIFIERS

Want to Sell

Ramko ESP-38 TT preamps (2), \$200 ea. C Green, Century 21 Programming, 800-937-2100.

Nakamichi 620 power amp, 125 wch. Audiofile's dream design. Like new, w/complete documentation, \$395. Klaus Heyne, 415-664-0163.

Fender Pro-Amp, could use a few new tubes, w/vibrato, brown tolex casing, \$400. B Ford, Spunk Prod, Box 1052, El Granada CA 94018. 415-726-4786.

Marantz 1 PM 200 stereo amp & pre amp, like new, \$150; Altec 1607A power amp & 5 chnl mixer w/meter, 200 W mono, \$200. J Parsons Sr, Parsons Electr, 10375 Cannas, N Huntingdon PA 15642. 412-863-9590.

Ramko DA mono in 3.5" cabinet, working cond, BO. P Hess, 134 Derwent, Pgh PA 15237. 412-366-1249.

Crown PSA-2 500 W stereo pwr amp, excel cond, \$750 pls shpg. W Laughlin, 753 Ruth, Hurst TX 76053. 817-282-9033.

Shure Vocalmaster 6 chnl 100 W, 4 out of 6 chnals work gd, \$150/BO. K Taylor, Image Support, 103 N Aspen, Sterling VA 22170. 301-864-4841.

Crown 75 power amp, very clean, SAE 31 in black, \$200 ea. Mr. Keith, ALI, Box 313, Keene NH 03431.

Peavey PA-400 six input amp w/individual input EQ, \$245. J Sigmon, WBZK, POB 398, York SC 29745. 803-684-4241.

Lauderdale Labs LEL DA-8 (6), new, 8 chnl mono, 4 chnl stereo, \$150. G Walden, KYW, 5th & Market, Phila PA 19106. 215-238-4893.

Sorry TA-3060 60 W stereo basic, compact, excell cosmetics, one chnl slightly weak, \$40; Crown IC-150 stereo preamp, rack mounting option, mint cond, orig box & packing, \$135. B Laughlin, 753 Ruth Ln, Hurst TX 76053. 817-282-9033.

Straight Wire Audio PH-2B-U audio phono preamp, \$150. T Teagarden, KELI, POB 3834, San Angelo TX 76902. 915-655-9879.

Want to Buy

Marantz 7 preamp. J Parsons Sr, Parsons Electr, 10375 Cannas, N Huntingdon PA 15642. 412-863-9590.

EICO HF-89A 50 W dual stereo amp, 30 yr old tube type, any cond, will pay shipping. K Smith, Smith Engr, 118 Barstow, Gorham ME 04038. 207-892-8776.

Tube amps & remote mixers, RCA Op-6, Op-6, BN-2, BA series, 80 series, etc. B Davies, Virgo Prod, 5548 Elmer, N Hollywood CA 91601. 818-761-9831.

ANTENNAS & TOWERS

Want to Sell

ERI FML2E 2-bay circular end fed antenna tuned for 100.9 MHz, \$2000; CBS FM Volumax peak leveller, mint cond, \$500. P Athanas, WRIC, Box 529, Richland Ctr WI 53581. 608-647-2111.

Rohn SSV Series, 160' self support tower, on ground, gd cond, not painted, new J rods, \$4000; Cablewave LFC-158-50J transmission line, 200' of 1-5/8", foam, never used, \$1650. A Wantuck, WAXY, 1975 E Sunrise, Ft Lauderdale FL 33304. 305-463-9299.

---FOR SALE---

Blaw-Knox 440' SS tower, \$125,000 installed; Harris 101.7 super high pwr FM antenna, like new & 500' 3-1/8" rigid RCA line, antenna & line \$18,000 installed; 2000' assorted 7/8" transmission line & 1000' 1-1/2" transmission line; assorted UHF/VHF 2-way antennas, \$150 ea.

Nationwide Tower Inc.
904-932-3004

Flanged heliix, 15-50' sections, 3-1/8" & 7/8", also some unflanged, (15) 3-1/8" elbows flanged, (2) 3-1/8-6" reducers, 6" Bird Thru-line section 50 ohms. J Kramden, WBRL, 3342 Perry, Marsellus NY 13215. 315-673-9049.

Andrew type 35381 tunable N jack connectors (4) for JH7-50A, 1-5/8" line, identical to Andrew type 87NT, w/tuning screws to adjust for minimum VSWR, new in box, \$200 ea/BO. C Osgood, WMMW, POB 2008, Conway NH 03818. 603-447-5988.

Allied 42UCSR 65' self-supporting tower, 8 yrs old, excel cond, on ground, solid rod, \$5000/BO. O Thein, Kirkwood Community College, 6301 Kirkwood Blvd SW, Cedar Rapids IA 52406. 319-398-5663.

Andrew LDF 750A 1-5/8" foam xmsn line, approx 235' EIA flange on one end, type N reducer other end, BO. A Bowab, WDLT, 2402 Wolf Ridge, Mobile AL 36618. 205-344-3698.

RCA 3 bay Class A, 106.3 antenna. T Rusk, KWTD, 704 Roberts, Lonoke AR 72086. 501-375-1440.

Various lengths of Heliix in various sizes, also various runs of cable, call for details. Adolph, 915-949-2112.

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Ask for Jim Newbanks

Gates 1970 phasor & (4) ATU shelves set up for 1170 kHz, 5 kW DA-1, for parts list/price info, call K Bucklew, WOBM, 360 Clayton, Howell NJ 07731. 201-364-4400.

Scientific Atlanta 8005 earth station satellite antenna, 4.6 meter, disassembled, you pay shipping & labor to load, free. O Thein, Kirkwood Community College, 6301 Kirkwood Blvd SW, Cedar Rapids IA 52406. 319-398-5663.

ERI 8 bay Class C, 98.5 MHz, single bay, various RF connectors. T Rusk, KUAR, 2801 S University, Little Rock AR 72204. 501-569-8485.

Andrew 1-5/8" gas pass Heliix flanges, (4) unused, \$75 ea/BO. D Carver, KZBK, 107 S Main, Brookfield MO 64628. 816-258-7458.

Rohn 65G 397' tower, 3 yrs old, guy wires, beacon, side lights, will sell standing, \$6000 or on ground, \$16000. M Blakemore, WCVF, Box 280, Murphy NC 28906. 704-837-2218.

Rohn 25 (6) 10' sections; tower bracket for Rohn 25; Cortana folded unipole-upper shirt. Adolph, 915-949-2112.

Hughes & Phillips T12035 3.5 KVA tower isolation transformer, 115/230 VAC input 117-120 VAC output 3500 W w/instructions, \$1150. N Winter, KLAY, 10025 Lakewood, Tacoma WA 98499. 206-473-3462.

ERI G5CPS 3-1/8 circularly polarized 10 bay widebeams tuned to 106.5 R Sweatte, KXXR, 600 Broadway Ste 220, Kansas City MO 64105. 816-421-1065.

Kintronc CVCJ1000-5S isolation coil in weatherproof housing w/tuning capacitor. D Engstrom, KOJA, 820 W Second, Ottumwa IA 52501. 515-684-5415.

Guyed tower, 713', 48" face w/reduced top section, less than 4 yrs old w/medium intensity strobe system, BO. F Giardina, Dittman Group, 2146 Highland, Birmingham AL 35205. 205-933-9274.

RCA BFA 8 bay FM, hor polarization on ground, complete, BO; Continental 300C 8 bay FM, vertical polar on ground, complete, BO; 400' 3-1/8" rigid coax in 20' sections on ground, BO. J Gray, WPFB, 4505 Central, Middletown OH 45044. 606-781-5715.

Rigid line, 380', 3", vgc, very little use, some spring type hangers included, \$4275/all or \$225 for ea 20' section. J Sigmon, WBZK, POB 398, York SC 29745. 803-684-4241.

Berkhalter 300' tower, 18" face, 4 yrs old, w/1-5/8" transmission line & 3 bay antenna mounts, \$7000. T Cooper, WGRQ, POB 689, King George VA 22485. 703-775-3744.

RCA 3 bay class A 106.3 MHz antenna, BO, ERI 8-bay class C FM 98.5 MHz; also various 3-1/8" Andrew hardline connectors, BO. T Rusk, KWTD, 307 Roberts, Lonoke AR 72086. 501-375-1318.

Andrews 120' + of 3-1/4" heliix on spool w/connectors, excel cond, less than 1 yr old, \$875. J Sigmon, WBZK, POB 398, York SC 29745. 803-684-4241.

FM ANTENNAS

1 BAY	\$1,500
2 BAY	2,300
3 BAY	3,150
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Dielectric DCRC antenna bays w/radomes. M Young, WJON, POB 220, St Cloud MN 56302. 612-251-4422.

Phelps Dodge 12 bay tower mount FM antenna, 97.5 MHz, gd cond, BO. E Monskie, Halls Comms, 24 S Queen, Lancaster PA 17603. 717-397-0333.

Advance model 155, heavy duty towers, 370' & 160', will hold 12 or more bays FM antenna, dishes, etc. can combine for 530' tower, excel cond. R Wright, WLLX, 1208 N Locust, Lawrenceburg TN 38464. 615-762-2916.

Scala HDCA-10EB yagi antennas, 75 ohm, 104.1 & 106.9 MHz. D Lainen, Independent Resources, POB 23498, Oklahoma City OK 73123. 405-721-1187.

Rohn 80 tower, 495' including 50' pylon, excel cond, on ground, FOB Gambills MD, \$15,000. B Sadler, WFSI, 918 Chesapeake, Annapolis MD 21403. 301-269-6500.

RCA BFC-7 high pwr 7 bay, tuned to 96.5 MHz, gd cond., circularly polarized, BO. J Boxler, WKYE, 109 Plaza Dr, Johnston PA 15905. 814-255-4186.

Jennings Model RC21 vacuum coaxial relay, new, \$1600. A Emerald, KGGG, 8956 Swallow, Fountain Valley CA 92708. 714-962-5940.

Dummy Loads RF Plumbing RF Cable FM Antennas

ARMSTRONG TRANSMITTERS
5046 Smoral Road (315) 488-1269
Syracuse, NY FAX (315) 488-1365

Andrews 6-1/8" rigid line, 1000' 51-1/2 ohms, over 20 yr old, BO; Andrews 400' 1/2" heliix, BO; (6) rolls 1" copper, one roll 3", one roll #10 or #12 bare wire, BO. R Myers, KMBR, 4935 Belinder, Kansas KS 66205. 913-677-8944.

ERI FMH GS-4 4-bay, high power horizontal only 4 bay antenna tuned to 94.5 MHz +/- 3 MHz. Available in Eugene, OR. Contact Chris Reid Murray, CE, KMG. 503-484-9400.

Want to Buy

Air heliix, 3-3/5", 350' or more on spool & in gd cond. K O'Malley, WNOR, 801 Boush, Norfolk VA 23510. 804-623-9667.

Rohn 65G, 10' tower sections, gd cond, on ground, want 18 sections. R Wallenburg, Electrocrom, 2104 N Claiborne, New Orleans LA 70116. 504-947-4743.

UHF TV translator antennas on old chnl 70 thru 83 band, Scala SL-8 or Parapanel, Bogner B4, B8, B16 or B24, Emcee DGA-10 corner reflectors. J Powley, 1536 Logan, Altoona PA 16602. 814-944-8571.

UHF TV bdc/translator antennas, Scala parapanel, any chnl, Scala SL-8, chnls 19-23, 32-36, 60-64, Bogner B Series, chnls 20-30, 31-42, 55-69, or Bogner LPS 1, 2 & 4. J Powley, 1536 Logan, Altoona PA 16602. 814-944-8571.

Broadcast tower, 300'-1000', 7/8 & 1-5/8 or larger feedline, 300' or greater. R Wachter, KNSX, 3418 Douglas, Florissant MO 63034. 314-921-2121.

CP antenna, 6-8 bay, tunable to 96.9 MHz, minimum 10 kW input rating; 500'-700' tower, must be cheap. D Carver, KZBK, 107 S Main, Brookfield MO 64628. 816-258-7458.

Need 190' AM used guyed tower. G Valle, KITA, 723 W 14th, Little Rock AR 72202. 501-375-1440.

Tower, 418' FM, 600' cable 1-5/8", 2 bay antenna tuned to 96.3, also beacon. L J Maierhofer, WTGC, 101 Armory, Lewisburg PA 17837. 717-523-3271.

Self supporting tower, 75' in gd cond, light to medium load capacity. E Goetsch, WXPR, 303 W Prospect, Rhineland WI 54501. 715-362-6000.

Tower, 900-1100', on ground or standing needed by 1/1/90. K Austin, KFXX, POB 392, Marlow OK 73055. 405-658-9292.

AUDIO PRODUCTION

Want to Sell

Shure SE30 mixer/limiter, rack mtg, clean & perfect, \$150/firm; Shure M625/M625AM voice gates (4) in rack shelf, clean & working, \$75. E Davison, 135 N Illinois, Springfield IL 62702. 217-787-0800.

dbx 142 NR units, w/manual, need I/O plugs, \$150 ea/BO; CRL SPP-800 stereo preparation processor, no manual, \$200. M Toschi, KIFM, 5125 Conroy Ste 304, San Diego CA 92111. 619-560-9800.

Mic Mix TW-1 time warp effects unit w/manual, as is, looks gd, \$75. D Bailey, 3422 Beech, Roulett TX 75088. 214-475-9796.

UREI 5Z7A EQ's (2), \$500/both; (2) 560 feedback suppressors w/rackmount, \$350/both. C Bucy, Cisco Snd, POB 16583, Lubbock TX 79490. 806-792-1662.

dbx 224 simultaneous stereo encode/decode Type II NR unit, vgc, \$125. P Combs, Only Son Prod, 2316 Forest Home Ave, Dayton OH 45404. 513-236-2340.

AKG stereo reverb BX 20 E w/remote, excel cond, amp updates, 2nd unit for spares, manual included, \$395/all. Klaus Heyne, 415-664-0163.

UREI 546 parametric EQ, \$500. B Musser, WMD, Ohio & Murray, Atlantic City NJ 08401. 609-344-5113.

Henry Mix-Minus, never used, \$185. T Drigger, 818 Quail Ct, Healdsburg CA 95448. 707-433-9370.

Howe 2100 Phase Chaser phase correction unit, excel cond w/manual, \$600/BO. C Osgood, WMMW, POB 2008, Conway NH 03818. 603-447-5988.

Realistic 12 band graphic EQ, stereo, & a stereo parametric EQ, \$100/both. R Coates, Lakes Recdng, 110 W 11th, Spencer IA 51301. 712-262-3113.

Revox B-77 remote tape drive control, full function w/25' cord, never used, \$50; Shure Level Lok audio level controller for mics, new, \$100; UREI 527-A 27 band 1/3 octave EQ w/security cover, \$450. B Spitzer, KIKLS, Box 460, Rapid City SD 57701. 605-343-6161.

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Orban XT2 6-band limiter accessory for use w/8100A-1, w/book, new cond, \$1700; Koss digital delay/reverb effects system, rack mt, vgc, \$300; Eventide FL201 instant flanger effects system, as new, w/book, \$400; Sansui QSE-5/QSD-1B 4 chnl encoder, decoder system, rack mt, configured for bdc & recdgy std, w/Sansui match box & manuals, \$700; Dolby 3344AFM stereo audio processor w/type 66FM peak limiter module, manual, \$800. E Stolz, KWOD, 1425 River Park, Sacramento CA 95815. 916-929-5000.

SAE 180 4 chnl parametric EQ, excel cond, \$200. W Laughlin, 753 Ruth, Hurst TX 76053. 817-282-9033.

Audiolab TD-2 degausser, will handle 2" tape, w/mixer & fan, \$150 pls UPS; Altec 1591A compressor, mint, \$175. J Kreines, DeMott/Kreines Films, 5330 Kennedy, Millbrook AL 36054. 205-285-6179.

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Beyer DT 109 headsets (2), vgc, \$100 ea. M Rica, WKBO, 2360 Hampton, St Louis MO 63139. 314-644-1380.

Various pieces of studio equip including Sound Craftsmen TG-2209-600 EQ; Ampex tube type mic mixer; Ampex 351 tube type R-R; Ampex tape transport system; mc swivel stands; BE cart rewriter; Teacaster 700-PP stereo cart machine; Marti omni-directional antenna; Rust remote control system, call for details on all these items. Adolph, 915-949-2112.

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SM-7 (2) in excel cond; MAP two processor mdl 231; Ampex ATR-700 in excel cond; Ampro 8 chnl board in gd cond, you pay freight. Pam Sutherland, WFGN, POB 1388, Gaffney SC 29340. 803-487-7885 aft 5PM.

Tascam 42B used 6 mos, \$2150 pls \$25 shpg. D Peluso, KJUL, 2880 E Flamingo Ste E, Las Vegas NV 89121. 702-732-2200.

dbx 140A type II NR units (2), \$250 ea or \$425/both plus \$20 shpg. D Peluso, KJUL, 2880 E Flamingo, Ste E, Las Vegas NV 89121. 702-732-2200.

Orban 111B reverb unit, like new, BO. S Chapekis, POB 22122, Denver CO 80222. 303-721-9156.

Henry Engineering Mix Minus Plus, never used, \$160. T Driggers, 818 Quail Ct, Healdsburg CA 95448. 707-433-9370.

Mic-Mix XL-210 reverb unit, new, BO. G Chapekis, POB 22122, Denver CO 80222. 303-721-9156.

Want to Buy

Pultec EQs, tube compressors, etc, especially need Fairchild 660 or 670; also other vintage tube signal processing equip. J Kreines, 5330 Kennedy, Millbrook AL 36054. 205-285-6179.

Pultec EQP-1, EQP-1A3, EQH-2 tube EQ's, will pay fair price/trade; API 550A, 560 EQ's, cash/trade; Aphex/B&B CH-1 compressor/noise gates, cash/trade. J Pines, 217-367-3530.

Manuals & parts for Garron STE 100 stereo phase enhancer meter & schematic; Sta-Maxx composite clipper schematic; Harris MSP90 audio processor main frame, low pass filters, etc.; Harris Solid Statesman peak AM limiter; CBS 450 dynamic presence EQ manual. C Gill, POB 371, Indianapolis IN 46206. 317-923-2800.

Fairchild 670 stereo or mono model compressor; Pultec EQ-1A EQs, working or repairable cond. Mike or Tony, 615-824-9439, 9-5PM Central.

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Sparta 25-08C 25 Hz osc/filter for automation production, 2 chnls, \$150/BO. J McDonald. 303-669-3442.

Sono-Mag 252RS Carousel stereo, BO; IGM 78 tray go-cart stereo bi-directional, BO; (2) Gates 25 Hz tone controller, BO; Sparta 25SEN 25 Hz tone decoder, BO; Gates FA25 25 Hz stereo notch filter, BO. KDKB, POB 6184, Kingman AZ 86402. 602-753-KDKB.

IGM automation system, includes Basic A CPU, keyboard, CRT, hard drive, (3) Instacarts, (4) ITC reel decks, Sparta Carousel, IGM time announce, new IGM encoder w/Televideo terminal, all cards, interfaces, maint kit & manuals, \$9500. J Katz, KJUG, 717 N Mooney, Tulare CA 93274. 209-686-2866.

Automated Broadcast Controls tone generator (2), \$150; Conex CS-25 Sensor, \$150; BE dual tone generator, \$50. C Green, Century 21 Programming, 800-937-2100.

Control Design CD-28, including racks, Carousels, R-R, time announce controller, gd working cond, spare parts, sell separately or as one. E Histed, WDNH, 350 Erie, Honesdale PA 18431. 717-253-1616.

IGM automation system including (3) 48 tray Instacarts, mono, will sell separately, (3) Scully 280 stereo decks, (2) SCM stereo decks, (2) UMC time announce decks, Techart disc drive, Extel logger, Brain w/10K event & keyboard, new CRT in carton, spare parts kit, (5) racks, \$6000 ea/Instacarts, \$17,500/system. K Stone, 512-445-9300.

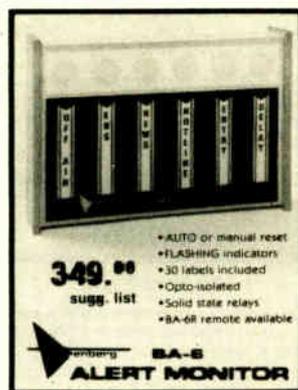
BE 16X complete w/4) Revox PR99s, time advance, delay record, live assist & much more, removed from service 2/89, excel cond, \$27,500. D Remy, KKKI, 2808 International, Colorado Springs CO 80910. 719-636-1000.

Insta-Cart 48 PBM, like new, all heads perfect, mono, \$5000 or trade w/extra control chassis. D Kohn, KESM, 200 Radio La, El-dorado MO 84744.

Sono-Mag/IGM mono 24-slot Carousel cart players (2) in roll-around rack, spare parts & manuals, vgc, \$850 pls shpg. B Mountjoy, WIDD, POB 1240, Elizabethton TN 37644. 615-543-5849.

SMC DPI-C automation system including (4) 350 RSB Carousels, (4) SMC/Otari R-R P/B, SMC dual cart, single play deck, (4) matching equip racks, logging w/X-tel printer, digital programmer w/brain & remote encoder w/monitor & manuals, \$13,500. Deb, KCIM, POB 886, Carroll IA 51401. 712-792-4321.

Complete budget automation system, (2) Ampex VIF 450, 1/2 trk mono PB decks, controller w/ether 25 Hz or silence sense, excel cond w/spare parts & manuals & 8' rack, \$1000 pls shpg. B Mountjoy, WIDD, POB 1240, Elizabethton TN 37644. 615-543-5849.



BE Control 16 including (4) Scully R-R (PB only), new heads in box, (2) 42-cart IGM Go-Carts, 24-cart IGM G0-Cart, new, (2) BE cart decks (PB only), BE triple cart deck (PB only), new pwr supply, new upgraded source cards, now in use, \$25,000. D Switzer, KAML, POB 1009, Gillette WY 82717. 307-682-4747.

Revox PR-99 4 deck, original boxes; P-3A controller, BO. J Phillips, WZOM, 409-1/2 Clinton, Defiance OH 43512. 419-784-1059.

Schafer 800-S solid state 10 chnl system, \$800; Schafer 902 solid state system w/new cards, 10 chnl, 4 racks, net join, remote control, 6-24 tray Carousels (250's), 5 random access units, \$5,875; 2 racks, \$100/ea. T Noor-dyk, WSHN, 517 N Beebe, Fremont MI 49412. 616-924-4700.

IGM 48 tray Go-Cart, mono (2), may need some repair, \$700 ea. T Devine, WVLLK, Box 1559, Lexington KY 40592. 606-253-5900.

Want to Buy

Emcor SSP26A, need 3-5 that Sono-Mag shipped automation systems in, tops & end pieces not necessary but rack doors are. B Moore, KJEL, POB 1112, Lebanon MO 65536.

Entire set-up for Transtar ACIL & cart carousel. V Axell, KSAY, POB 2269, Ft Bragg CA 95437. 707-964-5729.

ITC 770 PB, want up to (4). J David, KMPL, POB 907, Silkeston MO 63801. 314-471-1520.

SMC TS-25 tone sensor. P Gray, KUDY, Box 399, John Day OR 97845. 503-575-1185.

CAMERAS (VIDEO)

Want to Sell

JVC BY-110 3-tube camera w/case, (2) batteries, pwr supply & charger, (2) cables, 10X lens, like new, \$2300/BO; (4) JVC 1-tube cameras S-6U, \$400 ea/BO. T Quinn, Monte Vista St, 208 Cherry, Capitola CA 95010. 408-475-0423.

Sony DXC-M3 3 tube, mic holder, cable, quick-release shoe, battery holder, 1.5 viewfinder, Fuji lens, molded case, low hrs, like new, \$3500. B Bridges, KCAM, 827 Meridian, Nashville TN 37207. 615-226-1122.

Panasonic AK-100/AK-1040 5" viewfinder, like new (2), \$300. B Bridges, KCAM-TV, 827 Meridian, Nashville TN 37207. 615-226-1122.

Sharp XC-700 3 tube w/access, refuted, \$2000/BO; (4) JVC S-62U, 1 tube, \$600 ea or BO; JVC 2 KY-2700 3 tube w/14x1 zoom, \$1800/BO; Sony DXC 1640 1 tube, \$800/BO; Sony DXC 1610. T Quinn, Monte Vista Sts, 208 Cherry, Capitola CA 95010. 408-475-0423.

Ilegami 79D excel cond, just overhauled, \$6000; Sony Betacam portable studio cams, excel cond, \$6000 or \$10,000 for both. Ugly George, 212-677-2200, M-F, 9-5; Fax 212-941-0956, M-F, 9-5.

JVC BY-110 3 tube color camera, like new, pwr supply, case, (2) batteries, pwr supply & camera cable, shop manual, \$2200/BO. T Quinn, 208 Cherry, Capitola CA 95010. 408-475-0423.

Panasonic WV-555B, complete ENG package, brand new, \$2500; JVC KY-1900, complete ENG package, \$1450. R Lawrence, Moonshadow Video, 4280 Reston Rd, Roseburg OR 97470. 503-679-8966.

Sony HVC-2800 tricolor color w/Sony HVA-220/220E AC adapter, works well, \$250. W Watrous, Watrous Video Prod, 739 S Orange, Sarasota FL 34236. 813-366-3316.

JVC KY310, Fujinon 12x1 lens w/2X extender, AC adapter/charger, battery, cable, case, gd cond, \$2295; Panasonic WV6000 camera, 10x1 lens, AC adapter/charger, battery, cable, case, like new, \$1095. D Brennan, Brennan Custom Video, 3596 Lorna Ridge, Birmingham AL 35216. 205-823-0088.

RCA TK-710 3 tube Saticon, 52DB, 500 lines, 14x1 Fuji lens. Camera w/full studio package: CCU, 250' cable, lens controls, large & small viewfinder, 1 yr labor warranty, works perfectly, BO. J Prewitt, Video Values, 5667-269 Del Prado Dr, Tampa FL 33617. 813-985-7446.

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RCA, Dumont, GE, pre-war & early post-war TV camera equipment, iconoscope, image detector, monitors, tripods, manuals for video museum. A Weiner, Britton Rd, Monticello ME 04760. 207-538-9538.

Dumont, RCA, GE old tube type TV cameras, image orthicon & iconoscope type. A Weiner, Britton, Monticello ME 04760. 207-538-9538.

Old RCA, Dumont, GE, early TV camera equipment. A Weiner, Britton Rd, Monticello ME 04760. 207-538-9538.

CART MACHINES

Want to Sell

Telex MC-PRIII R/P, like new, \$950. L Chatman, IVA, 424 Commerce Ste 1, Berlin NJ 08009.

SMC 510 single cart player (2), \$150 ea/BO. J McDonald, 303-669-3442.

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Fidelipac Zenith & height gages for head alignment, never used, \$50. D Bailey, 3422 Beech, Rowlett TX 75088. 214-475-9796.

Rapid-Q ROM-2 R/P mono, fair cond, \$200 or trade. D Kohn, KESM, 200 Radio La, El-dorado Springs MO 84744.

UMC Beaucart RP stereo record w/spare parts, manual, 3 tones, \$1125. B Carr, WRED, 1201 Fremont Pk, Toledo OH 43469. 419-837-9696.

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Harris Criterion III compact 3 deck, clean cond, PB stereo, \$800. B McKittrick, B McKay Enter, 331 Mulberry, Catasahqua PA 18032. 215-264-5295.

BE 2000 R/P, 2 decks, one has new motor, manual, \$700/both; (3) Ampex 602 R-R decks for parts, BO. B Oostenburg, KCKY, POB 6, Coolidge AZ 85228. 602-963-9290.

ATC Criterion Series mono R/P, gd cond, \$300. B McKittrick, 331 Mulberry, Catasahqua PA 18032. 215-264-5295.

BE cart tape winder, almost new, w/timer, both in original packing, \$425. G Cahill, In-visible Inc, POB 5786, Hudson FL 34674. 813-725-5003.

3M/ITC Delta I stereo, gd cond. E Trevino, KBOR, Box 3407, Brownsville TX 78523. 512-541-6348.

3M/ITC Delta I stereo, gd cond, presently working. E Trevino, KBOR, Box 3407, Brownsville TX 78523. 512-541-6348.

BE/Spotmaster TP-1A cart winder, without timer, \$100, will throw in 100 plus carts for \$150; (3) record amps, mono, for RCA RT-277BA-27 series cart machines, \$40 ea. F Vobbe, Great Northern Bdct Co, POB 5031, Lima OH 45802. FidoNet 1:234/16.

SMC 792 mono, gd cond, \$900. E Trevino, KBOR, Box 3407, Brownsville TX 78523. 512-541-6348, Fax 512-542-4109.

BE 5302B mono, triple decker, gd cond, \$1300. E Trevino, KBOR, Box 3407, Brownsville TX 78523. 512-541-6348.

Tepecaster 700RP R/P; (2) Tepecaster 700P & a 700XP cart player, all in vgc & clean, \$1000/all includes shipping. B Mountjoy, WIDD, POB 1240, Elizabethton TN 37644. 615-543-5849.

ITC RP mono, 3 tones, mint cond, \$1100; ITC RP w/network delay, excel cond, \$1250; ITC SP, 3 tones, new heads, \$575; (3) ITC RA's, 3 tones, \$550 ea; ITC RA, 1 kHz tones, \$500; B&H oscil, \$75; relapped mono cart machine PB heads, \$70; stereo PB cards, 3 tone Q cards, rack mounting ears, relays & other small parts for ITC Premium series cart machines. M Brown, 503-245-4884.

Spotmaster cartwinder w/timer, \$350. C Berner, WUSL, 440 Domino, Phila PA 19128. 215-483-8900.

BE 303C 3 deck mono, works, \$250. T Devine, WVLLK, 300 W Vine, Lexington KY 405077. 606-253-5900.

Tepecaster 700RP; (3) 700P; 700RP; (2) 700P; 700XP cart decks, gd cond, \$1000/all; Otari MX5050B, \$900. B Mountjoy, WIDD, POB 1240, Elizabethton TN 37644. 615-543-5849.

ITC WRA Series stereo ITC 3 tone record unit, excel cond, BO. C Miller, Studio VU Prod, 4722 Pochontas Ave, San Diego CA 92117. 619-270-6908.

BE Spotmaster 1070 RP, gd cond RP (2), low hrs, workhorse, original packing, \$350 ea or \$650/both. R Robbins, Box 1079, La Conner WA 98257. 206-445-6616.

Fidelipac CTR 12 stereo cart machine, \$1000; Allied A1 500 N cart rack, \$374. T Teagarden, KELI, POB 3834, San Angelo TX 76902. 915-655-9879.

ITC RP stereo new heads, all tones, excel cond, \$1200 pls shpg. P Woods, WPEG, 520 Hwy 29N, Concord NC 28025. 704-333-0131.

Want to Buy

Parts & manuals for RCA 7 Series; record amp for RCA 7 Series; parts & record amp for Harris Criterion ATC Series. C Gill, POB 371, Indianapolis IN 46206. 317-923-2800.

ITC 3D mono w/WRA record amp, triple deck. C Waltman, KNEW, 66 Jack London Sq, Oakland CA 94607. 415-836-0910.

Eraser splice finder. KDKB, POB 6184, Kingman AZ 86402. 602-753-KDKB.

Rapid cue R/P mono or stereo, any model, schematics & operative units, must work, need several, may be interested in units for parts. N Williams, WTJZ, 553 Michigan, Hampton VA 23669. 804-723-1270.

ITC-SP. W Axell, KSAY, POB 2269, Ft Bragg CA 95437. 707-964-5729.

ITC 3D mono, all tones, working cond. R Yaw, KOJM, Havre MT 59501. 406-265-7841.

Stereo record in gd working cond, used carts 40 sec, 70 sec, 100 sec, 2.5 min. A Moll, KLXQ, 128 Memory Trail, San Antonio TX 78232. 512-496-0677.

ITC stereo R/P. Lj Maierhofer, WTGC, 101 Armory, Lewisburg PA 17837. 717-523-3271.

Tepecaster P & RP 700, any cond from junk to excel, call or write w/descriptions & lowest prices, complete or parts only. T Crockett, Hot Tracks, Box 10501, Blacksburg VA 24060. 703-953-0222.

Mono RP in working order. T Knapp, Univ of NV, Las Vegas NV 89154. 702-739-3305.

Stereo R/P for EDFM, gd cond, inexpensive or will help w/appraisal for taxes. J Goggan, MO River Christian Bdct, POB 87, Washington MO 63090. 314-239-0400.

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Magnecord P-90 in fair cond, BO; Telex 1422, needs motor to operate at slower speeds, BO; Ampex AG600 portable, fair cond, BO. J Ketter, WKOK, POB 1070, Sunbury PA 17801. 717-286-5838.

Sony PCM-701 ES, 16 bit digital processor, use w/VCR, digital masters similar to PCM-F1 but is AC only, never used, \$1500. B Ford, Spunk Prod, Box 1052, El Granada CA 94018. 415-726-4786.

Ampex 602 & 622 recorder & separate speaker/amp, excel cond except PB head has developed an open circuit, \$100. A Smith, 25 Stonehedge, Lincoln MA 01773. 508-841-2209.

Scully 280 solid state elect, block letters, excel cond, \$150 ea; Scully heads, 4-chnl 1/2" stack w/Amphenol end cables, excel cond, \$170; Scully 280 pwr supply cube, excel cond, \$75; Scully reel motors w/disc brake assemblies & solenoids, excel cond, \$100 ea; Scully capstan motor, 7.5-15 ips, excel cond, \$75. J Newman, 404-239-8046.

Studer PR 99's, play only tape decks (8) . 2.5 yrs old, balanced audio output, gd working cond, w/capstans recently replaced, rack mounts, speeds 1.875 & 3.75. Also (2) 25 Hz Conex tone detector panels each w/40r detectors, manual, package price \$10,500 or BO. Call Bruce LaRose, 201-750-9210.

Ampex MM1000 16 trk 2" recorder wiremate, \$6000; Technics 1520 2 trk mix down, 14", \$1000, both in excel cond. J Maestro, FM Studios, 1351 Brook, Bayshore NY 11706. 516-666-4560.

Scully 255 reproducer, 1/2 trk, stereo, BO. KDKB, POB 6184, Kingman AZ 86402. 602-753-KDKB.

Otari DP-4050-OCF duplicator, like new, never used; Ampex tube stereo elect for 350 deck; Ampex 350 stereo headstack assembly; (2) MCI SH110 tape recorder stereo 2 trk; MCI SH110-A tape recorder stereo 2 trk. Kinura Records, Box 660236, Miami Springs FL 33166. 305-887-5329.

Pioneer RT1020L 2 speed 10.5" reels, 1/4 trk R/P w/4 trk repro head, excel cond, \$400. B Ford, POB 1052, El Granada CA 94018. 415-726-4786.

Pioneer 2044 & 2022, Teac 2-A pro 4-trk, 4 chnl or change plug in heads for 2 trk, Teac 2-A mixer 6x4x2, 1/2 trk heads never used, like new cond, \$1800/all. R Coates, Lakes Recdg, 110 W 11th, Spencer IA 51301. 712-262-3113.

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Otari ARS-1000 (5), \$1200; MCI JH-110B PB only (2), \$1800; MCI JH-110C mono, \$1800; Otari 5050III 8 trk, \$3200. C Green, Century 21 Programming, 800-937-2100.

Otari MX5050-4, 14" 4 trk, heads just lapped, \$950. B Petruzzi, Rouse St Prod, 804 E Old Hickory, Madison TN 37115. 615-868-6516.

Ampex AG500-2 stereo 2 trk, in case, built in mic/lens mixing w/plugs, mic preamps, vgc, 7.5-3.75 ips, \$300 plus shpg. M Saady, First City Recd, 141-60 84 Rd 3E, Briarwood NY 11735. 718-846-2062.

Pioneer 1020L 10.5" reels & (8) reels of tape, stereo 1/4 trk w/400 repro capability (4th), excel cond, \$400. B Ford, Spunk Prod, Box 1052, El Granada CA 94018. 415-726-4786.

Scully 280-1 (2), ea in Ruslang roll-around cabinets w/overbridge, \$3000/pr; (4) Scully 270-2 stereo PB, late mdl, manual, \$3K/all; Ampex AG440B electr chassis, as-is, \$100; Telex 4-chnl, slow-speed logger system, current mdl, \$2000/all; Tape-A-Thon Programmer III, current mdl, \$5000. E Stolz, KWOD, 1425 River Park, Sacramento CA 95815. 916-929-5000.

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AEI 700A continuous loop tape machines (2), \$700 ea/BO. Jim or David, 407-778-5192.

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Crown 700 1/2 trk stereo portable, excel cond, \$250; Ampex 602 FT, mono, \$100; Ampex 440 1/2 trk, stereo, excel cond, \$1000. W Kramer, 301 SW 16th, Ft Lauderdale FL 33315. 305-524-5652.

Sony PCM -701-ES digital 2 trk processor/recorder use w/any VCR, \$1500/firm. B Ford, Spunk Prod, POB 1052, El Granada CA 94018. 415-726-4786.

ITC 750 (3) PB R-R, just rebuilt, \$600 ea or \$1500/all. M Harris, WNNND, POB 549, Fuquay-Varina NC 27526. 919-552-2263.

Ampex 350, 7.5-15 ips, FT, cabinet mounted, \$400; Teac A120A, complete, cond unknown, \$100/BO. J McDonald, 303-669-3442.

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RECORDERS . . . WTS

Revox A-77 15/75 ips w/Dolby B 2 trk stereo, \$450/BO; Revox B-77, 15/75 ips, excel cond, \$1250/BO. B Henry, KLLK, 12 W Valley, Wil-lits CA 95490. 707-459-1250.

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Ampex 1200 24 trk matched pair, all the mods, great shape, heads have been lapped, many spares, \$30K/Pr, will consider 15K ea breaking set. D Hewitt, Remote Record, Box 334, Lahaska PA 18931. 215-794-5005.

Recordex 330II cassette duplicator, 1 master & 3 slaves, 16X duplication speed, automatic rewind, erase heads, long-life Vior record heads, LED level meters, \$700/BO. G Curry, Int'l Ministries, 4725 Peachtree Corners Circle Ste 250, Norcross GA 30092. 404-449-6766.

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Otari ARS-1000 in excel cond, (4), \$700 ea. C Knerl, KCNA, 139 SE J St, Grants Pass OR 97526. 503-474-7564.

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Otari 5050B2 7.5 & 1.5 ips 2 trk, less than 1 yr old, excel cond w/manual, \$950/firm. S Mahaffey, Mahaf Prod, 3592 N Delsea Ste 12, Vineland NJ 08360. 609-692-3439.

Ampex 601 tape transport, as is, for parts \$30; (3) Rotron 115 V Whisper fans for equipment cooling, \$10 ea or \$25/all. E Welch, Welch Media, POB 1455, Moncks Corner SC 29461. 803-781-7585.

Teac X-2000R 10.5" 1/4 trk, 7.5-3.75 ips, dbx, bi-directional 6-head system, auto-locator, 3-motor transport, very low hrs, excel cond, \$1000. G Curry, Int'l Ministries, 4725 Peachtree Corners Circle Ste 250, Norcross GA 30092. 404-449-6766.

Tascam 122 fairly new, \$600. E Trevino, KBOR, Box 3407, Brownsville TX 78523. 512-541-6348.

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Revox PR-99 (4) w/Persons Programmer 3A, mint cond, BO. J Phillips, WZOM, 409-1/2 Clinton, Defiance OH 43512. 419-784-1059.

Revox B77 excel cond, \$1000/BO. D Johnson, J-Con Ltd, 200 E Racknet Club, Ste 31, Palm Springs CA 92262. 619-323-4399.

Ampex ATR 800 (6) 1/4" stereo R/P, excel cond, manuals, \$2400 ea or \$13,000/all or BO. V Kilion, KRVN, POB 880, Lexington NE 68850. 308-324-6717.

Ampex AG 500-1 & AG500-2, both in vgc, \$600/both/BO. S Kozak, 351 Pinewood, Bay Village OH 44140. 216-871-5897.

Crown SX844 4 chnl 1/4", like new, \$850; Crown SC844 variable speed 4 chnl 1/4", mint cond, \$1200; Magnecord 1022 4 head, 1/2 trk stereo RP, 4th head 1/4 trk play, mint, \$300. J Parsons Sr, Parsons Elect, 10375 Cannas, N Huntingdon PA 15642. 412-863-9590.

Studer Revox B77 1/4 trk, excel cond, \$675. R Herman, Frontier Radio, POB 9292, Austin TX 78766. 512-280-5691.

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Scully 1/2 trk tape heads (28) play; (12) mono Magnacord Presto, play; (16) Magnacord stereo lapped Presto, play, sacrifice price. Call 616-782-9258.

Ampex ATR 800 roll around consoles (2), \$200 ea; Kavouras Radac 500 color radar, 120 & 240 mile range, phone dial-up access, low hrs, \$5000/BO. V Kilion, KRVN, POB 880, Lexington NE 68850. 308-324-6717.

Denon DN950F cart-CD player, new in box, \$1000; (2) ADC Pro Patch chassis PPA-3-18, Mark II, NO, new, \$500 ea; ADC Pro Patch assembly B/JF 104-4, Mark II, new, \$500. J Perez, 1901 Amy, Santa Rosa CA 95401. 707-526-5050.

Teac A-170S, top load cassette recorder w/Dolby, gd cond, \$75; Teac R-435X auto-reverse w/Dolby B & C, dbx, metal, record mute, microphone inputs, like new, \$150. L Hoover Jr, Logical Audio Solutions, 325 Saude, Essington PA 19029. 215-521-2933.

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Magnecord N35B portable, w/manual, excel cond, \$75. A Smith, Smith Sound, 52 Summer, Westboro MA 01581. 508-841-2209.

Teac A-3300SX 1/2 trk, vgc, almost new heads, 7.5 & 15 ips, 10" reel capability, remote, \$450. J Block, The Prod Block, 906 E 5th, Austin TX 78702. 512-472-8975.

Akai 4000DS MK II in excel cond, needs reel retainer for supply reel, \$300. T Devine, WVLK, 300 W Vine, Lexington KY 40507. 606-253-5900.

Tascam Series 8 trk studio equip, including 80-8 recorder, DX-8 dbx unit, M-35 board, A-3300SX 2 trk master, much more, \$12,000. R Bolling, POB 493, Pound VA 24279. 703-796-5146.

Kenwood KX-720 top load cassette recorder w/Dolby, gd cond, \$75; Sony TC-660 auto-reverse w/built-in amp & speakers, gd cond, \$200. L Hoover Jr, Logical Audio Solutions, 325 Saude, Essington PA 19029. 215-521-2933.

Ampex 602 & 622 speaker/amp, excel cond, except PB head has developed an open circuit, \$100. A Smith, Smith Sound, 52 Summer, Westboro MA 01581. 508-841-2209.

Yamaha K-960 w/Dolby B & C, dbx, metal, memory rewind, timer, record mute, mic inputs, vgc, \$225. L Hoover Jr, Logical Audio Solutions, 325 Saude, Essington PA 19029. 215-521-2933.

Tascam EM 1542, new reel motor for Tascam 38 deck, \$75. J Roper, Imperial Snd, RR 31 Box 405, Terre Haute IN 47803. 812-877-2663.

Technics RS8-85 w/dbx, 3 heads, Dolby B & C, \$275. S Chapekis, POB 22122, Denver CO 80222. 303-721-9156.

Denon DRM-33 3 hrs, Dolby B & C, \$200. S Chapekis, POB 22122, Denver CO 80222. 303-721-9156.

Teac A3440 4 chnl w/warranty, new, BO. G Chapekis, POB 22122, Denver CO 80222. 303-721-9156.

Collins stereo twintape spare parts; PC boards for PB deck & stereo record amp, power supply, relays, switches, etc, \$500/BO. Hank, 818-355-3656.

Lyrec tape timers (2), 7.5 & 15 ips, very accurate, w/mount for Ampex decks, \$300 ea. Hank, 818-355-3656.

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Tascam 70 4 or 8 trk in working cond, also parts & manuals. R Barrett, Inner City Prod, 5539 E Burnside, Portland OR 97215. 503-234-6225.

Sony TC 788-4 4 trk in gd cond & w/maintenance manual. C Fuller, Voices, POB 153, LaGrange IL 60525. 312-579-9578.

High speed cassette duplicator mono or stereo to record 10 at one time in working cond, need not be Elabrite. R Sweatle, KOCR, 800 Bdw Ste 220, Kansas City MO 64105. 816-421-1065.

Multi-track R-R or porta-studio in gd cond for small market studio, affordable price. Call 314-998-2377 or write: WLD Recdng, W Dougherty Jr, Rt 1, Music Valley, Mill Spring MO 63952.

Teac A7030S6, A7030GSL, A3300SX & broke/poor cond machines for parts. J Parsons Sr, Parsons Elect, 10375 Cannas, N Huntingdon PA 15642. 412-863-9590.

Fostex B-16 16 trk recorder. M Sokol, JMS Prod, 121 E Baltimore, Hagerstown MD 21740. 301-791-2568.

Teac 80-8/3440 remote controls, punch in foot switch record, play, FF, rewind, stop features, will pay shipping. J McCallum, McCallum Rec Fac, 3311 Bruce Randolph, Denver CO 80205. 303-399-8548.

Tape reel hold downs for Ampex 300, 351, 302, 354, AG440 MR 70, etc; power cords for Ampex 351 & 354, AG440. P Hons, Mainline Comm, 106 Poplar, Portage PA 15946. 814-736-3883.

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.

CONSOLES

Want to Sell

McCurdy SS-7500 stereo console parts, P&G faders, plug in preamps, etc. J.C. Aegerter, Satcom, 5431 W Center, Milwaukee WI 53210. 414-445-2300.

RCA BC5A (2), modified to 7 inputs, complete w/spare parts & manuals, gd cond, BO; Kel-don KD20A remote broadcast console w/(2) TTs, (2) waterproof speakers, gd cond, BO. J Keller, WKOK, POB 1070, Sunbury PA 17801. 717-286-5838.

Sphere Eclipse A/B 20x16 w/(8) 9-band graphic EQ, full patch bay, producers desk, \$6000. H Alrich, Box 869, Greenville CA 95947. 916-284-6929.

EV EVT 5212 12 in, stereo out & mono & monitor, mint cond, \$500. D Bailey, 3422 Beech, Rowlett TX 75088. 214-475-9796.

Ramsa WR 8112, 12x4x2, \$1500. C Green, Century 21 Programming. 800-937-2100.

Harris Micromac 16 input mainframe, manuals, spare pwr supply, \$10,000/BO. V Kilion, KRVN, POB 880, Lexington NE 68850. 308-324-6717.

Midas Pro Custom Recording, 16x8, Remix switch-over, (8) Pro 5, (8) Pro 3 modules, peak meter, clock/timer, flight case, \$10,500. H Al-rich, Box 869, Greenville CA 95947. 916-284-6929.

RCA BC8A dual mono console, clean shape, \$500 plus crating & shipping. J Kreines, DeMot/Kreines Films, 5330 Kennedy, Millbrook AL 36054. 205-285-6179.

BE 4BEM 50 w/4 pots; (2) Ramko solid state; Collins 212 F-2 tube type w/6 pots; AT1 8 chnl stereo w/pwr supply, call for details. Adolph, 915-949-2112.

Sunn Magna 5000, 24 inputs, 4 outputs, 3 aux sends, 3 band, 5 frequency EQ, Duncan faders & (2) spare modules & case, \$2300. B Petrucci, Rouse St Prod, 804 E Old Hickory, Madison TN 37115. 615-868-8516.

Interface 104L 16x8 monitor mix console, 9 freq, 3 band EQ pads, solos, etc, \$950. B Petrucci, Rouse St Prod, 804 E Old Hickory, Madison TN 37115. 615-868-8516.

Tascam M-520 20 chnl, mint cond, 6 mos old, \$4250. D Miller, Airborne Audio, 11647 W 83rd Terr, Lenexa KS 66214. 913-492-8822.

Autogram AC-6 6-channel 23-input stereo console, excel cond, includes ESE built-in timer, \$3000/BO plus shpg. D Kelley, KISZ, POB 740, Cortez CO 81321. 303-565-1212.

Tascam 5 in excel cond, 8x4x2 w/talkback module, \$450. J Block, The Prod Block, 906 E 5th, Austin TX 78702. 512-472-8975.

Gates Stereo Statesman, 5 chnl audio board in working cond, (2) modules missing, \$500; Robins 7 chnl custom board, 3 mic channels, 4 line channels, stereo, \$500. R Long, Northwestern College, 3003 N Snelling, St Paul MN 55015. 612-631-5312.

Yamaha M916 16-M1, 16-M2 inputs, 6X sub in, 2X off in, 2X echo in, balance & unbalance inputs, balance & unbalance outputs, talk-back, high pass filter, mixing busses, gd remote or studio mixing. M Legner, 703-971-7069.

Harris Stereo 80, recently removed from svc, vgc w/manual, \$1000/BO. M Berry, KFAS, 100 E Florence, Casa Grande AZ 85222. 602-836-7779.

Wheatstone SP 5A 15 input, 8 trk output audio console, never used, original documents, all inputs are stereo w/solo bus, 3-mic/line input modules, 12-A/B selectable line input modules, all have equalization, studio muting on mic inputs, dual studio talkback, built-in machine remotes, timer controls, \$12,000. J Perez, 1901 Amy, Santa Rosa CA 95401. 707-576-7543.

ADM ST-160 16 input stereo w/furniture, photos avail, \$6000/BO. J Bretner, WDFX, 306 S Washington, Royal Oak MI 48067. 313-398-1100.

Want to Buy

Auditronics 110 Grandson, need assorted modules, sell or trade, need pots & input modules. D Payne, WZPL, 1440 N Meridian, Indianapolis IN 46202. 317-637-8000.

Auditronics 100 Grandson, need 1 or 2 IME modules & 1 or 2 SPF4 modules. B Larson, WUSN, 875 N Michigan, Chicago IL 60611. 312-649-0099.

Old Hycor passive EQ; Lang PEQ-2. A Aaron, Gannett Outdoor Co, 1695 Eastshore Hwy, Berkeley CA 94710. 415-527-3350.

WE, RCA, Langevin mixers/consoles; also amps, speakers, mics, transcription players, literature. R Van Dyke, Squires Ave, E Quogue NY 11942. 516-728-1327.

DISCO & SOUND EQUIPMENT

Want to Sell

Community Light & Snd RS440 4-way speakers (one pair) w/Community VB790 bass bins, in Anvil cases, excel cond, \$2200 plus shpg. J Kreines, DeMot/Kreines Films, 5330 Kennedy, Millbrook AL 36054. 205-285-6179.

Community Light & Sound RS440 4-way speakers (pair) w/Community VB790 bass bins, in Anvil cases, excel cond, \$2200 plus shpg. J Kreines, DeMot/Kreines Films, 5330 Kennedy, Millbrook AL 36054. 205-285-6179.

Cross-overs (10) including (4) JBL 5234; Bi-Amp SM/23; plus 5 more, sell all or individually, BO. D Keller, Keller Bdcg, 8700 Cheltenham, Wyndomoor PA 19118. 215-233-5401.

JBL 4311 control monitors, walnut, excel cond, \$400/pr. R Treat, 38 Blue Pond PO56, Scottsville NY 14546. 716-887-4973.

Delta Lab Electron II digital delay & special effects, rack mt, excel cond, \$350/trade for EC RE20 mic. T Crockett, Hot Tracks, Box 10501, Blacksburg VA 24060. 703-953-0222.

Remodeling 8 studios, all boards, TT's, Scully R-R's & misc equip now avail in gd cond, call for detailed list & low prices. J Ballard, 213-659-5779.

Arp 2600 Odessey electr synthesiser, \$300. F Vobbe, Great Northern Bdc Co, POB 5031, Lima OH 45802. FidoNet 1:234/16.

Atesix Midflex & Midverb & rack unit, (2) complete stereo digital effects units in a 1-track space package, barely used, sell package or separately, \$450/BO. W Sams IV, 13009 Pardue Pl, Tampa FL 33617. 813-988-2449.

Eventide H-910, Harmonizer, gd cond, \$850. L Hoover Jr, Logical Audio Solutions, 325 Saude, Essington PA 19029. 215-521-2933.

EV SH-1502ER (2) two-way loudspeaker, 15" woofer, high freq horn in carpet covered cabinet w/handles & metal corners, 5 yr warranty, \$600/pr. B Fisher, KPOK, POB 477, Bowman ND 58623. 701-523-3883.

Rane AC-23 3-way stereo, 5-way mono active crossover w/time correction, barely used, will trade for AC-22 or equivalent in comparable cond, \$300. W Sams IV, 13009 Pardue Pl, Tampa FL 33617. 813-988-2449.

Yamaha NS-10 monitors, one pr still boxed, one pr opened, black, 2-way speaker monitors, as new, BO; JBL 4312 monitors, 3-way speakers, like new, \$400 ea. Mr Keith, ALI, Box 313, Keene NH 03431.

Digital delay or digital reverb for small market recdg studio, affordable price. Write WLD Recdng, W Dougherty Jr, Rt 1, Music Valley, Mill Spring MO 63952.

JBL 4315, 4333, 4343 monitors in gd cond, R Cobb, Solid State Svc, POB 5332, Sun City FL 33571. 813-634-1940.

Ibnie MSP-1000 limiter-EQ notch finder. D Wade, Collegium Sound, 35-41 72nd, Jackson Hts NY 11372. 718-426-8555.

LIMITERS

Want to Sell

CRL APP 400, PMC 300A, SEP 400B, SPF 300, in service, 2.5 yrs old, vgc, in use, avail 30 days, \$2700. M Tracy, KOAQ, POB 1263, Scottsbluff NE 68381. 308-635-2690.

RCA BA-6A tube limiter, rack mt, vgc, \$450/trade. J Pines, 217-367-3530.

Trade new Valley Intl Gain Brain 2 for Valley Intl Maxi-Q. J Pines, 217-367-3530.

Aphex Aural Exciter Type B in excel cond, \$1000/BO. R Pollard, KSKG, 1217 S Santa Fe, Salina KS 67401. 913-825-4631.

UREI 1176 LN excel cond, schematic, silver face mdl w/LN module installed at factory, \$300. R Jordan Jr, Southland Recdng & Snd, 812 Young, Selma AL 36701. 205-874-8009.

Audio & Designs vocal stressor 4 band EQ & compressor, limiter, noise gate at same time, vgc, \$1100; Programming Technologies Ecoplate2, excel cond, \$650/trade. J Pines, 217-367-3530.

Modulation Sciences CP-803 (2) new composite clippers, \$950. R Jesse, KLTQ, 3645 South, Springfield MO 65807. 417-887-9650.

Urei BL 40 mod/limiter, \$295. K Crosthwait, WTNH, 13206 Buttermilk, Knoxville TN 37932. 615-531-2297.

CRL FM System including SPP-800, SEP-800, SMP-800, SG-800 & CC-300A, \$4500; Orban Optimod 8000A, excel cond, \$1800. B Musser, WJMD, Ohio & Murray, Atlantic City NJ 08401. 609-344-5113.

Orban 8000A Optimod, works perfectly, \$1800. K Reising, WRZQ, POB 690, Columbus IN 47202. 812-379-1077.

CBS Audimax 4450, BO; CRL APP 300, BO; (2) CBS Volumax 411, BO. KDKB, POB 6184, Kingman AZ 86402. 602-753-KDKB.

CRL CC-300 composite controller, works fine w/documentation, \$350. E Schechter, KMLE, 645 E Missouri Ave, Phoenix AZ 85012. 602-264-0108.

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CBS Labs stereo limiter, 1 side chnl not working; Universal Audio BL-40 Modulimiter. Adolph, 915-949-2112.

CBS Labs 411 stereo Volumax, \$300; CBS DPE 4500 units (pair), \$500. C Benner, WUUL, 440 Domino, Phila PA 19128. 215-483-8900.

Harris MSP 90, studio end works fine, xmtr end needs work, BO; DAP 310 AGC peak limiter, has been updated, BO. T Rusk, KITA, 723 W 14th, Little Rock AR 72202. 501-

MICROPHONES . . . WTS

Neumann U-47 Nuvistor (2). Kinura Records, Box 660236, Miami Springs FL 33166. 305-887-5329.

Neumann KMR 82 shotgun, like new, leather case & windscreen, \$650. D Scales, Scales Film Snd, 3142 Market Pl, Bloomington IN 47403. 812-339-4446.

Sennheiser MKH815, \$500 & MKH 816, \$575, shotguns w/foam windscreen in mint cond. D Scales, Scales Film Snd, 3142 Market Pl, Bloomington IN 47403. 812-339-4446.

Neumann U47f2 (2), mint cond, w/leather box, warranty, \$995/ea. Klaus Heyne, 415-664-0163.

EV 635A omni dynamic, excel cond, w/clamp, \$40 plus shpg. M Saady, First City Recd, 141-60 84 Rd, 3E, Briarwood NY 11735. 718-846-2062.

Shure 5B, antique ring & spring type w/table stand, gd cond, \$385. R Cane, 6142 Miramar Pkwy, Miramar FL 33023. 305-962-8111.

Audio Technica all models, call. K Taylor, Image Support, 103 N Aspen, Sterling VA 22170. 301-864-4841.

Sennheiser MD421, (2) w/boxes; RCA 77, perfect pair, matched w/original bags, BO. J Phillips, WZOM, 409-12 Clinton, Defiance OH 43512. 419-784-1059/

AKG DD202E (4) w/clips, vgc. (2) w/case, \$100 ea. M Rice, WKBO, 2360 Hampton, St Louis MO 63139. 314-644-1380.

Sony C-55P (3) very rare, mint cond, FET condenser, tiltable capsule for front or side pick-up, w/case, mic holder screen, \$500/BO. J Diamond, Box 102C Chubbic, Canonsburg PA 15317. 412-746-2540/4040.

RCA 77DX, BO or trade for E-V RE-20s. D Kelley, KISZ, POB 740, Correz CO 81321. 303-565-1212.

EV CO-90 tie clasp lavaliere mic (2), like new, \$79 ea; Vega Orator III bodyback wireless mic systems w/directional tie clasp mic, like new, \$545. G Meyer, 231 N 2475 W, Provo UT 84601. 801-375-4074.

RCA ribbon mics including (1) 44BX; (1) 77D; BK-11; 74-B; (2) SK-46; Shure 330 ribbon; Dynamics (2) Shure 555W, \$60 ea; EV 611; EV 630; Astatic DN-HZ. Tracy Eaves, 615-821-6099 (evenings).

Want to Buy

RCA 77's, 44's, Neumann 47's, 87's, will purchase or trade R-R's or TT's. W Kremer, 301 SW 16th, Ft Lauderdale FL 33315. 305-524-5652.

Old mikes, WE, Altec 630, 633, 670, Shure 556, SM-33, 300, any Amperite, American D-33, DR-330, RCA Velocity Jr, Turner 9A, working or not. D Igou, KGNB, 1540 Loop 337 N, New Braunfels TX 78130. 512-625-7311.

Vintage tube condenser mics, especially Neumann, Telefunken, Schoeps, AKG & classic ribbon mics, RCA 77s/44s. J Kreines, DeMott/Kreines Films, 5330 Kennedy, Millbrook AL 36054. 205-285-6179.

RCA, JBL Mod 1-0001 RCA ribbon mic, mod 4311B, studio monitor loudspeaker (1). RL McDonald, 5231 Horton, Mission KS 66202. 913-722-2677.

RCA 44's, 77's, etc. any model working or not: WE 633 mics, etc. B Davies, Virgo Prod, 5548 Elmer, N Hollywood CA 91601. 818-761-9831. 913-722-2677.

MISCELLANEOUS

Want to Sell

Stancil Hoffman CRM-7 logger system. M Young, WJON, POB 220, St Cloud MN 56302. 612-251-4422.

Rare vintage bdct equip: RCA console, mics, TT, speakers, varied other items, all in working order. T Heathwood, Heritage Radio, POB 16, Boston MA 02167. 617-969-1746.

Extel AL Series, like new, will trade for cart machines, Marti equip or, etc. BO. A Moll, KLXQ, 828 S Getty, Vualde TX 78801. 512-278-1102.

Custom studio furniture, (2) pedestals & top to form console, in walnut & black laminate, \$100; various headsets (3), all work, \$10. D Bailey, 3422 Beech, Roulett TX 75088. 214-475-9796.

Various pieces of equip including Fisher audio component system; TT's; table top lazy susan; xmtr breaker box; on-air lights; Extel 1A1 11 R printer w/stand & book, Multilith off-set mdl 85, GE AP printer, stands, etc, call for details. Adolph, 915-949-2112.

Toshiba 720K 3.5" disk drive w/mounting kit to use in 5-1/4" slot, new sealed in box, \$80. M Peterson, 3610 Lancaster Ste 6, Plymouth MN 55441. 612-544-6391.

RCA equip manual from 1967; boards; xmtrs, etc, excel cond, \$25. D Miller, Airborne Audio, 11647 W 83rd Terr, Lenexa KS 66213. 913-492-8822.

Phasemaster T-7500-A2 240V single phase to three phase rotary phase converter, 1 yr old, \$3500. D Quinlan, KLAB, 1020 Pine, Klamath Falls OR 97601. 503-882-8833.

Bdct Development Group, Don Werlinger, if you have had towers erected or equip installed by the above, I would like to hear from you. Chuck, 919-623-9966.

Excess wire & cable inventory, Belden types 8449, 8447, 8790, 8422, 8459, 9750, 8448, 8663, 8627; control cable, microphone cable, bonding cable, various lengths, some spooled, some rolls, all new, you ship. R Karbaw, WTNJ, Box 1127, Beckley WV 25802. 304-877-5592.

Patch panels (7), 4 stereo TRS, 3 mono double plug type, BO; 25 Hz tone gen, missing cover, no instructions, 3.5" rack mount, remote controllable, BO. P Hess, 134 Derwent Dr, Pgh PA 15237. 412-366-1249.

Misc equip racks, call for details, Adolph, 915-949-2112.

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Large amount of misc furniture/furnishings including steel/padded vinyl chairs, kitchen table, desks, R-R stands, lamps etc., call for more details. Adolph, 915-949-2112.

Extel AH/P11R teleprinter w/stand, like new, BO. J Anderson, WKCU, 2192 Hwy 72 East, Corinth MS 38834. 601-286-8451.

Heavy duty road case, foam lined, 43.25"x27.25"x8" inside dimension, \$60. D Wade, Collegium Sound, 35-41 72nd, Jackson Hts NY 11372. 718-426-8555.

Magnavox BM7622 12" composite computer monitor, 60x25 amber display, audio input for sound, like new, \$75. L Hoover Jr, Logical Audio Solutions, 325 Saude, Essington PA 19029. 215-521-2933.

Sprague EMI/RFI noise line filter assy, model JN17-23, rating 3 phase, 125 A, 440 VAC, new, \$125. A Emerald, KGG, 8956 Swallow, Fountain Valley CA 92708. 714-962-5940.

Extel AF-11 teleprinter (3), G Hofer, KJLT, POB 709, N Piate NE 69101. 308-532-5515.

Extel AF-11R teleprinter, needs some work, includes service manual & 79 rolls of printer paper, cond unknown, \$150/BO pls shpg. D Kelley, KISZ, POB 740, Cortez CO 81321. 303-565-1212.

Dynaco PAT-4 transistor preamp, inputs: special, tape, head, phono, tape tuner, tape monitor w/high & low filters, vgc, \$125. L Hoover Jr, Logical Audio Solutions, 325 Saude, Essington PA 19029. 215-521-2933.

Radio Shack TRS-80 MDI II includes 3 drive expansion unit, Okidata 82A lineprinter, working when removed, \$600/BO pls shpg. D Kelley, KISZ, POB 740, Cortez CO 81321. 303-565-1212.

Potter & Brumfield KHP17D11 12 V DC relays, never used (approx 140), \$1 ea. T Devine, WVJK, 300 W Vine, Lexington KY 40507. 606-253-5900.

Want to Buy

Pre 1960 bdct equip magazines, catalogs, instruction manuals, 7" & 10" blank recording discs, RCA & WE studio equip. R Van Dyke, 2 Squires, E Quogue NY 11942.

VPI HW-17 record cleaning machine. D Weston, KCOP, 5922 W 76th, Los Angeles CA 90045. 213-216-7814.

Equip rack-cabinet or open type, Chicago area pick up only. William, Lactrotech, 5810 N Western, Chicago IL 60659. 312-769-8262.

Transcriptions, RCA Thesaurus & Associated. B Davies, Virgo Prod, 5548 Elmer, N Hollywood CA 91601. 818-761-9631.

WWII vintage radar equipment units & complete systems. A Weiner, Britton Rd, Monticello ME 04760. 207-538-9538.

Jazz record collections, 10" LP/12" LP bebop, swing, dixie, highest prices paid. B Rose, Program Recdgs, 228 East 10th, Nyny 10003. 212-674-3060.

MONITORS

Want to Sell

Gates GTM-88R FM RF amp, working when removed, \$100. R Huckleby, KJLF, POB 336, Butte MT 59703. 406-723-4006.

McMartin EBS 2 monitor, needs new filter, BO; McMartin TG2 EBS tone gen, gd cond, BO. J Keller, WKOK, POB 1070, Sunbury PA 17801. 717-286-5838.

McMartin TBM-3500 mod mon, BO. KDKB, POB 6184, Kingman AZ 86402. 602-753-KDKB.

Nema-Clarke 8 tower phase monitor, \$300. F Vobbe, Great Northern Bdct Co, POB 5031, Lima OH 45802. FidoNet 1:234/16.

McMartin TBM3500 & TBM 2200A FM mod monitor & stereo mod monitor, \$500/ea. L Collins, Collins Assoc., POB 422, Washington NH 03280. 603-495-3983.

Gorman-Redlich EBS encoder-decoder, \$250/BO. Hank, 818-355-3656.

Want to Buy

Potomac AM 19(204) antenna monitor for 4 tower array needed ASAP. G Sies, WRYT, 9 Cougar, Edwardsville IL 62025. 618-692-9798.

Belar or TFT FM mod monitor, stereo, preferably w/freq monitor, also need crystal 96.3; Wegener SMN receiver frame w/format cards for sat mvs network, splitter 1601. LJ Maierhofer, WTCG, 101 Armory, Lewisburg PA 17837. 717-523-3271.

Belar FMMI, FMSI, SCAI, RFAI, gd cond. J Phillips, WZOM, 409-12 Clinton, Defiance OH 43512. 419-784-1059.

FM monitor for EDFM, gd cond, inexpensive or will help w/appraisal for taxes. J Goggan, MO River Christian Bdct, POB 87, Washington MO 63090. 314-239-0400.

MOVIE PROD EQUIP

Want to Sell

New Eiki SL-0 16mm slot load projector, \$450; Maurer 05 body, 4 mags, no motor, \$750; new Bell & Howell 70 DR w/Anvil case, 1" Comat, instructions, \$325. J Kreines, DeMott/Kreines Films, 5330 Kennedy, Millbrook AL 36054. 205-285-6179.

Want to Buy

Mitchell 35 & 16mm cameras & access; other professional 16/35mm cameras; Upright Moviolas, especially 35mm; Westrax 35mm optical recorders; Zeiss 9.5mm Distagon, reasonable, need not be mechanically mint. J Kreines, DeMott/Kreines Films, 5330 Kennedy, Millbrook AL 36054. 205-285-6179.

RECEIVERS & TRANSCEIVERS

Want to Sell

Motorola Pulsar mobile telephone 20 W all VHF chnlis includes control head, antenna, cables & manual, \$400. D Bailey, 3422 Beech, Rowlett TX 75088. 214-475-9796.

Microdyne 1100-FFC-X1-RD(R) SSCP rcvr, also Cal Microwave demod shelf & Mod Associates cue alarm, \$800/all. S Icenogleg, KTRS, 251 W 1st, Casper WY 82601. 307-235-7000.

RCA Super Controlfone 500 UHF repeater crystalized on 464.3 MHz transmit, 469.3 MHz receive, in weather tight rack cabinet w/Decibel DB472 6 cavity duplexer, Decibel DB-410 16 bay high gain antenna w/mounting clamps & approx 160' of 5/8" hardline w/connectors, \$900/system or will break up pieces. M Peterson, 3610 Lancaster, Ste 6, Plymouth MN 55441. 612-544-6391.

Scientific Atlanta 7300/7325 digital satellite rcvr, 15 kHz, 1-75 kHz, voice cue card, (3) crystals, like new, \$9000; HD955 delay, mono, 6.4 seconds, 15 kHz, \$1750; ABC Talk Radio cue demod, McCurdy MRP-1, w/interface & printer cables, \$500. J Katz, Westcoast Bdcty. 209-686-2866.

Johnson Electronica ST-4A subcarrier receivers, converted for 4800 baud data reception, 92 & 67 kHz. D Lainen, Independent Resources, POB 23498, Oklahoma City OK 73123. 405-721-1187.

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Want to Buy

Manual for R-391 receiver. S Daitch, PSC 1 Box 362, APO San Francisco 96286.

Scientific Atlanta 7300 dual 75 kHz audio card. T Shinn, WKSF, POB 6447, Asheville NC 28816. 704-257-2700.

Group home radio club needs ham receiver & xmtr, USB, DSB, LSB, LW, must be gd cond, call or write, I Dechowit, WHBI, 696 Wood, Avenel NJ 07001. 201-602-1242.

Used EBS receiver in working cond. S Kile, Keckman Inst., 10493 Dupont Rd, Bloomington MN 55431. 612-888-1627.

KLH 21 FM table radio, will buy or swap other equip. J Roper, Imperial Snd, RR 31 Box 405, Terre Haute IN 47803. 812-877-2663.

Motorola 2-ways, 2m or 10m ham rig. J Schloss, KICD, 2600 Hiway Blvd, Spencer IA 51301. 712-262-1240.

REMOTE & MICROWAVE EQUIP

Want to Sell

Fairchild Dart 15 kHz card, fits Fairchild Dart 384 receiver, call for price. P Baillon, 612-222-5555.

Data Signal MTI-700 modular telephone interface. BO. KDKB, POB 6184, Kingman AZ 86402. 602-753-KDKB.

Moseley TRC-15AW (2) complete systems, working when removed, telephone line, can be converted for STL, \$1000/BO ea. R Huckleby, KJLF, POB 336, Butte MT 59703. 406-723-4006.

Wegner satellite rcvr & decoder for SMN, country & Starstation (AC) formats, includes all the elect you'll need for both, plus auto-lock switches for both formats, \$3200/all. D Silver, KNKK, Layton Hills Mail, Layton UT 84041. 801-973-7759.

Secode DTMF 5 chnl decoders (2), Vega data control telemetry system includes xmtr & rec units, FS keying, BO. R Huckleby, KJLF, POB 336, Butte MT 59703. 406-723-4006.

Harris SCA gen card for MX-15 exciter, BO. Moseley SCG-4T sub-carrier gen, BO. KDKB, POB 6184, Kingman AZ 86402. 602-753-KDKB.

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QEI 7775 ATS, will sacrifice, BO. J Katz, KJUG, 717 N Mooney, Tulare CA 93274. 209-686-2866.

Ringo Ranger II on 161.70 MHz & Ringo Ranger II on 450.950 MHz, used on temporary installation, includes documentation, mounting hardware, \$20 ea or \$35/both. F Vobbe, Great Northern Bdct Co, POB 5031, Lima OH 45802. FidoNet 1:234/16.

TFT 7601 configured for 110 kHz/67 kHz operation or 2 wire telco, works great w/manual, \$1800/BO; Moseley 505C presently on 945.5 MHz, older version, works well, needs some alignment, will consider trade for Marti RPU gear, \$1500/BO. E Schechter, KMLE, 845 E Missouri Ave, Phoenix AZ 85012. 602-264-0108.

CRL SCA 330A, new in box, tested but not used, BO. D Laustsen, Sunset Comm, 19 Meadow, Doylestown PA 18901. 215-340-9738.

Marti SCG-10 subcarrier gen tuned to 92 kHz, 7 mos old, \$1000. A Matos, WRFE, Box 846, Aguada PR 00602. 809-868-7793.

Moseley TRC-15AW recently removed from svc. JR Curtis, KAEZ, POB 4299, Longview TX 75606. 214-663-3700.

Scientific Atlanta 7300 2.8m dish, 120K LNA, 7300 BPSK rcvr, 7325 DPU, 15 kHz card, 75 kHz card, 3 kHz card, vgc, 19-23-3-15 crystals, typical Westwood 1 set-up, \$7000. M Lahmoth, WSNL, 1944 Innerbelt Bus Ctr Dr, Overland MO 63114. 314-426-0101.

Marti STL-8 xmtrs/rcvrs (2), tuned to 950.375/950.625 MHz; HRC-8 xmtr combiner, rcv combiner, cables & books, recently removed from svc, ready to ship, \$2800/BO pls shpg. L Ayst, KPRL, POB 8849, Moscow ID 83843. 208-882-2551.

LAUX satellite system, to be sold as package only, call for details; Harris satellite system also to be sold as package, call for more info. Adolph, 915-949-2112.

Marti STL-8 (2) xmtrs & rcvrs, 946.850 & 947.150 MHz, \$2000/BO. B Stuart, KSUE, 3015 Johnstonville Rd, Susanville CA 96130. 916-257-2121.

Moseley 606/C tuned 947.500 MHz, \$7500. T Langham, TL Engr, 1508 S Owasso, Tulsa OK 74120. 918-587-0941.

Moseley SCG-8 92 kHz subcarrier gen, 6 mos old, \$850, or gd cond-ITC-750 deck as part. K Browall, KTRZ, Box 808, Riverton WY 82501. 307-856-2922.

Fairchild Dart 384 15 kHz dual audio card in gd working order, have two only one, \$750. RL Wood, KOWO, 222 N State, Waseca MN 56093. 507-835-5555.

Moseley MRC-1600, excel cond, 2 yrs old, \$3500/BO. B Simmons, KGRV, POB 1598, Winston OR 97496. 503-679-8185.

Microdyne 1100 PCDR-5 SSCP demodulator, excel cond, 3 yrs old, \$1400. J Shea, WHUC, Union Tpk, Hudson NY 12534. 518-828-3341.

Fairchild Dart 384 7.5 kHz dual program card, excel cond, \$600/BO. D Kelley, KISZ, POB 740, Cortez CO 81321. 303-565-1212.

1987 custom built remote studio trailer, 8x20, (3) rooms, generator, kitchen, dual AC & heat, (2) PA systems, custom paint & detailing, call for info. BO. J Rabell, 619-278-1130.

Moseley TRL-1 xmtr & rcvr w/manuals, complete system, \$2000. B Slowikowski, WQCB, 49 Acme, Brewer ME 04412. 207-989-5631.

Want to Buy

Complete satellite system, dish down-converter, receiver-demod & audio program chnl for SATCOM 1R, transponder 23. 15 kHz digital chnl, must be compatible w/present digital format. B Stuart, KSUE, 3015 Johnstonville, Susanville CA 96130. 916-257-2121.

Marti STL-10 need (2) w/manuals. M McVey, 620 Lake Rd, Ottamwa IA 52501. 515-682-0498.

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Moseley PCL-505 STL. W Axell, KSAY, POB 2269, Ft Bragg CA 95437. 707-964-5729.

Marti RPT-15 or RPT-30 for sports bdcets. UHF. P Baillon, 612-222-5555.

Moseley PCL806-C composite STL, excel cond. \$5900. C Knerr, KCNA, 139 SE J St, Grants Pass OR 97526. 503-474-7564.

TSL System, prefer Moseley, TTF or Marti. D Kelley, KISZ, POB 740, Correz CO 81321. 303-565-1212.

TFT 7701 STL rcvr, will consider other mdl of composite STL rcvr using 75 microsecond de-emphasis. M Blumstrom, KUNR, Reno NV 89557. 702-784-6083.

DDual audio channel program module, 75 kHz for a Fairchild Dart 384. J Cole, WBTM, 710 Grove St, Danville VA 24543. 804-793-4411.

SA or Fairchild digital rcvr & 3.8 m dish for ABC Radio network, must be in gd cond. L Dupree, KQID, 1115 Texas Ave, Alexandria LA 71301. 318-445-1234.

STATIONS

Want to Sell

Selling equity interest in AM located in dynamic growing southern Utah community, turn around opportunity has been successful but under capitalized, principles only. M Skinner, 341 S Bluff, St George UT 84770. 801-628-1000 inquiries confidential.

Hot Daytimer, New York State for sale 75% to sales mgr-operator, long time pro-operator mgr stays, negotiable. G Dacre, WTBO, 62 Main, Florida NY 10921. 914-651-4446.

Large AM construction permit in the West, located in major market area, great night time coverage. C Hall, KRDA, 2207 S Nevada, Provo UT 84606. 801-374-6809.

1 kW AM on 1580 kHz, authorized for FT in a city of approx 15,000, less than 3 percent unemployment & only one other locally operated station, 1 hr So of Nashville, excel opportunity for owner and/or mgmt team, 200K cash or will consider reasonable cash offer. A Wilkerson, WLIL, POB 340, Lenoir City TN 37771. 615-986-7536.

Class A FM & 10 kW AM daytimer w/PSA priced for quick sale in Price UT. J Dart, 801-637-0863 or 1752 for details.

AM/FM combo fully automated, w/3 bdr studio combo on 3 acres of land avail, retiring, priced to sell. P Robillard, 318-624-0105.

Mid-Michigan AM 1000 W FT, only station in two-city metro of 14,000, only one other station in county of 50,000, w/building, land, \$235,000, terms considered. M St Cyr, 517-487-5986.

FM in Southwest Texas, all new equip w/bldg & land, will sell part to investor. A Moll, KLXQ, 128 Memory Trail, San Antonio TX 78232. 512-496-0677.

FM Class A single market in SW OK needs owner-operator, responsible party take over payments of \$1426/mo at 9% interest, upgrade possible. BO. R Kerr, KRFM, One Confederate Rd, Altus OK 73521. 405-482-3966.

Fully equipped Mississippi AM in a single station market. Std/xmtr/tower on single site renting for \$250/mo. Continuous operation for 20 yrs, currently losing less than \$1000/mo, absentee owner has other interests. J Clinton, 601-268-7892.

Class A stereo FM radio station, Mississippi, cash or terms. G Shurden, 601-843-4091.

SF Bay area bdcet school & cable FM network, 10 yrs old, profitable, expansion potential in top affluent market, modern studios/offices, Dept of Ed approved, \$375K. J Bryan, KCRK, 1656 N California, Walnut Creek CA 94596. 415-935-5100.

Want to Buy

Looking for AM, FM or LPTV, problem stations, turnarounds, daytimers, dark, etc. OK, bdcet seeking new challenge, send complete details w/price & terms. J Powley, 1536 Logan, Altoona PA 16602. 814-944-8571.

Looking for AM, FM or LPTV, problem stations (turnarounds, daytimers, etc), broadcaster seeking new challenge, send complete details w/price & terms. J Powley, 1536 Logan, Altoona PA 16602. 814-944-8571.

AM stations: high power turnarounds at gd price, top 150 markets, daytimers & dark stations OK, include price/terms & city grade coverage map. Mr Stevens, POB 732, Langley SC 29834.

Looking for FM or AM/FM in Northwest Ohio, Southeast Michigan, confidential serious replies only. F Vobbe, Great Northern Bdcet Co, POB 5031, Lima OH 45802. FidoNet 1:234/16.

AM/FM stations or CPs including dark stations, bankruptcy situations, assumption of debt situations. Doc Pollock, First Bdcet Corp, POB 691, Wilmette IL 60091. 312-902-4410.

STEREO GENERATORS

Want to Sell

Moseley SCG-4T subcarrier gen, like new, may be returned. J Kramden, WBRL, 3342 Perry, Marsellus NY 13215. 315-673-9049.

Moseley SCG-3T stereo gen, BO. KDKB, POB 6184, Kingman AZ 86402. 602-753-KDKB.

Motorola 1300/1310 C-Quam stereo system, 1360 kHz, CRL SPP 800, (2) SEP 400, SMP-900, all gd cond, BO/whole package. J Davis, WCHL, POB 2127, Chapel Hill NC 27514. 919-942-8765.

Modulation Sciences DSCA-188 data Sidekick SCA gen, 92 & 62 kHz. D Leinen, Independent Resources, POB 23498, Oklahoma City OK 73123. 405-721-1187.

Harris TE-3 exciter, (2) stereo gen, (2) SCA gen 67 kHz, BO. C Benner, WUSL, 440 Domino, Phila PA 19128. 215-483-8900.

Gates 6095-6146 exciter/stereo gen in 4' rack, includes stereo Audimax processor, metering, on-off controls, manuals; complete working 10 W stereo xmtr, \$700/BO pls shpg. M Meyer. 313-686-0447.

Want to Buy

Harris audio input control module for model TE1 or TE3 FM exciter; RCA BTS-1A stereo gen, low pass, pre-emphasis filters. C Gill, POB 371, Indianapolis IN 46206. 317-923-2800.

SWITCHERS (VIDEO)

Want to Sell

Echo II SE6 switchers (2) w/RCA TG-3 synch/pulse pattern gen w/racks, \$1400, may sell separately. R Lawrence, Moonshadow Video, 4280 Roston Rd, Roseburg OR 97470. 503-679-8966.

Want to Buy

Telemation/Bosch 1000 Series routing switcher, 40x20 or larger, in operating cond or as parts. T Steinke, POB 413, Milwaukee WI 53201. 414-229-5470.

TAPES, CARTS & REELS

Want to Sell

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Background music on 10" reels, 375 ips, 1/2 trk mono, 1960 & 70's, min 6 hrs per tape. (12), \$25 pls UPS. E Davison, 135 N Illinois, Springfield IL 62702. 217-787-0800.

U-matic cassettes, like new, one pass only, mostly 5 or 10 min lengths, cassettes include library cases, some shipping cases, approx 350-500 avail, \$2 ea pls shpg. J Powley, 1536 Logan, Altoona PA 16602. 814-944-8571.

U-Matic cassettes, like new, one pass only, mostly 5 or 10 minute lengths, include library cases, some shipping cases, approx 350-500 avail, \$2 ea pls shpg. J Powley, 1536 Logan, Altoona PA 16602. 814-944-8571.

Audiopak A-2 (1270) music length, gd cond, \$75 ea. L Kolk, WSNX, 875 E Summit, Muskegon MI 49444. 616-733-2126.

Fidelipac NAB-300 carts, vgc, \$2 ea & (215 recd) Master carts at 7.5 min long, \$2 ea/BO. R Pastorik, WCMY, 216 W Lafayette, Ottawa IL 61350. 815-434-6050.

A&D Cartridge Rebuilding Service

We clean, load & pack. Serviced within 10 work days! Work guaranteed!
3380 Blakely Ave., Eau Claire, WI 54701
(715) 835-7347

Over 3000 45's & LP's, all spanish in top cond, will record for automation if needed. A Moll, KLXQ, 128 Memory Trail, San Antonio TX 78232. 512-496-0677.

Ampex tape, (300) 10" reels, bulk-erased, including reels, \$5 ea. T Moore, WBCO. 419-468-2326.

Sound Ideas sound effects library on 14" reels, over 3000 effects, excel cond, including catalog, \$650/BO. T Keenan, Creative Media, 11105 Knott, Cypress CA 90630. 714-892-9469.

Reels, (1000) 5" w/NAB hubs, BO. S Voros, 1537 S 81st, Milwaukee WI 53214. 414-475-6200.

Want to Buy

ET's 16" Thesaurus Here's to Vetercius guest star, orig or top quality tape copies & library catalogs. C Fuller, Voices, POB 153, La Grange IL 60525. 312-579-9578.

Used tapes & reels for automation, 10" reels. A Moll, KLXQ, 128 Memory Trail, San Antonio TX 78232. 512-496-0677.

New, boxed, unused Seeburg/Rowe 16 rpm background music records, any quantity, write price; also jazz/swing 78 rpm libraries or collections wanted. F Luppino Jr, Mktg Insights, 1445 Sunset Ridge, Glenview IL 60025. 312-729-2047.

Thesaurus, standard, Capitol ET's or gd 14" dubs, also catalogs, call collect. C Hunt, Voices, POB 153, LaGrange IL 60525. 708-579-9578.

TAX DEDUCT EQUIP

Bdcet Eng student at New England School of Bdcetg in Bangor ME seeks any & all old bdcetg equip in working cond or in need or minor repair, will pay shipping & will send tax receipt. S Brough, POB 159, Skowhegan ME 04976. 207-474-9068 or 5171 (work evens).

Non-profit missionary station in El Salvador needs 8008's in any cond so long as the bases, pins & plate caps are gd, will pay shipping; Also need 892R's for xmtr, will pay shipping. J Counter, YSLE, 5484 San Patricio Dr, Santa Barbara CA 93111. 805-967-6410.

Comm College has CP for new stereo FM, need: 3 kW xmtr, antenna, iso-coupler, mod mon, compressor limiter, RT machines, TC machines, TT's. J Gaboury, Arizona Western College, 602-344-7695.

Any type of video equipment, working or not for local chapter of Red Cross video training studio, will pay shipping & provide tax deduction certificate. G Kirby, 13613 US 36, Marysville OH 43040. 513-644-0468.

Non-profit university seeks used AV prod equip, primarily cart/cass machines, audio processing gear & portable video equip. G Curtsinger, Univ of Detroit, 3800 Puritan, Detroit MI 48238. 313-927-1173.

Used radio equip for donation to college station. P Hess, WPPJ, 201 Wood, Pgh PA 15222. 412-392-4725.

HF/VHF/UHF amateur and/or commercial comm equip in working or repairable cond, transceivers or handhelds, packet TNC & PC equip; 12V battery back-up, will pay shipping or pick-up; CB equip also. J Bondon, 7101 W 80th, Los Angeles CA 90045. 213-642-3698.

Group home working w/troubled teenagers seeking donated video & audio or related equip for tax purposes. R Scott, ISOT Inc, Box 35, Canby CA 96015. 916-233-4106 or 233-5151.

Electronics eng student seeks donation of old but repairable, studio or xmtr equip. RS Lynn, Rt 1 Box 152-D, Loudon TN 37774.

Radio reading service for the blind & print-handicapped in CT looking for donation of 2 cart machines for Fairfield county satellite studio, will pay for shipping or pick-up. Cynthia Clark, CRIS Radio, 589 Jordan Ln, Wethersfield CT 06109. 203-246-3579.

Missouri River Christian Bdcetg seeks 1 kW FM xmtr, exciter, stereo gen, FM monitor, cart machine. Will help w/appraisal for taxes. J Goggan, KGNV, POB 87, Washington MO 314-239-0400.

Christian Ministry needs donations for low power, 250 W, FM station: FM mod mon; FM AGC processor limiter; hi-gain antenna on ED band; 7/8 coax, 400-900'; (4) R-R, mono; (4) mono cart machines; Marti RPU xmtr & antenna; Marti rcvr & antenna; CD players (2); J Setzer, POB 93, Brookfield MO 64628. 816-258-5310.

El Salvador Christian station needs (2) 8008 pull-outs & usable 892R's, we pay freight. J Counter, YSLE, 5484 San Patricio, Santa Barbara CA 93111. 805-967-6410.

Eng student desiring donation of old bdcet equip (anything) in repairable cond, will pay all shipping charges, EE student at Purdue. C Gill, POB 371, Indianapolis IN 46206. 317-923-2800.

BEE

EMPLOYMENT

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

HELP WANTED

Shadow Traffic Network's New York network center needs a second engineer. Duties include repair & maintenance of audio, RF, computer & telecommunications equip.

Chief Engineer

KQLH-FM, San Bernardino, California Keymarket Communications needs an engineering mgr in this FT position to build, operate, & maintain new studio & transmitting facilities.

Retired or Semi-retired salesman, wanting the challenge of getting clients for very small market, 100 watt FM in Southwest Arizona.

Radio Engineer

University 30,000 watt public radio facility offering full benefit package, modern equipment in a new building.

General Manager, WMUB, Miami University Oxford, Ohio 45056

Chief Engineer for Richmond Country FM wall new studio & RF facility. Position includes company benefits & market competitive salary.

Staff Engineer, experienced-motivated for Tampa Bay AM/FM. AF, RF, heavy maintenance. \$21-24K, benefits. Reply to: Engineering Manager, POB 20146, St Petersburg FL 33742. EOE.

Instructor for FCC General Class License preparation. Send resume to Bob Johnson Telecommunications, 1201 Ninth, Manhattan Beach CA 90266 or General Delivery, Greenhurst NY 14752.

Engineering Assistant needed to major FM radio station. Two yrs prior radio bdcnt tech exper preferred. Strong R.F. & audio troubleshooting skills a must.

POSITIONS WANTED

Air personality, 8 yrs exper, seeks PT fill-in on-air work in Los Angeles market. T Greene, 215-224-4651.

Small/Medium Mkt GM/station mgr avail, credible ref, prof, former owner, preferably Southeast but all offers considered.

Engineering/programming or entry sales position in SF Bay area, also interested in rep position for broadcast equipment.

Experienced newsman would like position in Texas, tape & resume upon request. Inquiries to: Radio World, POB 1214, Falls Church VA 22041. Attn: Box 89-09-01RW.

Announcing or engineering position wanted for 28 yr old. Mark, 304-525-3981.

Engineer, FT, RF, video, audio, solar, FCC genrl, SBE cert, ham, educ or com'l, Sunbelt, Chicago, manu, sales. Frank, 312-890-9246.

Newcomer wanting entry level radio, 10 mos station work in tech, traffic & mgmt, will start from bottom. D Rayner, 503 Sunnyside, Aurora IN 47001. 812-926-2013.

Engineer w/20 yrs exper in AM radio, FCC license, looking for night, week-end board shift, prefer south, mid-west or southern California. Reply to: Radio World, POB 1214, Falls Church VA 22041. ATTN: 89-10-02RW.

Wish to relocate to Charlotte NC, 13 yrs in radio, air, production, traffic, detail-oriented pro, on- or off-air position considered. Jim, 813-461-3192.

Sharp, young, aggressive audio sales pro seeks position as marketing mgr for respected, stable pro audio mfr. Bill, 415-726-4786.

Bdct vet w/15 yrs exper will soon be leaving national syndicated company, desires GM/GSM position in North Carolina or eastern area. John, 1-800-527-2514 X520.

Engineer, 20 yrs exper including AM directional, high power FM, station construction, seeks position in Northeast or Upper Midwest, but all locations considered. Reply to: Radio World, POB 1214, Falls Church VA 22041. ATTN: Box 89-10-01RW.

Innovative veteran NYC talk-radio producer seeking greener pastures in Top 12 markets: Radio/TV. J Segal, 212-966-0186.

Commercial writer & salesman w/unique approach will grab accounts for you, Orlando area, radio only. R Harvey, Apt 1126, 4200 Center Key Rd, Winter Pk FL 32792. 407-678-4591.

CE Nat'l Black Network, former CE NJ state college radio station, NARTE, NABER, FCC commercial license w/radar, PT, FT, contract work. M Rakoff, 114-41 Queens Blvd Ste 148, Forest Hills NY 11375. 718-591-3859.

Electronic comm eng w/11 yrs exper, fluent in French/German, FCC license, computer skills avail, overseas preferred, will to relocate. C Martin, POB 9781, Bowling Green KY 42103.

Quality entertainer w/33 yrs exper, marketable, specialize in Big Bands, oldies, 7-midnight or all night. J English, 2450 Pine Island, Matlacha FL 33909. 813-283-3910.

Eng/announcer, w/over 18 yrs in radio, 13 yrs as chief & PT adv salesman, seeking gd FT position, dedicated & team player, FCC, SBE, NARTE, desire SE US, East or West Coasts. E Garrett, 5857 Sheldon Ct C, College Park GA 30349. 404-766-0742/2577.

Broadcast eng w/yrs of exper as CE & consultant, excel track record of tech achievements & effective teamwork. Write: Radio World, POB 1214, Falls Church VA 22041. Attn: Box 89-11-01RW.

TV/Radio thorobred, dynamic, intelligent, creative, charismatic GM, earned mgmt from talent/sales successes, incredible motivator, team player, can & will do it all. A Stephens, 8101 S US Hwy One Ste 7C, Jupiter FL 33477. 407-743-1456.

Personality desires fun, promotionally active situation w/creative freedom, AM or FM, night or day shift, Eleven year pro, in AZ now. Call Mike, 602-721-7263.

Five plus yrs exper, reliable, dependable, hardworking seeks on air spot in South Dakota & surroundings states. B Csongradi, 605-882-3239, leave message.

Quality entertainer, 33 yrs exper, marketable, specialize in Oldies & Big Bands, 7-Midnight/all night. J English, POB 10, Matlacha FL 33904. 813-283-3910.

Experienced, 8 yr veteran in programming, on air & some engineering exper. Currently working top ten market. Dade Moore, 713-441-8193.

Announcer/Engineer, Bdctg degree, over a yrs exper at Chicago station. Would like to relocate South or Southwest US, any size market. Mike, 312-636-0119.

On-Air 5 yrs plus, PD, ND, MD, dependable, hardworking seeks on-air in SD, ND, MN, write: BC, 225 4th St SW, Watertown SD 57201.

Exper announcer w/winning attitude avail for medium or large market CHR or AC, overnights OK in Midwest or South. Patrick, 217-789-9806.

TEST EQUIPMENT

Want to Sell

Leader LSG-231 FM stereo signal & generator, brand new, \$400. D Agnew, KKNB, 5601 S 27th, Lincoln NE 68512. 402-421-2223.

3M 210 SG/CB signal/color bar generator, BO. R Rhodes, POB 1550, NUNY 10101. 212-245-5045.

RCA MI 11350 B1-11A transmission measuring set, made by Daven, precision attenuators over 100DB in 0.1 dB steps. input & output Z wide range, meter calibration changes automatically w/out put Z, requires external audio source. \$250. R Cone, FM Unlimited, 6731 N Hermitage, Chicago IL 60626. 312-743-5850.

HP AN/USM-37A microwave test set w/standing wave ind, 415B, slotted lines 806B, H810B, X810B, 809 carriage, waveguides & metal case, \$500; Narda 25223 microwave coupler directional, 1.7-4.2 GHz, \$100. J Cunningham, KHKC, Rt 2 Box 113B, Stonewall OK 74871. 405-265-4496.

TEST EQUIPMENT We Buy and Sell

All types of late model Test Equipment Hewlett-Packard, Tektronix, Wavetek, Fluke R.F. & Microwave a Specialty. G.V. BELL & ASSOCIATES. San Mateo, California 1-800-366-5240 (Inside 408/415 area) 415-366-5240 FAX 415-369-9698

Delta 01B-3, almost new in-line bridge & RG-3, \$4000. J Battison, 2684 State Rte 60, Loudonville OH 44842. 419-994-3849.

Houston Instruments DMP29 8-pen plotter, A/B size, DM/PL language compatible w/everything from 1-2-3 to AutoCad, never used, \$800. J Kreines, 5330 Kennedy, Millbrook AL 36054. 205-285-6179.

General Radio 1606A impedance bridge, excel cond w/fitting & manual, \$800/firm. F Shields, KERV, POB 2187, Kerrville TX 78028. 512-895-1230.

Harris/Gates 994-7023-001 stereo gain test set, line or mike level out, allows stereo proofs w/only one initial set-up, I, r, mono. L+R, L-R, noise, \$300/BO. S Daitch, PSC 1 Box 362, APO San Francisco 96286.

Tek FG504 function generator, 0.001 Hz to 40 MHz, amplitude or freq modulated, log or linear sweep, phase-lock mode, mint cond, BO. K Andrysiak, 1128 E Victoria, S Bend IN 46614. 219-287-3267.

Tek 1L20 spectrum analyzer, 10 MHz-4.2 Gmz; Tek 547 oscilloscope, BO. C Springer, KSEC, POB 890, Lamar CO 81052. 719-336-2206.

Delta 01B-3 & RG-3, gd cond, \$4000/BO. J Battison, 2684 State Rte 60, Loudonville OH 44842. 419-994-3849.

RCA WF48A AM freq meter, 1070 kHz, gd cond, BO; Nems Clarke 108E phase monitor, fair cond, BO; RCA WA7-44A audio oscillator, fair cond, BO; military surplus audio oscillator, fair cond, BO. J Keller, WKOK, POB 1070, Sunbury PA 17801. 717-286-5838.

Potomac Instruments AG-51, excel cond, \$1000. P Lancaster, Howard Schwartz Recd, 420 Lexington, Ste 1934, NUNY 10170. 212-687-4180.

Sencon VA-62, NT64, CV63, PR-57, all like new, \$2500. L Clinton, KARN, POB 4189, Little Rock AR 72214. 501-661-7500.

Old test equip to sell or trade, includes Heathkit oscilloscope, color bar gen, resistance sub box, condenser sub box, iso trans, grid dip, ant imp, EICO multi tracer, Senco transistor checker, genometer, Sprague telomike, EICO 950, Cornell Dubilier, Jackson TVG-2, military signal generator & more, also alot of tubes. R Scott, Box 35, Canby CA 96015. 916-233-4106 or 233-5151.

Bird 8745-677 20 kW water cooled dummy load w/3-1/8 EIA flange, \$995. G Liebisich, WPTF. 919-876-0674.

B&W 200 audio oscillator; B&W 400 distortion meter. Adolph, 915-949-2112.

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Heath scope IOW-12, gd cond w/book, \$60/BO; EICO 221 VTMV, gd cond w/book, \$25/BO. D Carver, KZBK, 107 S Main, Brookfield MO 64628. 816-258-7458.

Several pieces of equip from estate of the late T A Giles/PE. R Giles, 6189 Hwy 62, Georgetown IN 47122. 812-944-6786.

RCA WX2D 3002-D field intensity meter, \$500. Chuck, 919-623-9966.

B&K 1260 rack mount video pattern/sync gen, like new cond, \$1100/BO. B Hoover, Colorburst Comm, Box 39, Valier PA 15780. 814-938-7237.

HP 330D dist analyzer, HP 200CD audio gen, Daven T893 attenuator network, \$150/set. L Collins, Collins Assoc., POB 422, Washington NH 03280. 603-495-3983.

Sound Technology 1500A audio test system, automatically test & display on internal CRT, freq resp, 2nd/3rd HD, flutter, speed, separation, noise, more, vgc, includes operating & maintenance manuals, \$2690. D Martin, House of Music, 3100 Airway Ave, Costa Mesa CA 92626. 714-641-8000.

Key Marka-Sweep 154C, clean, but needs some work, less markers, \$80. J Cunningham, KEOR, Rt 2 Box 113B, Stonewall OK 74871. 405-265-4496.

Potomac FIM-41 field strength meter, less than 1 yr old, perfect cond, proof of calibration, \$2200. M Cooney, Dakota Bdct, POB 97, Brookings SD 57006. 605-692-1430.

Telemation TSG 3000 gdct sync gen, excel cond w/manual, BO; Telemation TMT 102, 101, 103, w/manuals, BO; Leader LCG 388 color bar gen, new, \$100. William, Lectrotech, 5810 N Western, Chicago IL 60659. 312-769-6262.

Johnson Electronics STS-11 synthesized signal test set w/power pak. D Leinen, Independent Resources, POB 23498, Oklahoma City OK 73123. 405-721-1187.

Want to Buy

B&W H10 dist meter and/or Gates gain set, will pay up to \$150 for ea in gd clean operating cond. J Alexander, 1511 N Jackson, Russellville AR 72801. 501-968-7270.

Need to find the whereabouts of Manke Instruments Co, originally in Fresno CA, made M-1 wow & flutter meter. E Davison, Multiplex Broadcast Station, 135 N Illinois, Springfield IL 62702. 217-787-0800.

Simpson 37B battery tester, will buy or swap Simpson 377/DC meter. J Roper, Imperial Snd, RR 31 Box 405, Terre Haute IN 47803. 812-877-2663.

TRANSMITTERS

Want to Sell

30 W digital FM exciter, field selectable, 1/2 price. J Phillips, WZOM, 408-112 Clinton, Defiance OH 43512. 419-784-1059.

McMartin BF25K-FM, 1978 25 kW w/Harris MS 15 exciter, complete spare HV PS & parts from stripped 2nd unit, in service, avail Sept-Oct, \$32,000. D Solinske, WWRM, POB 22000, St Petersburg FL 33702. 813-576-1073.

Trade RCA 20 kW for Harris or Collins 1-10 kW xmtr. J Mauk, KMJ, POB 70002, Fresno CA 93744. 209-266-5800.

Home built carrier current AM 25 W carrier current tube type, set to your freq, complete w/instructions, \$400. J Cunningham, KHKC, Rt 2 Box 113B, Stonewall OK 74871.

30kW UHF-TV RCA TTU-30C Tunes Channel 30-51 Just off the air! ARMSTRONG TRANSMITTERS 5046 Smoral Road (315) 488-1269 Syracuse, NY FAX (315) 488-1365

Gates 250-GY 250 W AM on 740 kHz, working order, needs to be retubed & cleaned, \$500/BO pls shpg; Collins 20V2 1 kW AM for parts only, BO. D Kelley, KISZ, POB 740, Cortez CO 81321. 303-565-1212.

RCA 50 kW AM (2), spare tubes & parts. O Borgen, WMIN, POB 25130, St Paul MN 55125. 612-739-4433.

Gates BC-10H 10 kW/5 kW AM in excel cond, \$15,000. Jim or Richard, 801-637-0863 or 1752 or 3028.

AUDIO broadcast group inc. 1-800-999-9281 TAPE CARTRIDGES. PLAYING TIME vs AUDIOPAK vs SCOTCH CARTR. Table with prices for various playing times.

Thomson-LGT EVHF-10S LPTV, 10 W, high band VHF, near new, Ch 9. \$4500/BO. L Baley, LPTV, 3317 Barrow Hill Tr, Tallahassee FL 32312. 904-893-1382.

Harris 3.5K, mint cond, \$23,000. R Wachte, KNSX, 3418 Douglas, Florissant MO 63034. 314-921-2121.

Up To \$500 REWARD For information leading to the purchase of used AM/FM Transmitters. ARMSTRONG TRANSMITTERS 5046 Smoral Road (315) 488-1269 Syracuse, NY FAX (315) 488-1365

CSI 3 kW FM, 93.5 MHz, 600', 1-5/8" foam filled coax, isocoupler, 3 bay antenna, Gates 1 kW AM xmtr for parts. K Holcombe, WIJK, POB 350, Evergreen AL 36401. 205-578-2780.

RCA BTE 15A FM exciter w/stereo generator & SCA generator. M Young, WJON, POB 220, St Cloud MN 56302. 612-251-4422.

Gates BC-1F 1 kW AM, excel cond, \$2000. J Kramden, WBRL, 3342 Perry Rd, Marselis NY 13215. 315-673-9049.

Jones-Teppo J-317 FM translator, 10 W, \$1400; antennas also available. D Silver, KNKK, Layton Hills Mall, Layton UT 84041. 801-973-7759.

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RCA BTE-10C/BTS-1A exciter, stereo gen, metering panel & CBS stereo Volumax in 4' rack w/spares, complete 10 W xmtr, will sell separately, \$700 pls shpg. T O'Laughlin, O's Own Labs, Rt 1 Box 41, Barneveld WI 53507. 608-924-2001.

McMartin BF25K 27.5 kW grounded grid, no PCBs, spare HVPS, circuit boards, transformers, in service, \$30,000. D Solinske, WWRM, POB 22000, St Petersburg FL 33702. 813-576-1073.

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EMPLOYMENT SECTION

HELP WANTED: Any company or station can run "Help Wanted" ads at the flat rate of \$25 per listing per month (25 words max). Payment must accompany insert; there will be no invoicing.

POSITIONS WANTED: Any individual can run a "Position Wanted" ad, FREE of charge (25 words max), and it will appear in the following 3 issues of Radio World. Contact information will be provided, but if a box number is required, there is a \$2 fee which must be paid with the listing (there will be no invoicing).

Mail To: BROADCAST EQUIPMENT EXCHANGE, PO Box 1214, Falls Church, VA 22041



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Crystal for 640kHz for Gates 1-T xmt. M Rice, WBOW, 1301 Ohio, Terre Haute IN 47807. 314-947-0600.

AM xmt. w/2-2.5Kw, prefer single stage power needs; also a used 3K FM. Write WRDN Box 208 Durand WI 54736. 715-672-8989.

Parts for RCA TT10AH/TT25BH as well as 5762 & 6166A tubes. J Paciorowski, The Imes Group, 603-641-9060.

FM 1 kW, exciter for EDFM, gd cond, inexpensive or will help w/appraisal for taxes. J Goggan, MO River Christian Bdct, POB 87, Washington MO 63090. 314-239-0400.

Crystal, 640 kHz for Gates 1T AM xmt. M Rice, WBOW, 1301 Ohio, Terre Haute IN 47807. 314-947-0600.

Harris plate transformer for MW 5A, new, in crate, \$1000/BO. J Long, 4452 Koblan Ct, Hixson TN 37343. 615-877-9000.

RCA BTA-5L 15 yrs old, 5 kW AM, great shape, \$15,000; Collins 21E 5 kW AM, great shape but needs new HV transformers for pwr reduction, \$5,000; Gates FM250B, works great, fully removable, \$1200. S King, KIXZ, 1705 Avondale, Amarillo TX 79106. 806-355-9777.

ITA FM-250B w/RCA exciter, all working when removed, \$1000. D Parsons, KLUH, POB 1313, Poplar Bluff MO 83901. 314-686-1663.

Bird Termaline 8732 coaxial resistor, water cooled dummy load, 10 kW 50 ohms, \$400. C Benner, WUSL, 440 Domino, Phila PA 19128. 215-483-8900.

Gates FM-10G w/Wilkinson FME-10 exciter at 102.7. M Ripley, KOZE, Box 936, Lewiston ID 83501. 208-743-2502.

Collins 830D 1 kW FM, original exciter, 1960's vintage. B Umberger, WNLT, 51 S Main, Clearwater FL 34625. 813-446-0957.

Collins 21-E 5 kW AM's (4), Gates BC-5E (3), RCA BTA-5T (1) Choice \$8700. 1 kW AM's, Gates BC-1G (2), Gates BC-1F (3), Gates BC-1J (2), Collins 20V3 (2), McMartin BA-1K (2), \$2000-\$5500. Jerry Kautz, Armstrong Transmitter. 315-488-1269.

GE BT 22-A all gd tubes & manual, as is, \$5000 pls shpg. S Weber, KGRV, POB 1598, Winston OR 97496. 503-679-8185.

QEI 695T 3.5 kW, avail after 1/90, includes QEI 695 exciter & spare parts kit, \$18,000. K Austin, KFXI, POB 392, Marlow OK 73055. 405-658-9292.

Lea SE-1201/240-60-2 xmt. line voltage surge protector for xmt. or studio unit, new, \$1400. K Austin, KFXI, POB 392, Marlow OK 73055. 405-658-9292.

Harris FM-5 H3 5 kW FM tuned to 98.1 MHz w/TE-3 exciter & documentation, avail immed, \$14,000. F Giardina, Dittman Group, 2146 Highland, Birmingham AL 35205. 205-933-9274.

Home brew 50 W AM, will set to your freq, \$500. J Cunningham, KEOR, Rt 2 Box 113B, Stonewall OK 74871. 405-265-4496.

Want to Buy

Any 10,000-20,000 W, fixable w/manuals, any age, w/filters & tunable to 101.5 MHz. M McVey, 620 Lake Rd, Ottumwa IA 52501. 515-682-0498.

Dummy load for 20,000 W FM xmt. used in gd cond. Kurt, KTRZ, Box 808, Riverton WY 82501. 307-856-2922.

TTC XL10FM 10 W FM translator. J Mache, KRBS, POB 5180, Roseburg OR 97470. 503-672-6641.

Low band (2-6) VHF TV, 100 W to 11 kW; RCA TTU-1B or TTU-2A UHF TV for parts. J Powley, 1536 Logan, Altoona PA 16602. 814-944-8571.

UHF & VHF TV translators, 10 to 100 W, will consider old UHF band (70-83) equip. J Powley, 1536 Logan, Altoona PA 16602. 814-944-8571.

Any 1kW amp, xmt, translator for channel 61. S Kappa, 402-476-6115, Fax: 402-476-6000.

Late model FM 1000 W stereo w/exciter or without, late model exciter. LJ Maierhofer, WTGC, 101 Armory, Lewisburg PA 17837. 717-523-3271.

Amp, 300W-1kW for FM aux, need type-accepted, working cond, fairly cheap. K Browall, KTRZ, Box 808, Riverton WY 82501. 307-856-2922.

Used TV xmtrs, antennas & rigid line, one watt to 60 kW. Fair market price paid. Turn-key handling. Call Broadcasting Systems, Kenneth Casey, 602-582-6550.

TUBES

Want to Sell

Tek CRT's for 52B, 52BA, & 1420 video monitors. A Weiner, Britton Rd, Monticello ME 04760. 207-538-9538.

EIMAC 8170/4CX5000A, new, unused, \$925. A Emerald, KGGGA, 8956 Swallow, Fountain Valley CA 92708. 714-962-5940.

3CX1500A7, 4CX5000A, 6146B, 4CX2508, 4CX3000A & more. We carry large inventory all major brands, Eimac, Amperex, RCA, etc. Call Stew 1-800-842-1489.

TRANSMITTERS ... WTB
Collins 21E 5 kW AM, gd workd cond, original owner, \$5000. C Webster, WGVM, 1383 Pickett, Greenville MS 38701. 601-334-4559.

Nautek AMPFET 10 AM solid state, 1510 kHz, 2.5 yrs old, excel cond, includes spares, etc, towers, ATU's, (4) tower phasor, will negotiate. B Williamson, WALL, One Bdct Pl, Middletown NY 10940. 914-343-7400.

FM TRANSMITTERS

10 kW
1970 CCA 10000D
12 kW
1979 CSI 12000E
20 kW
1976 Collins 831-G2B
PMA Marketing
414-482-2638

McMartin BF25K-FM, 1979 27.5 kW w/low pwr cut back, grounded grid, spare HVPS & boards, panels, iron from stripped second unit, \$30,000. D Solinske, WWRM, POB 22000, ST Petersburg FL 33742. 813-576-1073.

INR Tech Mdl 1000 drive-buy radio transmitter, synthesized FM xmt. to advertising message, uses standard endless cassette tape for message, new in box, \$425/BO. M Peterson, 3610 Lancaster Ste 6, Plymouth MN 55441. 612-544-6391.

Johnson Viking I 100 W shortwave xmt. vfo ham bands 80-10m, AM, \$75. J Feasel, 13549 Morse, Pataskala OH 43062.

RCA BTF 20E1, to trade for Harris or Collins 1-10 kW FM xmt. J Mauk, KMJ, POB 70002, Fresno CA 93744. 209-266-5800.

Harris MW1, 500 W D 1520 Hz, like new, BO. HS Killgore, KMPG, POB 1507, Hollister CA 95023. 408-637-7476.

RCA 250M excel cond, less than 500 hrs, full power, clean, you pick up, BO. LJ Maierhofer, WTGC, 101 Armory, Lewisburg PA 17837. 717-523-3271.

WANT TO BUY

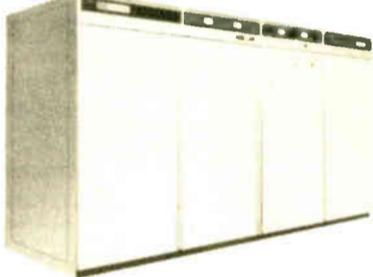
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TUBES . . . WTS

ELECTRON TUBES

Partial List: 6623, 23791, TH150, 6425F, 5604, 6696, 6697, 5681, 5682, 5671, 7804, 3CX10, 000H3, 3CX20, 000H3, 4CS5000A, 4CX35, 000C

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Want to Buy

RCA 6181, used as final in RCA TTU-1B UHF TV xmitr. J Powley, 1536 Logan, Altoona PA 16602. 814-944-8571.

REBUILT ELECTRON TUBES

Partial List: 6623, 23791, TH150, 6425F, 5604, 6696, 6697, 5681, 5682, 5671, 7804, 3CX10, 000H3, 3CX20, 000H3, 4CS5000A, 4CX35, 000C

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TV FILM EQUIP

Want to Sell

Buhl Multiplexer 573-200-(190) film chain w/4" lens, (2) Kodak 650-H projectors, manuals, top cond, video, film, slide dup & transfer, \$500. B Bridges, KCAM-TV, 827 Meridian, Nashville TN 37207. 615-226-1122.

Want to Buy

Kodak VPI or VPX super 8mm video player. H Ellenbogen, Ellenbogen Eng & Video, RD 5 Box 27, Kingston NY 12401. 914-331-5849.

RCA TK-26 film camera. A Weiner, Britton Rd, Monticello ME 04760. 207-538-9538.

VIDEO PROD EQUIP

Want to Sell

Panasonic AU-A30 edit controller, new, \$650. B Bridges, KCAM-TV, 827 Meridian, Nashville TN 37207. 615-226-1122.

Telemet 350B video test signal gen, w/access, \$250; Computer Image Corp 3-bus program & prod video switcher, EFX, joystick, 2 faders, variable border, chroma-key, \$2000; (2) RCA proc amps/DA card frames, modules, pwr supply, \$50/log; Conrac 7" mono monitor, HP7803A scope, 19" Conrac dual rack frame, \$150/lot; Telechrome video/audio modulator, chnl 4 module incl, vgc, \$1000. E Stolz, KWOD, 1425 River Park, Sacramento CA 95815. 916-929-5000.

Illusion digital EFX, all upgrades thru 1988, bubble, perspex, rotation, exceptional unit w/striking effects, like new, \$22,000. B Bridges, KCAM, 827 Meridian, Nashville TN 37207. 615-226-1122.

Sigma CSG-350A video master sync generator, new, \$925. B Bridges, KCAM-TV, 827 Meridian, Nashville TN 37207. 615-226-1122.

Tekskil 909 teleprompter, complete & portable, excel cond, \$2800. B Bridges, KCAM, 827 Meridian, Nashville TN 37207. 615-226-1122.

Panasonic AU-B110 AC adaptor, new in box, \$125. B Bridges, KCAM-TV, 827 Meridian, Nashville TN 37207. 615-226-1122.

Sony RM-580 remote control unit for VTR, never used, \$525. B Bridges, KCAM, 827 Meridian, Nashville TN 37207. 615-226-1122.

Sony CVM-1900 profess monitor/rcvrs, low hrs, excel cond (2), \$700 ea. B Bridges, KCAM-TV, 827 Meridian, Nashville TN 37207. 615-226-1122.

Audio Kinetics Pacer chase synchronizer w/remote pacer pad & interconnect cables to Tascam Series audio recorders, sync-locks multi-track ATR to any make VTR, new cond, \$1500. B Dombrowski, Whirlwind Prod, 10356 W Warren, Dearborn MI 48126. 313-584-4038.

Sony SLO-260 R/P, new components to SLO-383 edit pac (2), \$600 ea. B Bridges, KCAM-TV, 827 Meridian, Nashville TN 37207. 615-226-1122.

Sony SLO-383 edit recorder, new cond (2), industrial Beta, \$1200 ea. B Bridges, KCAM-TV, 827 Meridian, Nashville TN 37207. 615-226-1122.

JVC CR4400U (4) 3/4" portapacks w/access, \$800/BO; (3) JVC BR6400U VHS source edit deck, \$1400/BO; Kodak 16mm telecine projector; RCA 16mm telecine projector, editing system w/Sony RM 400, VP 2260, VP 2860, \$2000/BO; 3M image enhancer; Panasonic NV 9300 recorder; Sony 2610 recorder. T Quinn, Monte Vista Sids, 208 Cherry, Capitola CA 95010. 408-475-0423.

Trompeter original gold J13-75 patch jacks, PN-2BE-75 (2M, 1F) paralleling, PNS-3/625 & PNS-4/625, TPC-9-75. O Berliner, SoundDesign, Box 921, Beverly Hills CA 90213. 213-276-2726.

JVC 3/4" edit system, CP 5500 player, CR 8200 recorder w/convergence controller ESC 90, includes all cables, breakout box, new head, excel cond, \$4200. Vanessa Gerwels, Peregrine Prod, 317 Weisgerber Bldg, Lewiston ID 83501. 208-743-8618.

RCA & Panasonic M-formal prod/post prod system, complete w/Hawkeye camcorder, AV220 portable, (2) edit decks w/built in TBC, controller, etc, \$7500. A Romanoff, First Light Video, 374 N Ridgewood, Los Angeles CA 90004. 213-467-1700.

Vidifont Mark IV CG w/2 disk drives, font compose, address keyboards, etc, \$1000/BO. D Boggs, Anderson Univ, 1100 E 5th St, Anderson IN 46012. 317-641-4344.

Panasonic NVA-950 edit controller for 3/4" VCR's, \$50; Froehlich 190-300 video stereo control center, \$90; Sony VCR-4 telecine adapter, high resolution unipler, gd cond, \$80. W Waitrous, Waitrous Video Prod, 739 S Orange, Sarasota FL 34236. 813-366-3316.

JVC LP-101 digital audio processor, new \$2000/BO; Microgen M-150 character gen, like new, \$1800/BO; Sony FCG-7000 frame code gen, new, \$1800/BO; liquidating video studio, everything goes. R Lawrence, Moonshadow Video, 4280 Reston Rd, Roseburg OR 97470. 503-679-8966.

Want to Buy

Sony RM-400 edit controller w/cables in fair-gd cond. P Badger, Box 104, Birdsnest VA 23307. 804-442-4037.

Unimedia SMT-9 (2) to convert to cross/pulse operation, need old or junked 065-0102A cross/pulse board, schematic/POC layout, source number for Unimedia-labelled chips. P Combs, Only Son Prod, 2316 Forest Home Ave, Dayton OH 45404. 513-236-2340.

Fostex 4030/4035/4050 SMPTE synchronizer & controller. M Sokol, JMS Prod, 121 E Baltimore, Hagerstown MD 21740. 301-791-2568.

VIDEO TAPE RECORDERS

Want to Sell

JVC CR4400U 3/4 port recorders (4) w/access, \$800 ea/BO; (3) Sony RM-430 edit controllers, \$500/BO; JVC BR-6400U VHS recorder, \$1500/BO. T Quinn, Monte Vista Sids, 208 Cherry, Capitola CA 95010. 408-475-0423.

Sony VO-6800 portable 3/4" U-matic VTR, AC-PS, 8-NP1's w/charger, Kangaroo case/strap incl, \$2950. S Christian, Master-piece Video Prod, 715 Cornwall, Silver Spring MD 20901. 301-439-5731.

Sony/Ampex 1", vgc, \$24,000; Sony VO-2600 U-matic VTRs, gd cond, \$350; blank 3/4" Betacam tape, \$4 ea. Ugly George, 212-677-2200, M-F, 9AM-5PM, Fax: 212-941-0956, M-F, 9-5.

RCA MI-4069B RCP for RCA TR-50 VTR, \$25. B Humpherys, UMC 8500, Logan UT 84322. 801-750-3133.

Panasonic AU-300 1/2", M-formal bdcvt VTR/edit, excel cond, \$2500. Brenda Bridges, KCAM-TV, 827 Meridian St, Nashville TN 37207. 615-226-1122.

Panasonic AU-100 broadcast 1/2" M-formal portable VTR, dockable to AK-100 camera, excel cond, \$1200. B Bridges, KCAM-TV, 827 Meridian, Nashville TN 37207. 615-226-1122.

Misc 3/4" decks for sale/trade for other A/V equip. Write/call w/want list & list of what you have to trade; Also need stereo cart machines, Ampex 350 R/P solid state electr & more. N Mishan, POB 335, Lynbrook NY 11563. 516-582-1338.

Ampex VPR-2B 1" studio editing VTR's (3) w/slo-mo & spec effects, (2) TBC's, excel cond, \$21,000 ea or \$50,000 for all. Ugly George, 212-677-2200, M-F, 9-5; Fax 212-941-0956, M-F, 9-5.

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JVC, Sony, Panasonic, (8) players, all need some repair or use as parts, \$50 ea. K Taylor, Image Support, 103 N Aspen, Sterling VA 22170. 301-864-4841.

JVC CR6600U 3/4" recorder, low hrs, nice shape, \$1250. J Kreines, DeMott/Kreines Films, 5330 Kennedy, Millbrook AL 36054. 205-285-6179.

Panasonic AG7400 S-VHS portable, AC adapter/charger, battery, case, excel cond, \$1950. D Brennan, Brennan Custom Video, 3596 Lorna Ridge, Birmingham AL 35216. 205-823-0088.

Panasonic AG-1950 low cost VHS editor, jog/shuttle control, remote control, perfect cond, less than 30 hrs, \$750. R Larson, Larson Prod, 3 Braden, Presque Isle ME 04769. 207-764-3770.

Sony VO-4800 3/4" portable, w/4 batteries, dual charger, AC/DC supply charger, \$1650 complete; Panasonic AG-6400 1/2" VHS hi-fi stereo portable deck, whole system w/hard shell carry case, \$1650. R Lawrence, Moonshadow Video, 4280 Reston Rd, Roseburg OR 97470. 503-679-8966.



YEAR END CLOSE-OUT
TECHNICS SL-1200 MK II
ONLY \$375⁰⁰



Sony VO-1600, clean but needs repairs, \$50 you ship. J Cunningham, KEOR, Rt 2 Box 113B, Stonewall OK 74871. 405-265-4496.

Want to Buy

Ampex VR-3000 portable quad VTR. A Weiner, Britton Rd, Monticello ME 04760. 207-538-9538.

RCA TR-3, TR-5 quad machines. A Weiner, Britton Rd, Monticello ME 04760. 207-538-9538.

Panasonic 6200 Series 6210 or equivalent model VHS hi-fi recorder in excel or vg working cond. L Fields, 3259 N Sheffield, Chicago IL 60657. 312-935-3635.

Ampex VR-2000. A Weiner, Britton Rd, Monticello ME 04760. 207-538-9538.

ACTION-GRAM

Equipment Listings

Radio World's Broadcast Equipment Exchange provides a FREE listing service for all broadcast and pro-sound end users. Simply send your listings to us, following the example below. Please indicate in which category you would like your listing to appear. Mail your listings to the address below. Thank you.

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 C. Educational FM station I. Mfg, distributor or dealer
 E. Network/group owner J. Other _____

II. Job Function

A. Ownership D. Programming/production
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 C. Engineering F. Other _____

WTS: WTB: Category: _____

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Brief Description: _____

Price: _____

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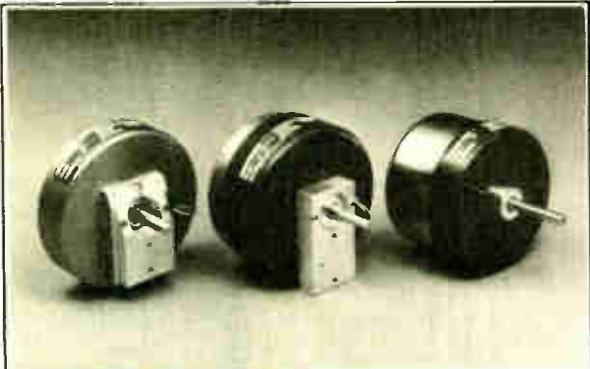
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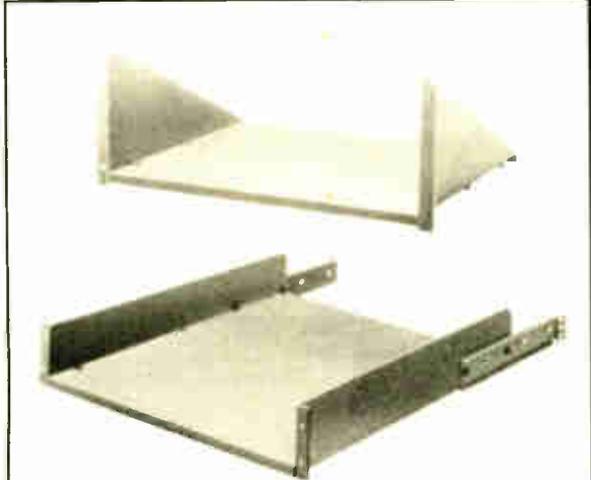
Capstan drive motors

Shown above are three capstan drive motors manufactured by the Beau Motors division of Manger Engineering.

Beau is the original manufacturer of many of the capstan drive motors currently used in tape and cartridge machines.

Beau can repair or replace most capstan drive motors, both foreign and domestic.

For information, call Paul Manger at the Beau Motors Division of Manger Engineering: 203-288-9351, or circle Reader Service 3.



Rack mount shelves

Two new types of rack mounted shelves by the Winsted Corporation—Universal Rack Shelves and the Extra Deep/Heavy Duty Shelf—are designed to fit all 19" EIA racks, and are available in four models.

For information, call Greg Hedlund at Winsted: 612-944-8556, or circle Reader Service 81.



Portable DAT

The Panasonic SV-255 portable DAT recorder features newly-designed mic preamps offering low distortion, high stability and 128 dB (EIN) signal-to-noise ratio.

Another new feature is the dual-channel mono recording mode. In this mode, the right channel input is recorded at full level on the right channel and 15 dB lower on the left channel.

For information, call Colleen McKenna for Panasonic: 213-471-6170, or circle Reader Service 17.



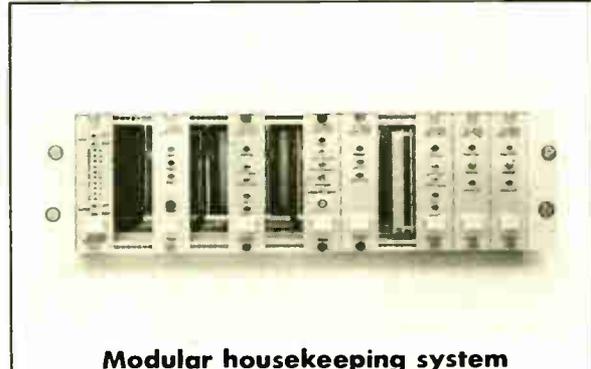
Digital recorder

Alpha Audio's new DR-2 digital hard disk recorder can record up to 60 minutes of 16-bit stereo audio with time code at 44.1 kHz or 48 kHz sample rates.

It connects directly to audio and video editing systems via dual RS-422 serial ports.

Options include 30 and 60 minute versions. Additional options soon to be available include digital I/O and remote for standalone use.

For information, call Spence Burton at Alpha Audio: 804-358-3852, or circle Reader Service 95.



Modular housekeeping system

The Model 8000 Modular System from J.N.S. Electronics, also known as The Frame, consists of 16 modules: stereo/mono DA, mic-to-line amp, audio monitor amp, audio EQ, stereo synthesizer, stereo audio limiter, stereo-mono-stereo switch, audio failure detector, program changeover, stereo audio switcher, AM RF detector, stereo validity generator and detector, program circuit loss alarm, audio test oscillator and video DA.

For information, call John E. Leonard at J.N.S.: 408-729-3838, or circle Reader Service 41.



Studio metering

ATI's new Micro-Meter Studio Monitoring System allows visual monitoring of many audio lines simultaneously with expandable ATI micro-meters that display one, two, three or four stereo signal pairs (up to eight channels) on high resolution, three color, 16 segment LED bar graphs with simultaneous VU and PPM peak display.

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For information, call Ed Mullin at ATI: 215-443-0330, or circle Reader Service 82.

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Radio World

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| C. Educational FM station | I. Mfg, distributor or dealer |
| E. Network/group owner | J. Other _____ |

II. Job Function

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Advertising Sales Representatives:

East & Midwest, Art Constantine: 800-336-3045 Fax: 703-998-2966
West Coast, Pat Macsata: 415-786-2198 Fax: 415-786-2754

RADIO PRODUCTION 1990.

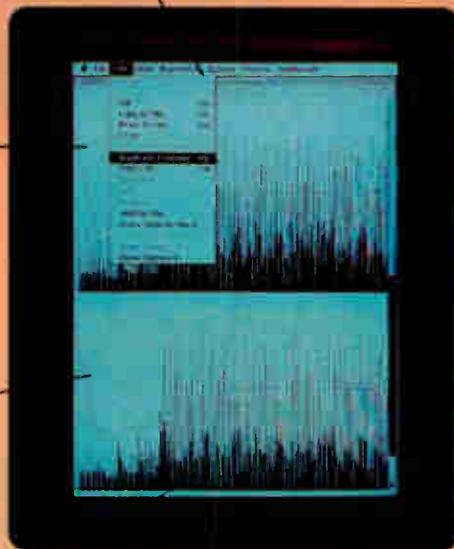
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A SUCCESS STORY

THE OBJECTIVE was no small task: design a radio console that would become the new standard.

THE METHOD involved listening to veteran broadcast engineers and installers. After all, they're the people who have seen and experienced all the ideas that came before. From this research we learned of the problems that had to be solved and the features that broadcasters required. We then added ten years of console building experience and innovation, and created the A-500α console.

THE RESULT: An unsurpassed console that exceeds prior broadcast standards. Its module/mainframe interface borrows from the computer industry, utilizing all-gold contact insulation displacement technology. The logic system is based on programming the module slot, allowing full module interchangeability. It also provides for separate programming of the module's "B" input selection, thus avoiding embarrassing false starts and mutes. Full console-to-machine control is supported without extensive use of interface boxes and cables. Three audio busses are provided to enhance talkshows and remote functions. There are separate processing loops for the speech and music paths, as well as individual channel insert points. A complete line of microphone and line inputs, remote selectors, and machine control modules is offered in virtually any combination, configuration or mainframe size you desire. The A-500α also features a full family of studio turret and turret components to ease facility design.

THE PERFORMANCE: Needless to say, it's a new age for audio, and the A-500α is a step ahead. While specifications don't say it all, ruler flat frequency response, .003% distortion, crisp square wave response and a noise spec that's unheard of deserve merit. Couple such performance, reliability and innovation together, and a new broadcast standard is set.

THE SUCCESS: WHEATSTONE broadcast consoles are installed in major markets all over the country, from frontline independents to national networks. They are in use right now at some of the world's largest institutions.

THE POSSIBILITIES: The possibilities are up to you.

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