

## Denon To Make NRSC Radio

by Judith Gross

**New Orleans LA** By the time AM broadcasters are required to comply with a mandatory NRSC standard, at least one manufacturer will have NRSC radios in the market.

Denon America Inc. announced during a session on AM Engineering at the Radio '89 show here that by March of 1990, all of its AM receivers will be designed to the NRSC standard.

By 30 June, 1990, the FCC has said that all AM stations must comply with the NRSC-2 transmission standard. Stations using NRSC-1 processing, however, will have a four year grace period to comply with the standard under a "presumptive" provision.

The announcement by Denon, however, is seen as encouragement for all stations to implement the processing, since the deemphasis in the NRSC receiver design complements the preemphasis

curve of NRSC-1 processing.

The announcement was made by Robert Heiblim, executive VP for Denon America, who said the company was "already selling" some NRSC receivers and expected to have several models in stores in time for the holiday shopping season.

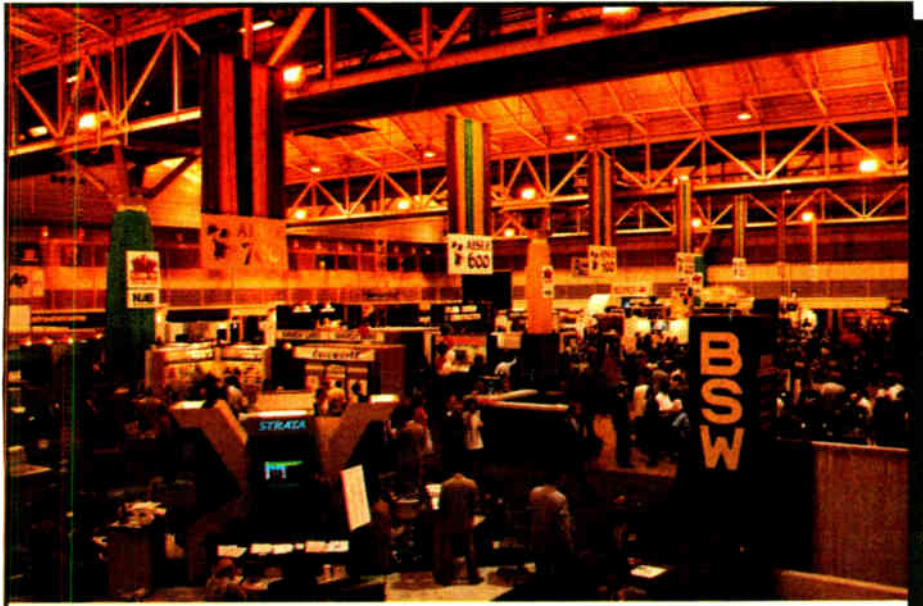
### Arm twisting

Heiblim said that the announcement by Denon, which is the first receiver company to commit to the standard with

a specific timetable, amounts to "twisting the arms of our fellow competitors" to do likewise and produce higher quality radios for AM.

Heiblim also said the company plans "aggressive marketing" to generate consumer interest in the new radios and that the development of a certification mark for new radios will help.

"Once we get a certification mark, we'll really go to town, spending money for  
(continued on page 17)



A record crowd attended Radio '89. See our post-show report, beginning on p. 17

## Lower RF for Seattle?

by John Gatski

**Seattle WA** The mayor of Seattle has recommended a less stringent RF radiation standard ordinance for the city, rebuffing an earlier Office of Long Range Planning staff recommendation, according to city officials.

City Senior Environmental Planner Cliff Marks said Mayor Charles Royer recommended a 200  $\mu\text{W}/\text{cm}^2$  RF exposure limit for frequencies that include FM, instead of the more restrictive Office of Long Range Planning Staff recommendation of 100  $\mu\text{W}/\text{cm}^2$  RF limit.

The mayor's proposal also is more acceptable to Seattle FMs than the staff recommendation, which was proposed

earlier this year, according to several station engineers.

Station engineers worried that a low standard, such as 100  $\mu\text{W}/\text{cm}^2$  could create a financial hardship if antenna changes are necessary to meet the standard.

Marks said the mayor decided to recommend the less restrictive measure because it would be in line with the National Council on Radiation Protection (NCRP) standard of 200  $\mu\text{W}/\text{cm}^2$ .

### Similar to ANSI

The mayor's recommendation also is similar to the proposed revision of the American National Standards Institute  
(continued on page 12)

## Justice Dept. Probes Power Tube Industry

by Alan Carter

**Washington DC** The US Justice Department is investigating possible antitrust violations in the power grid tube industry with a focus on Richardson Electronics and Varian Associates, a Justice investigator confirmed.

An ongoing grand jury is collecting evidence, said Terry Lubeck, a chief in the Justice antitrust division based in Washington, DC. The grand jury is meeting in Chicago.

Lubeck said he could neither discuss the case further nor indicate when an announcement would be forthcoming from the grand jury.

### Companies respond

At Richardson Electronics, President and CEO Edward Richardson said the company had to submit documents to the grand jury by 12 September in response to a subpoena. In June, Richardson Electronics provided information

relating to the manufacture and distribution of power grid tubes and the company's acquisitions and agreements relating to these products, Edward Richardson said.

According to information the Justice Department gave Richardson, the investigation focuses on sections of the Clayton and Sherman acts looking at "horizontal acquisitions and agreements in restraint of trade in the production and sale of power grid tubes."

Specifically, the Justice Department also sought information relating to the agreement between Richardson and Varian Associates to form VASCO. Richardson Electronics has an aftermarket replacement marketing agreement with Varian Associates.

### Employees subpoenaed

Varian said a number of its employees were called to testify before the grand jury, but the company declined to identify them.  
(continued on page 10)

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## NEWS BRIEFS

### NTIA Will Study Radio Frequency Use

**Washington DC** The National Telecommunications and Information Administration (NTIA) will conduct a study on the use and management of radio frequencies in the US to encourage effective use of the spectrum.

The study, according to Assistant Secretary of Commerce for Communications and Information Janice Obuchowski, was prompted by sweeping changes in spectrum-related technology.

"The changes require the development and fostering of policies that will encourage the most effective, efficient and fair use of spectrum," she said.

The study is NTIA's first re-examination of spectrum policy objectives and issues since the agency was organized in 1978.

### WGMS-AM Move Opposed

**Germantown MD** WGMS-AM is facing citizen opposition as it seeks local government permission to construct a new

antenna farm here, after selling its old site for a profit.

But it appears WGMS will not be stopped easily. The station is before a board of zoning appeal after opposition questioned the station's request for a special exception permit to build four antennas. Testimony on the move was scheduled before the board this month.

### US Radio Broadcast in USSR

**Washington DC** Soviet citizens soon may be tuning in to National Public Radio and other American radio programs as a result of what is called a historic "Memorandum of Understanding" signed here in August.

The agreement between the USSR State Committee of Television and Radio Broadcasting (GOSTELRADIO) and the US nonprofit Public Service Satellite Consortium (PSSC) makes programs from each country available to radio stations of both using satellite communications.

The action will establish for the first time the exchange of programs from varied sources on a regularly scheduled basis. The program exchange will become operational in early 1990.

Exchanges between Radio Moscow and domestic US stations were instituted as far back as 1958, with occasional satellite exchanges recently.

### NAB Offers Five-Day Engineering Management Course

**Washington DC** The NAB will offer the 25th annual Management Development Seminars for Broadcast Engineers 4 to 9 February, 1990 at the University of Notre Dame in South Bend IN.

The course intends to develop and sharpen the managerial skills of broadcast engineers, NAB said.

"Participants will learn the proven concepts, methods and techniques of getting results through the efforts of others," NAB noted.

Richard Cupka, president of Cupka Corp, West Lafayette, IN, will conduct the seminars. The fee is \$1350 for NAB members and \$1650 for non-members.

For information contact NAB Science and Technology at 202-429-5346.

### Jingles to Accompany NAB/RAB Campaign

**New York NY** The Radio Futures Committee, the creative force behind last spring's "Radio: What Would Life Be without It" campaign, has hired TM Communications to create musical jingles for the campaign that will be compatible with various radio formats.

TM, based in Dallas, is a music and radio production company.

The jingle, originally recorded by Richie Havens, will be made compatible with AOR, EZ listening, country, CHR and Spanish formats.

"We believe these new jingles will give our industry's campaign added legs to power it through the end of the year," said Jerry Lyman, co-chairman of the Radio Futures Committee.

## We Re-invented the Wheel AND IT'S SQUARE!

Naturally, with all of Wheatstone's experience at building and interfacing consoles, it was inevitable that we would take on the design and manufacture of suitable furniture for our audio installations. First we listened to engineers and their requests, then we went to work. The result is a significant improvement over previous designs.

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# FCC Reviews Indecency Filings

by Charles Taylor

**Washington DC** The Rev. Robert Brunk wasn't pleased with the banter he heard one morning over KLSS-AM/FM in Mason City, IA.

A sexual joke about the late Liberace pushed the limits of what is appropriate over the nation's airwaves, he insisted.

Brunk called for action against the station and questioned the FCC's judgment: "I do not know why Congress continues to fund you and we have to continue to pay your salaries if you will not enforce our laws aggressively," he wrote.

## Block renewal of station

Likewise, Miami attorney John Thompson challenged the renewal of WIOD-AM there, based on the antics of morning jock Neil Rogers, who not only played what Thompson said were obscene songs over the air, but made copies available to listeners.

These complaints, like 100 or so counterparts sent in letter form within the past two years to the FCC, claim that much of what is broadcast over the air rings of indecency.

The Commission's new administration under the leadership of Chairman Al Sikes last month took a stand on the issue when it sent letters of inquiry to

three stations—WLUP-AM in Chicago, KSJO-FM in San Jose, CA, and WFBQ-FM in Indianapolis—alleging indecent programming.

**"We can't act as a censor, but we are charged to follow the law. . ."**

Potential action against the three stations depends in part on the content of responses from them, due by the end of October, according to the FCC.

## Overstepped the boundaries

The fate of those remaining 102 complaints, filed in boxes in the office of a Commission enforcement official, depends in large part on a number of factors the Commission uses to judge when programming has overstepped the boundaries of acceptable taste.

"This is obviously a sensitive issue for the Commission," said the FCC enforcement official, who asked not to be named. "We can't act as a censor, but we are charged to follow the law and its guidelines for obscenity and indecency."

At least 65 of the 102 complaints must be dismissed because they are broadcast at night. Broadcasts after 8 PM are pro-

hibited by federal law, according to Roger Holberg, an attorney with the enforcement division.

"At the current time, there's a very unsettled state of the law with respect to evening broadcasts," he said. "In terms of them being actionable, our authority is clear with respect to daytime broadcasts but is less clear with evening broadcasts."

Other objections are dismissed readily, even though they make mention of "sexual or excretory activity or organs,"—the legal elements of indecency—because they are not judged patently offensive by FCC officials using community standards.

An example would be mention of a sexual organ in a news program about a surgical procedure.

## Missing the specifics

Still others are rejected because they don't include specifics about the time of the offense, the call letters of the offending station or a substantial portion of the broadcast either on tape or in transcript form. In essence, the stations get off on a technicality, the enforcement official said.

But then there are those, like the complaints filed against WLUP, KSOJ and

WFBQ, that face potential action by the FCC.

"If, after they emerge from the review process and they warrant further investigation, we would go out with a letter of inquiry to the licensee," Holberg. "We never take action without giving the licensee opportunity to respond."

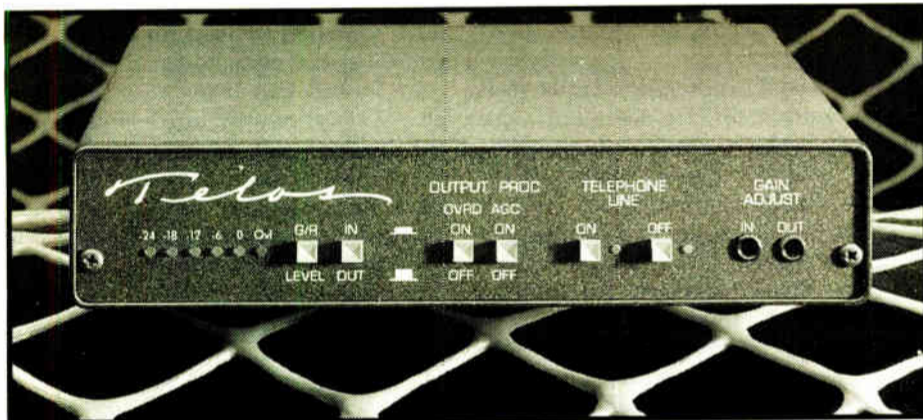
Among the 102 complaints currently on file at the FCC, the officials estimate that 19 are subject to further inquiry. The enforcement staffer stressed, however, that it is impossible to know what sort of language will actually end up prompting the Commission to fine a station.

"There are First Amendment considerations," he said, "and reviews on many levels."

The last time a broadcast station was fined for indecent broadcasting, in August, a US Court of Appeals overturned the decision when it ruled that the Commission had inadequately supported its view that indecent broadcasts should air after midnight to protect children.

KZKC-TV in Kansas City, MO, was fined \$2000 for airing the movie "Private Lessons" at 8 PM.

For information on indecency in broadcasting, contact the Commission's enforcement division at 202-632-7048.



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# Crawfish And Other Delights

by Judith Gross

**Falls Church VA** Ahhhh, smell that Cajun catfish! Hear that sultry jazz! Taste that New Orleans pizza ... pizza?!

It was a good idea to pull folks into the exhibit hall one afternoon of the radio show: a pizza and beer party. OK, for-



get for a moment that pizza and beer (which I like to think of as "ambrosia of the gods") smacks more of, oh say, Hoboken than N'Awlins. Fact is, it worked.

That, and a walk-around Cajun lunch—rice and beans, now that's more like it—helped lure hungry conventioners into the exhibit hall to see the nifty new gizmos on the showcase floor. You gotta like convention management that knows that bringing them into the booths is what keeps a show successful.

Of the exhibits themselves, there were several new attempts to bring radio into the digital age with hard disk storage, automation systems, etc. There still doesn't seem to be enough hard disk storage available at a price to keep radio CEs and GMs at the comfort level. But it's getting there.

Transmitter companies were quick on the draw to meet the needs of Class A FMs who can benefit from the power boost to 6 kW. Harris had one on the floor and Continental has put out a mailing to those who have its existing transmitters in that power range for upgrades.

There were a few other new goodies.

Modulation Sciences' FM ModMinder, the talk of the industry, was there for a first-hand look-see. Gentner has a new digital hybrid. The console makers were out in force, including a very spiffy-looking booth from Arrakis, which had decided to shun the SBE show.

The seminars at Radio '89 drew a nice turnout from engineers. The new one, on shortwave, included a tour of local WRNO. Then George Jacobs, from George Jacobs & Associates told me that as a follow-up, reps from 13 of the 17 FCC-licensed international broadcast stations met to form a new group.

Ed Bailey from KNLS was appointed president of the Association of Shortwave Broadcasters, which is the first ever for shortwavers. For more info you can call Ed at 615-371-8707.

Interesting to hear, at the NRSC meeting, Rick Zerod of Ford who told those present that Ford would manufacture NRSC radios when consumers ask for them. Come on, now, really.

The average radio listener is just about as likely to ask for an NRSC radio as for



And the winner of a CRL mic processor is...

a BTSC TV receiver. Would you settle for someone asking for better fidelity AM, Rick?

And there's only one thing I'm going to say about the controversy at the NRSC meeting (you can read about it in this is-

sue). If the final result is that more voices in the industry—Bob Orban, Greg Ogonowski, Eric Small, Frank Foti, et al—are heard, then it's a good thing no

go, Dan.

Happy to see Barry Honel, formerly of Texar, in one piece and enjoying the exhibit floor. Barry's consulting now,



It sure doesn't taste Cajun...

matter how the whole thing got started. Period.

Thanks to the NAB's Janet Elliott for pulling out the name of the winner of the CRL mic processor at the BSW booth. Janet, with Pat Medved of BSW and Bill Ammons from CRL drew the name of lucky Jerry Noble, PD of "Yes 99.5" Sault Ste. Marie. Congrats Jerry.

Loved what I overheard at Target Tuning's booth. Yes, that's right, the Moonachie, NJ company that makes those personal frequency locked radios for AM, FM and now SCAs.

A station owner listened to one and then asked about AM.

TT Prez Dan Flohr asked "Are you AM stereo?" "No," was the reply.

"Well have you heard our AM stereo?" Dan persisted. "Believe me, when you hear it you'll want to go stereo." Way to

down in Rex, GA. He wanted to let me and all his other pals know that yes, he was in a severe car accident, but no, he's alive and well.

Have to give the show overall good marks with a few demerits for the usual snafus that develop. Like the mix-up which kept exhibitors out of the sessions until somebody wised up the security guards at the escalators.

And NAB can lose those annoying give-away prize announcements that all but drowned out civilized conversation for the last hour of the exhibits.

But hey, who's griping? It was New Orleans and the hurricanes were good (the drink, not the storm).

Heard something interesting? Spill your guts to Earwaves. Write PO Box 1214, Falls Church VA 22041, or call me at 703-998-7600. Best tidbit of the month wins a coveted 1989 edition Radio World mug.

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### Praise for diversity

Dear RW:

Thanks for your informative publication. I read it faithfully each time you send it my way. As a young working broadcast technician, I find there are always items of interest in it.

Regarding your recent article on FM diversity reception—I saw an FMDR radio in a catalog a few years ago and just had to have one. I had enough patience to look for a better price than the \$579 list and I managed to get a demo for under \$200. I really like the way it works. It's a Clarion (Audio DTX 1000) and does not contain a power amp, so you must use a separate power amp with it.

Talk about expensive features—it was definitely a premium radio, and it does not surprise me a bit to hear that Clarion is pulling the newer version off the market, because very few consumers would pay upwards of \$600 for a radio of any quality level.

It is interesting to watch the antenna indicator on my radio as I travel along (not recommended when you are driving!). Sometimes the switching is so fast that it looks like both antennas are on at the same time, yet the audio is always seamless.

The system is executed very well and since I have it in my service vehicle I get lots of opportunity to hear it in action in city and country. I did have to go to a fair amount of extra work to put a decent quality second antenna in my car, but the results have been well worth the effort.

## Radio World

Vol 13, No 19 October 11, 1989

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**Radio World** (ISSN: 0274-8541) is published semimonthly by Industrial Marketing Advisory Services, Inc., 5827 Columbia Pike, Suite 310, Falls Church, VA 22041. Phone: 703-998-7600, Fax: 703-998-2966. Second-class postage rates is paid at Falls Church VA 22041 and additional mailing offices. POSTMASTER: Send 3579 farms and address changes to Radio World, P.O. Box 1214, Falls Church VA 22041. Copyright 1989 by Industrial Marketing Advisory Services, Inc. All rights reserved.

Free subscriptions are available to professional broadcasting and audiovisual equipment users. For address changes, send current and new address to RW a month in advance at the above address. Unsolicited manuscripts are welcomed for review; send to the attention of the appropriate editor.

**Next Issue RW**  
**October 25**

Here in the US, most radio listeners are unwilling to invest in better receivers to overcome reception and interference problems. I understand that this is not generally the case among Japanese consumers, who understand that to get optimum performance you usually have to pay for it.

As the FM band continues to get "busier" here in the States, things like selectivity will become more important than having the ultimate in sensitivity. Clean reception will become more and more a factor of how well a radio discriminates against adjacent channel signals.

Also, it will be necessary for audio sales people to be up to date on reception technology so they can better educate their customers. This includes FMDR (if it ever becomes widely available), FMX, NRSC-AM and, of course, AM stereo.

In the broadcast field, we go to a lot of work to put out the highest quality signal we can, but if receivers in the field don't utilize the available technology to produce the best quality reception possible, we can work as hard as we can and it won't make a whole lot of difference.

Mark Croom, CO

KTIG-FM

Pequot Lakes, MN

### In the heat of the studio

Dear RW:

Copious applause to John Shepler for his article in your 9 August 1989 issue.

At the risk of being rude, I would like to toss out an additional thought or two on that subject.

1. It probably goes without saying (but should be) that keeping the surfaces of components clean will promote longer life by removing an insulating film permitting better heat reduction by conduction. Air molecules need to get into contact with the surface of the parts to promote cooling.

It may be true that most heat immediately removed from individual components is removed by radiation and from the environment around the components by convection; but direct transfer should not be impeded.

2. Heat sinks: the purpose of a heat sink is to use the principles of thermodynamics (literally, heat moving) to move heat from point "A" to point "B" on the assumption that point "B" is safe for the heating, and point "A" is not.

Because heat always moves from that point with greater heat content (not necessarily higher temperature) to other points with lesser heat content, it is possible to install a heat sink on a transistor (for example) and find that in certain environments you have actually made a means for pumping heat into the transistor rather than your intent to remove it.

I had difficulty with an STL receiver which lost a local oscillator "canned" IC and found a radial heat sink on the can, next to the crystal and heater assembly. The heat sink was rather efficiently soaking heat from the surrounding air near the oven and pumping it into the can,

The NAB has every reason to feel elated at the success of its Radio '89 show. But as the afterglow fades, it's an opportune time to reexamine the entire year's convention schedule and decide if future changes are warranted.

The fact remains that there is no single radio show, one which can garner the full support of every faction of the industry.

This is partly the result of the evolution of the fall radio show dating back to the days of the NRBA and the NAB's programming conference.

And it's partly the result of a heavy fall convention schedule with SBE, RTNDA and regional SBE shows all vying for exhibitors and attendees.

The radio industry remains fragmented among the fall shows and the massive NAB spring convention, where radio is increasingly

## Set Goals For Show

feeling the squeeze of TV, video and non-broadcast production participation.

But if changes are to be made, they will have to come from the exhibitors and attendees themselves. NAB's radio staff is open to industry feedback on the future of the fall show and exhibitors have the clout to make or break any exhibit floor.

While a variety of ideas have been bantered about during casual convention talk and in informal gatherings, it's time a more official fact-finding mechanism was put into place.

The NAB should draw on the success of Radio '89 by setting up an advisory committee comprised of exhibitors and radio broadcasters to set clear goals and directions for growth of the radio show.

SBE, IEEE, RTNDA and others should be invited to participate in these discussions.

Whether or not any mergers or splitting off of radio events from the spring NAB show occur, it would be the ideal way to keep the radio show—and other conventions—on the right track and insure that they continue to serve the industry.

—RW

which had a significantly lower heat content than did the surrounding air. The system worked very well . . . only backwards.

3. There is a comment which John did not make, but which I am certain he thought about when he referred to the way in which equipment is installed in the facility. This is of great concern, and I would hope that the advertising groups which patronize *Radio World* would attend to this.

We do not normally install our equipment in "burn-in test racks." We do normally install our equipment in nice looking furniture.

Everyone likes to work in a clean, neat, and probably stylish place. In our last studio remodeling here at JOY-107, we spent some serious money on the cabinetwork, which was designed to promote ventilation, mechanical rigidity, useability by the talent and *up-scale appearance*.

This means some compromise between what the machines might want in terms of total open ventilation, and what is "real-world." John's initial point about the durability of satellites is well taken . . . why then (other than cost) don't the manufacturers of equipment take our installation needs into consideration?

After all, if a satellite can rotate in an environment in which 50% of it is at -250° Fahrenheit while 50% of it is at +300° Fahrenheit and do this reliably for years, why can't they make a cart machine that is not the equivalent of a space heater? Obviously we can't pay NASA prices for our equipment, but we can reasonably expect some improvements with advancing technology.

One small point in support of the "buried" approach to studio equipment layout is the idea that a combination operator running his/her own board, while on mic, can only see about 20" to either side without turning his/her head . . . and risking getting off mic.

They did a study of this back in the early '70s and decided that the optimum width for broadcast facility layout should be something like 38".

To get close to this, and to permit your operators to use the stuff more easily, you need to do some piling up and cramming in. It does not take a lot of common sense to recognize that we do it this way for a reason and it seems that the equipment suppliers fall short by not recognizing this.

To counter anyone saying, "well, the air staff will just have to get used to working with the stuff spread all out for ventilation," I would ask, for whom did we built it? If you build a machine that a person can't use effectively, what have you accomplished? 'Nuff sed.

John has hit this subject very well and is again reminding us that we need to pay attention to the little scutty gritty jobs like dusting and cleaning and making sure that we have oiled our bearings, and our gate hinges . . . just like Dad used to do.

Thanks for a fine publication.

James L. Sorensen, CE

WJQY-FM

Ft. Lauderdale, FL

PS: I recently saw a piece on lightning which indicated that the energy level of a typical bolt of lightning, when passing through a mile or so of air, raises the temperature of that string of air to 30,000°+ centigrade by its passage. That's a bunch of energy. No wonder we have problems with surges.

### Diversity worth studying

Dear RW:

I was quite pleased to read the 9 August 1989 article "Diversity Tuning Comes of Age" by Charles Taylor. However, the phrase "comes of age" may be pushing the facts a bit! The very comments within that article indicate the lack

(continued on page 15)

“...maximum loudness...  
with greatest quality.”



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## SPECTRUM

LEONARD FELDMAN

### EVERYTHING IN MODULATION

A few weeks ago, I had a chance to visit the transmitter sites of two of New York City's better classical music FM stations, WQXR-FM and the municipal public radio station, WNYC-FM. My host was Eric Small, president and co-owner of Modulation Sciences, a company that has been supplying signal processing gear to radio and TV stations for quite a few years. As a long-time fan of FM radio, I couldn't resist the temptation to crawl around atop the Empire State Building, where WQXR's transmitter is housed, and atop the 110-story World Trade Center, the "home" of four of the city's

in 1983, in order to get Type Approval, a modulation monitor had to flash if 10 consecutive cycles of 10 kHz exceeded 100% modulation. This meant that the response time of the peak flasher had to be 1,000  $\mu$ S, or 1 mS. Also, in the automatic transmitter system rules of the same era, the maximum number of overmodulation events permitted per minute was 10. Small discovered that virtually all modulation monitors made before and after the 1983 FCC deregulation had peak flash indicators that operated in one cycle of 10 kHz or less, which translates to a response time of 100  $\mu$ S or less. Apparently,

ModMinder ignored brief (less than 1-mS) spikes, which have no impact on occupied bandwidth. As Small explained, one way to describe ModMinder is as a device that allows reducing the apparent ratio of peak-to-average modulation. This improvement can be used to increase the number of peaks allowed through (reduce the amount of signal processing or compression), increase the average modulation (make it louder), or do a bit of each. For lightly processed classical music stations, the difference amounted to as much as 5 dB. Very heavily processed stations showed less than 1 dB of difference.



FM station transmitters, including that of WNYC-FM.

My purpose was to watch an experiment Small was about to conduct—an experiment that he felt could free FM stations from the need to employ vast amounts of compression.

It's no secret that most stations, to remain competitive, must try to sound as loud as—or, in some cases, louder than—their competitors. In playing the "louder than the next guy" game, the only way stations can accomplish their goal without exceeding modulation limits imposed by the FCC "way back when" is to limit dynamic range. I know of at least one station in New York City that compresses so heavily that their average dynamic range, monitored over a period of several days, was no more than about 6 dB! And this, in the era of digital Compact Discs, no less! Well, if a station's format is nothing but hard rock, perhaps that's not too serious, but if a station's format calls for classical, jazz, or other forms of pop music, that kind of compression can make music sound lifeless.

What Eric Small set out to prove with his newly designed modulation monitor, the ModMinder, was that most, if not all stations were actually using more compression than necessary, simply because their modulation meters were providing false indications of overmodulation. Before the deregulation of modulation monitors by the FCC,

makers of this equipment must have felt that faster was more conservative, or that it was easier to design a fast peak detector than a slower one.

While deregulation opened the door for slowing down the response times of peak flashers, most modulation monitor manufacturers continued to play it safe, providing peak flasher response times that were much faster than they needed to be. The result: Stations had to either back off too much on their modulation levels or introduce more compression than was needed in order to remain competitively "loud."

In stereo TV, modulation must be set exactly to the reference level of the dbx L-R noise reduction encoder which forms a part of the MTS stereo TV system. In the course of trying to resolve TV audio modulation problems, Small and his engineers discovered just how overly fast most peak flashers responded. Once they slowed down such flashers to meet the old FCC spec of 10 cycles of 10 kHz, most of the TV overmodulation problems vanished. It was then that they became curious as to what effect the 1-mS response time would have on typical stereo modulation.

With a prototype monitor having a 1-mS response time, they monitored various off-air signals using a high-quality tuner. On some stations, the prototype ModMinder indicated as much as 5 dB below the "standard" modulation monitors. This was because the Mod-

but even stations that used moderately heavy processing were able to show an improvement in loudness of almost 2 dB by merely adjusting total modulation using the ModMinder. No changes in the adjustment of the processing equipment had to be made.

At both stations we visited, the engineers were surprised to find how much difference the ModMinder made when used in place of their current peak modulation meters. In one case, there was a difference of about 20% in peak modulation indications. (The ModMinder never showed higher than 80% modulation readings with the other meter adjusted to flash and limit at what it "thought" were 100% modulation peaks.) The second station visited had been operating even more conservatively, with the ModMinder indicating no more than around 75% peak modulation while the conventional meter showed peaks of 100%.

ModMinder holds the promise of combining maximum loudness—and, hence, better S/N ratios—with greatest quality. Stations that have suffered a competitive loss because they refused to "nail the processing to the wall," as Eric Small puts it, can now maintain maximum loudness without overprocessing, and heavily processed stations now have an alternative that could enhance their competitive position without further squashing and squeezing! **A**

AUDIO/OCTOBER 1989

57

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# Overcoming Lightning Strikes

by John Gatski

**Washington DC** One force stations have little control over is the unexpected lightning hit. The problem has become of greater concern since the introduction of solid state transmitters, which can be more susceptible to damage from strikes than their vacuum tube counterparts.

Several companies that manufacture lightning protection products offer different equipment and approaches to help prevent costly strike damage to radio stations.

A station could spend as much as \$20,000 on elaborate lightning protection systems that companies claim can dispel lightning strikes, but other companies also claim similar performance with less expensive methods.

There are a variety of systems on the market including lightning rods, lightning dissipation systems, improved ground systems and surge protection.

Lightning rods, based on technology developed 200 years ago, are still widely available as a diversionary path for lightning strikes.

However, several companies manufacture products that are said to eliminate the conditions that lead to a strike, known as dissipation systems.

**Cortana makes a point**

The Cortana Corp. of Farmington, NM, has made lightning dissipation systems for several years. Dissipation systems are said to provide a continuous discharge path for the static charge found on all towers as well as a reduction of a cloud charge that can lead to lightning strike.

The continuous discharge is possible, according to Cortana and other dissipation equipment manufacturers, by numerous metal points soaking up the cloud charge.

Cortana's Stati-Cat systems offer a variety of products and installations based

on the need of a station, according to the company.

The 120-point Stati-Cat SC-1 sells for about \$350 and the larger 720-point Stati-Cat CN-1 sells for about \$1400. Cortana also lists the Stati-Kitty SC-3 for static noise reduction among its products.

WVMI-FM in Biloxi, MS, suffered several lightning strikes in 1984 and 1985 on its 200' STL tower, but has not been hit since it installed a Stati-Cat SC-1 in 1986, according to CE Bob Thornton.

Low cost dissipation systems also are available from Lightning Eliminators & Consultants (LEC) of Boulder, CO,

can not only handle voltage surges, but can also take the brunt of a direct lightning strike, according to company VP Robert Lamkin.

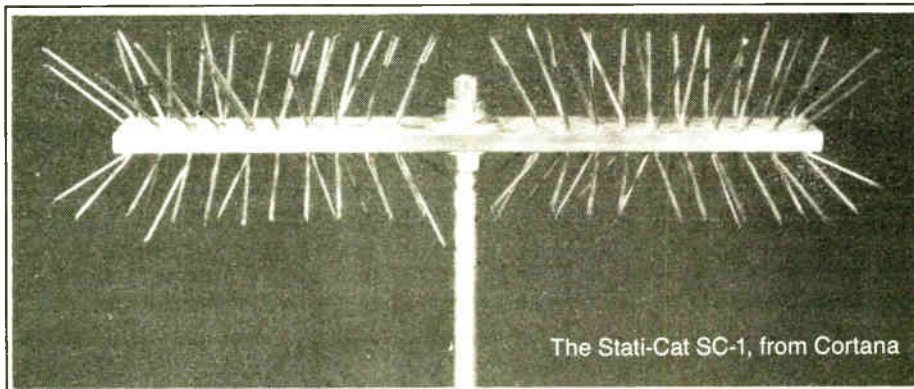
Lamkin said the Protector is based on the assumption that lightning strikes cannot be eliminated 100%.

The Protector is a sealed container that weighs about 15 pounds and is wired into the studio. It is filled with a "special chemical" with "unique" heat transfer capability and electronics that allow it to take a lightning strike, Lamkin said.

To install it, the Protector is wired into the transmitter disconnect panel, Lam-

grounding at the 1988 NAB show and, when requested, will provide advice to stations installing new towers on how to get the best lightning protection without spending a fortune.

For more information about these lightning protection systems, contact Cortana at 505-325-5336, Robert Lamkin of Energy Control Systems at 817-483-8497, John Schneider of RF Specialties of Washington Inc. at 206-546-6546, Lawrence Behr of Lawrence Behr Associates at 919-757-0279 and Lightning Eliminators and Consultants (LEC) at 303-447-2828.



The Stati-Cat SC-1, from Cortana

which also makes a more expensive dissipation/surge protection and ground system that sells for as much as \$15,000.

And another company, Lawrence Behr Associates (LBA) President Lawrence Behr said his company, based in Greenville, NC, will offer a \$2000-\$3000 dissipation system by the end of the year.

**Something different**

Some manufacturers have taken different approaches to lightning protection other than dissipation.

Energy Control Systems International, based in Fort Worth, TX, offers lightning protection not at the tower, but in the studio.

The company manufactures the Protector. It is basically a surge protector that

kin said.

Energy Control Systems sells two Protectors: the IP Series for about \$1300 and the "more heavy duty" HDP series for \$1700.

**Good grounds**

Still another approach to lightning protection comes from RF Specialties of (Seattle) Washington Inc. President John Schneider said he believes a properly grounded tower coupled to a new generation of chemical ground rods can divert the strike away from the vulnerable broadcast equipment.

"It's not a system ... it's more of a technique," Schneider said of his approach.

Schneider presented a paper on

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# Broadcasters Fight Ft. Lee FM Petition

## Widespread Opposition To NJ Engineer's Plans For Local Translator

by Benn Kobb

**Washington DC** Broadcasters in New Jersey and elsewhere are blasting Gerard Turro's latest request to allow full-time local origination on a translator in Fort Lee, NJ, two miles from Manhattan Island.

Turro, a consulting broadcast engineer, has been trying for three years to bring local FM radio to Bergen County, NJ, via his translator, W276AQ.

Bergen is the largest county in the US without its own licensed commercial FM station and engineering studies indicate that no new commercial FM could be allocated to the area. County residents receive some 60 signals from stations in the New York City market.

### Widespread opposition

The FCC and the US Court of Appeals previously rejected Turro's request for a waiver of the rules prohibiting full-time local origination on translators. He returned to the FCC on 28 July with an updated request including letters of sup-

port from county, state and federal officials.

The filing drew the wrath of the NAB, CBS, the New Jersey Broadcasters Association, the New Jersey Class A Broadcasters Association, broadcast associations from nine states and from stations in New Jersey and as far away as Arizona. Fairleigh-Dickinson University, which operates share-time educational station WFDU, supported the request.

NAB and most other commenters argued that Turro's request should be denied under the principle of *res judicata* (the matter has already been decided).

Even if the FCC should consider the merits of his request, the NAB said, Bergen still receives more AM and FM service than the nationwide average.

"What Turro seeks to do, in his latest *deja vu* petition, is to avoid the FM allotment procedures of the FCC and to use the 'back door' in order to put a new FM radio station on the air in Bergen County," NAB said.

Instead of local origination on his translator, NAB suggested that Turro buy airtime on existing stations, investigate whether a station in the area could change its city of license, or wait for

more allocations to the area from the expanded AM band.

### NJ Broadcasters

The New Jersey Broadcasters Association argued that Turro may have inadequate financial backing to operate his proposed station. The association also said that he ignored the efforts of adjacent-county and New York City stations to serve the county.

The association said Turro's 8 W ERP translator will only serve a "tiny portion of the county with a listenable signal" yet will provide "potentially lethal compe-

light of the still-outstanding FCC Notice of Inquiry into translator service (MM 88-140).

### Too long to wait

That NOI includes questions about possible expansion of local origination. "The citizens of this county can't wait that long," Turro said in an interview.

The NAB said "we share what may be Mr. Turro's frustration over the fact that the Commission has not yet elevated its ongoing inquiry on FM translators to rulemaking status."

## Instead of local origination on his translator, NAB suggested that Turro buy airtime on existing stations . . .

petition" to the area's AM stations.

Daytimers and disadvantaged AM's should be given priority access to translators or low power FM stations, it told the FCC. The New Jersey Class A Broadcasters Association recommended that instead of granting Turro's request, the FCC should allow all Class A's in the state to increase power to 6 kW.

Many commenters said that a grant of Turro's request would be premature in

Bergen includes the community of Alpine, where radio pioneer Edwin Armstrong originated the first FM transmissions. "It's a shame that the historic birthplace of FM doesn't even have its own commercial FM station," Turro said. Reply comments on the waiver request were due 4 October.

For information on the translator proposal from Turro, contact attorney Ray Kraus at 202-467-5700.

# Radio Legislation Gets Short Shrift on the Hill

by John Gatski

**Washington DC** Success of radio-related legislation, like any other bill on Capitol Hill, often depends on committee scheduling. And radio doesn't seem to be as pressing as other broadcasting issues in Congress.

Some of this year's proposed legislation, including radio renewal, AM improvement and spectrum allocation, will have to wait their turn behind more high-profile broadcasting legislation such as must-carry, limiting commercials during children's programming and restoration of the Fairness Doctrine, according to the House Telecommunica-

Chairman Alfred Sikes and commissioners Sherrie Marshall, Andrew Barrett and James Quello, who testified at recent Capitol Hill hearings.

The Radio Renewal Bill (HR 1136) was introduced by Rep. Matthew Rinaldo (D-NJ) last winter. The bill would tighten up licensing procedures for radio stations to prevent abuse of the renewal process by authorizing the FCC to enact a two step process with closer financial scrutiny.

The bill has 150 House sponsors, according to Haines.

At a recent Telecommunications and Finance Subcommittee hearing Sikes, Marshall and Quello endorsed HR 1136 while Barrett withheld comment pending further study of the bill.

An identical Senate bill (S 1207) also was introduced into the Senate Communications Subcommittee by Sen. Robert Packwood (R-OR) earlier this year.

## . . . radio doesn't seem to be as pressing as other broadcasting issues in Congress.

### Technical improvements

HR 1136's technical companion bill, "The Radio Quality Improvements Act of 1989 (HR 2714)," addresses a number of ills of the AM and FM bands. It would mandate AM stereo in FM stereo radios by 1992, allow AM stations to homestead on the proposed, expanded AM band (1605 kHz to 1705 kHz) and limit FM translators.

The commissioners have withheld any comment on the technical improvements bill, pending further study.

Another bill being watched by industry insiders is the Emerging Telecommunications Technologies Act of 1989, which would allocate 200 MHz of government-reserved spectrum for use by the commercial bands, perhaps for digital radio.

For more information about radio legislation, contact Terry Haines at 202-226-3400 or the House Telecommunications and Finance Subcommittee at 202-226-2424.

tions and Finance Subcommittee.

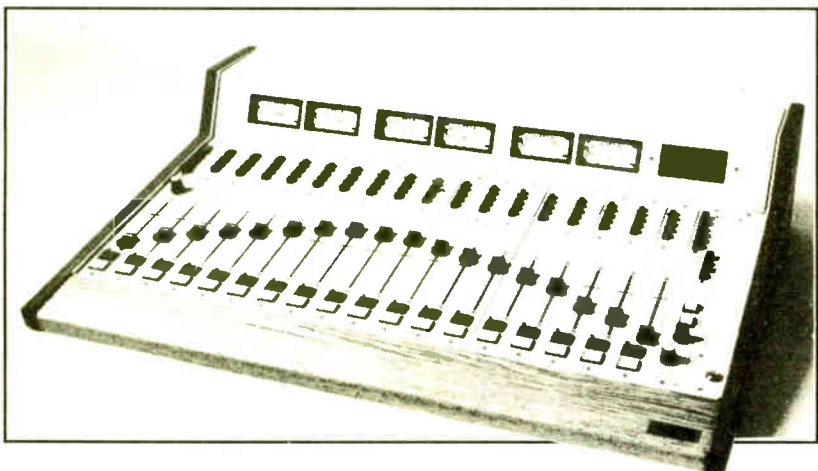
The Fairness Doctrine bill already has been debated in several hearings, and must-carry and children's TV are next on the list to be scheduled for hearings, which puts radio-related bills in an precarious position for hearings before the fall session ends, a subcommittee spokesperson said.

The House session is tentatively scheduled to end 15 November, and there is uncertainty whether the radio legislation will make it to hearing, according to the subcommittee spokesperson.

### FCC is receptive

Despite the radio bills' pecking order, Telecommunications and Finance Subcommittee Minority Counsel Terry Haines said the bills have been well received including support from new FCC

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# AES Convention Looks to Future

## Sessions Carry Theme Of "Audio for the Next Decade and Beyond"

by Alan Carter

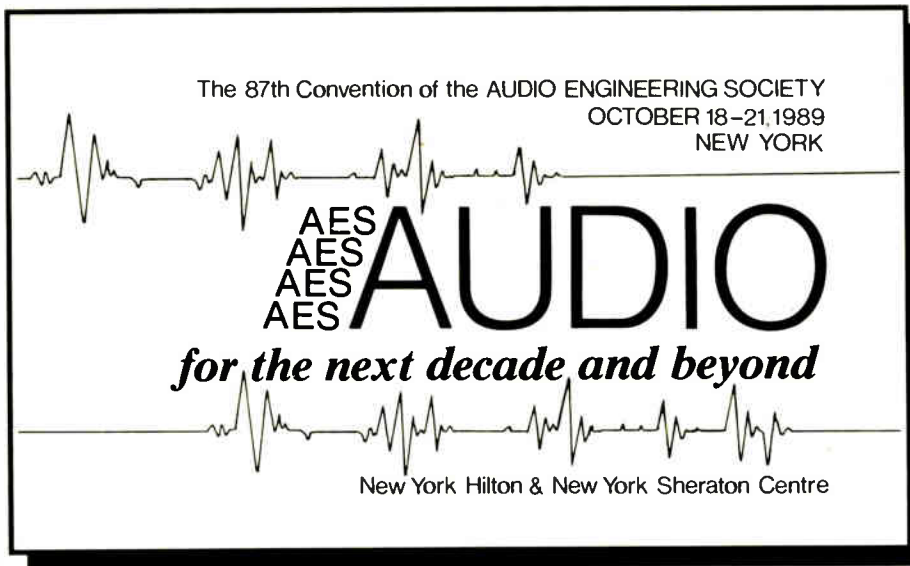
**New York NY** Digital workstations, fiber optics and new directions in audio are among some of the topics for the 87th Audio Engineering Society (AES) convention, 18-21 October, here in New York.

The technical sessions, organized by Ted Uzzle of Altec Lansing Corp. and workshops, planned by Mary Gruszka of MCG Audio Consulting, center around the theme, "Audio for the next decade and beyond." The convention will be at the New York Hilton and the New York Sheraton.

More than 250 exhibitors will display their equipment during the convention. Exhibit hours are: noon-6 PM, 18 October; 10 AM-6 PM, 19 October; 10 AM-6 PM, 20 October, and 10 AM-5 PM, 21 October.

Among the workshops, Thomas Drewke of Technical Directions will lead a session on "Capturing the Live Sound," which focuses on broadcasting a live concert.

Fiber optics also will be addressed as "The New Medium for Audio." The



workshop will discuss the traditional wired digital interface and include a tutorial on fiber with applications in professional audio. Demonstrations will be provided on fiber optic cable with audio transmission.

### Design trends

In another program, Peter D'Antonio of RPG Diffusor Systems will present an overview of current acoustical design trends in listening environments in which prerecorded and live performances are auditioned.

Also, Carlos Gomez-Fernandini of

tions to existing facilities.

A workshop on digital audio workstations chaired by Matthew Weiner of Martin Audio/Video Corp. will present users of various workstations discussing and comparing their equipment.

### Audio engineering

A final workshop will be a presentation from recording engineer Bruce Swedien whose credits including projects for Michael Jackson, Quincy Jones and the Chicago Symphony. The day-long presentation will cover topics including special miking techniques, use of signal processing equipment and stereo panorama.

The technical sessions include a variety of topics such as architectural acoustics, audio electronics, audio and acous-

## More than 250 exhibitors will display their equipment during the convention.

Communications Engineering will chair a panel discussion on "Design for Studios and Facilities." Topics will include site selection, choosing the design team, project planning, working with contractors, acoustics and noise control, grounding and shielding and modifica-

tic tests and measurements and broadcast sound.

Other topics slated are concert sound systems, new directions in audio and sound reinforcement.

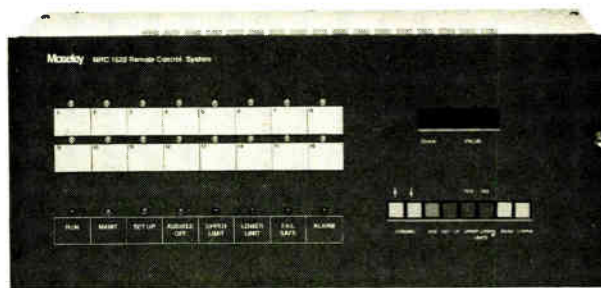
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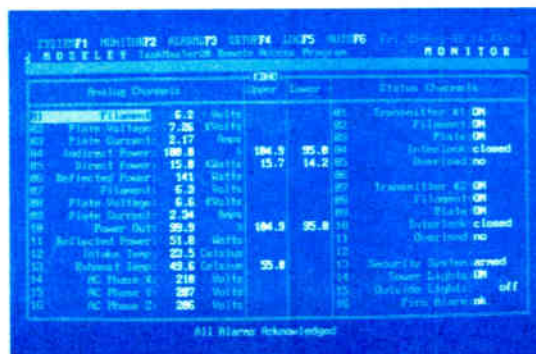
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# Ariel Debuts Digital Microphone

by Frank Beacham

**Highland Park NJ** Harnessing the power of a new Motorola analog-to-digital audio processing chip, a small East Coast computer accessories manufacturer unveiled what it called the world's first high-quality digital microphone.

Ariel Corp., headed by Anthony M. Agnello, inventor of the Eventide Harmonizer and other digital processing products, announced the new microphone, which samples and converts analog signals into digital format within the microphone. He said the new microphone will be marketed to radio and television broadcasters and recording studios for use with digital audio workstations and mixing consoles.

The first version of the Ariel Digital Microphone, on sale now for \$595, is designed exclusively for use with the NeXT Computer, a new desktop product recently introduced by former Apple Computer head Steve Jobs.

A broadcast/recording version with a standardized AES/EBU output—suitable for use with portable DAT recorders and digital consoles—is expected to be shown in prototype form at the October AES convention in New York and will go on sale by year end.

The microphone has two electret condenser capsules in an X/Y configuration

to pick up analog sounds in stereo. Two Motorola 56ADC analog-to-digital 16-bit converter chips convert the signals to digital format.

The device has a dynamic range of up to 92 decibels with a total harmonic distortion of less than .005%. When connected with the NeXT computer's digital signal processing input port, the information can be processed, displayed and mixed with other signals or can be stored on computer disk.

## Bandwidth adjustable

The new microphone also allows the user to precisely limit the bandwidth of the acquired signals. For speech applications, undesirable high frequency noise can be completely rejected by properly setting the sampling rate.

The NeXT computer, through software selection, can adjust the microphone's sample rate to one of five values from 88.2 kHz down to 5.5 kHz, including the digital audio standard of 44.1 kHz.

In addition, the microphone has line-level right and left input jacks for directly connecting outboard equipment through its A-to-D conversion circuitry. Devices ranging from compact disc and DAT players to special receivers for inaudible signals such as thermocouples, accelerometers and motion sensors can be connected to the microphone.

The digital microphone is only the be-

ginning of a long product development cycle promised by Agnello.

For broadcasters and recording studios, his company has plans for digital signal processing that can include computer manipulation of the microphone's characteristics, digital low cut filters, au-

or other interference. What we are hearing is very, very crisp, clear sound."

Reaction to the announcement from high-end studio microphone companies was interest and surprise.

"The idea of putting the A-to-D conversion closer to the mic capsule is a logical step," said Jurgen Wahl, Neumann's West Coast representative. "It would be nice to record on a DAT machine without having to go through some poorly-designed conversion. That would be a major advantage."

However, Wahl said factors such as head room, maximum sound pressure levels and limitations of the processing chip would have to be measured and evaluated in order to compare the digital microphone to today's best analog models. He said Neumann, the German manufacturer, has no such digital microphone in the works.

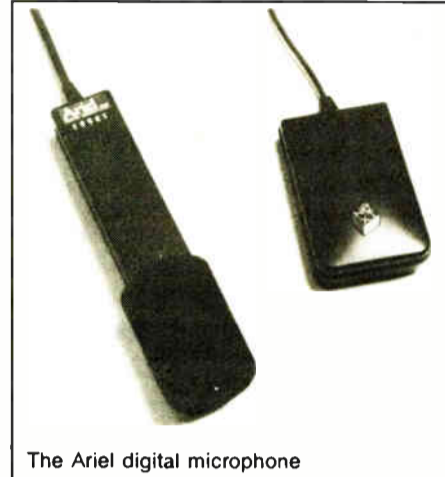
## Majors have no plans

"This is the first I've heard of a commercial product using this technology although it's obviously one that was going to happen sooner or later," said Jerry Bruck, owner of New York's Posthorn Recordings, exclusive US importer of German-made Schoeps microphones. "To the best of my knowledge, none of the major companies—Neumann, Schoeps, Sennheiser, AKG, what have you—have immediate plans to come up with something like this."

"It has a lot of possible virtues and obviously some pitfalls," Bruck said. "Like anything else, if it's done really well I'm sure it will be fine. If it's not done well then we'll be back where we are with CD players and oversampling and how many bits are we going to have this month. It certainly is an interesting idea to pursue. It should be pursued to see what's possible with it."

Founded in 1982, Ariel specializes in the design and manufacture of digital signal processing hardware and software for IBM PC's and compatibles, Hewlett Packard workstations and the NeXT Computer System. Agnello took over as president of Ariel in 1985 after a tenure as vice president of engineering at Eventide.

For information from Ariel Marketing, call Les Listwa at 201-249-2900.



The Ariel digital microphone

tomatic squelching of feedback and auto microphone mixing.

"We're really not talking about all this yet, but the implications are fairly obvious," Agnello said.

The current model DM-N microphone does no signal processing inside the microphone. "What the microphone is doing is performing an analog to digital conversion," Agnello said. "We are trying to move the conversion as close to the source as possible. By transmitting it digitally, the signal is more robust and less prone to pickup of any kind of interference, such as hums and buzzes."

## Analog comparison

When asked to compare the sound of the Ariel Digital Microphone to top-of-the-line precision studio microphones from such companies as Neumann and Schoeps, Agnello said no head-to-head comparisons had been made.

"Everyone who has listened to the microphone says it's remarkably clear," said Agnello. "What is apparent is there is no signal degradation. Anytime you transmit an analog signal down a wire, you are guaranteed to have some corruption. With this microphone, broadcasters will no longer have to worry about hum

## Power Tube Investigation On at Justice Department

(continued from page 1)

tify them in accordance with grand jury proceedings.

Varian said the company was not clear on the focus of the investigation but a spokesman said the company had not seen "anything that warrants a grand jury investigation."

In a prepared statement, Varian Chairman Thomas Sege said, "... If a problem is discovered, we would take immediate appropriate corrective steps."

## Combination of events

Edward Richardson said the investigation could have stemmed from "a combination of events" including competitors. He said Richardson Electronics is

"aware" that eight to ten manufacturers and distributors had to submit evidence to the grand jury.

Richardson recently completed the purchase of the assets and worldwide marketing rights of the Philips (Amperex) Transmitting Tube line in August 1988. In 1981, the company acquired National Electronics.

Addressing the investigation in an annual report, Edward Richardson did not back away from the company's aggressive expansion in the tube industry. "I believe that the conclusion of this investigation will be a positive mandate for the company to continue its strategy of growth in all areas of the electron tube business," he stated.

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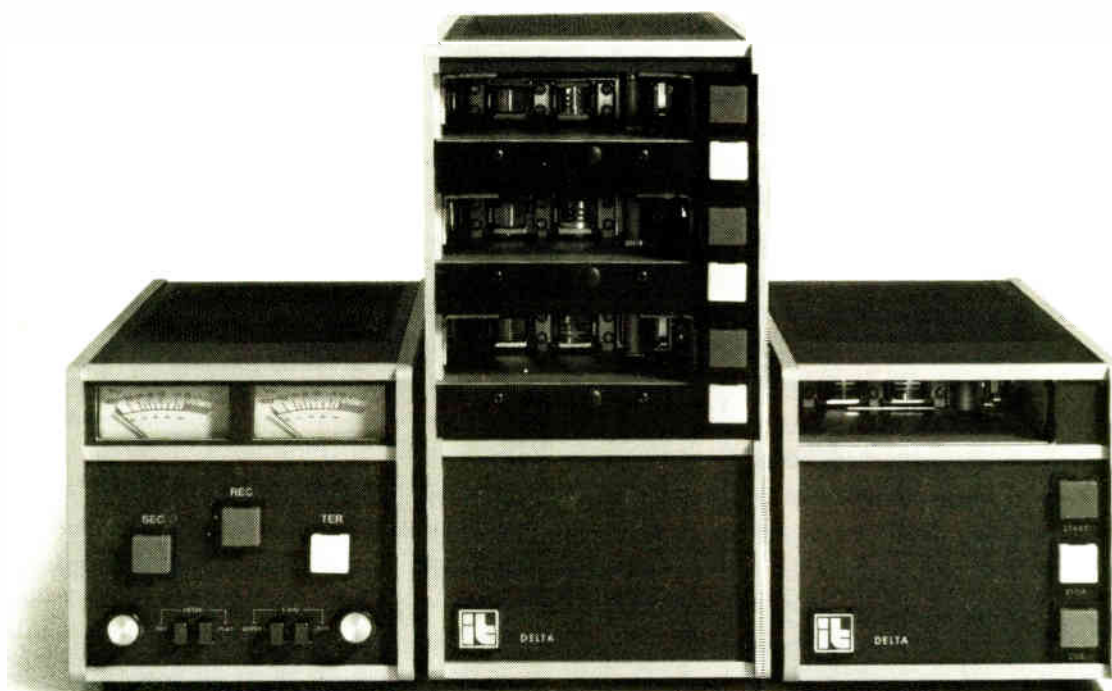
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# C-QUAM Chips Improve Steadily

by John Gatski

**Chicago IL** As successive generations of AM stereo chips are produced, AM stereo's performance continues to improve, according to Motorola, the manufacturer of C-QUAM, the most widely used AM stereo system in the US.

The company manufactures a single AM stereo receiver chip (MC13024) that enhances the prospects of low power, portable AM stereo radios, according to Motorola AM Stereo Engineering/Equipment Manager Donald Wilson.

Since 1988, the company also has made a medium voltage AM stereo decoder chip (MC13022) that automatically adjusts audio bandwidth to minimize noise and maintain optimum sound quality.

The MC13024 for portable radios contains all AM stereo functions, including dynamic range mixer, IF amplifier, AGC, AFC and pilot tone detector, which means a receiver needs no other chips to complete the AM stereo function of the receiver, Wilson said.

The MC13024 also features tuning and stereo indicator, blend to mono during poor reception and a typical channel separation of 25 dB.

The chip is now being used in Target Tuning's line of single frequency promotion AM stereo radios and performs very

well, according to company President Dan Flohr.

Although somewhat "over engineered" and costly (about \$2 per chip including the C-QUAM royalty) for use in the company's single frequency radios, Flohr said the chip is the only one on the market that meets the requirements of lower power consumption for portability.

## Low power requirements

The chip requires as little as 1.8 V to 8 V DC for operation. The Target Tuner uses a pair of AAA batteries.

"For a small, 'Walkman' type radio, it is the only game in town," Flohr said.

Wilson said the MC13022 was designed for portable, but is better

adapted for medium voltages such as in home and automobile receivers.

The chip features 32 dB typical separation, IF amplifier with two speed AGC, post detection filters with 10 kHz notch, and allows user or automatic audio bandwidth adjustment.

The latter feature is important, Wilson explained, because a receiver in the daytime can use more bandwidth while a receiver operating at night may need reduced bandwidth to cut down on noise.

## Companion chip

Motorola also makes the MC13023 companion chip to the MC13022, which completes the AM stereo circuitry with the mixer, local oscillator and IF amplifier.

Audio companies Carver and McIntosh have expressed interest in using the MC13023 in their radio receivers, Wilson said.

The original C-QUAM AM stereo chip, MC13020P, is still available from Motorola. It went into production in 1985.

About 550 AM stations broadcast in C-QUAM stereo in the US and an additional 200 around the world, according to Motorola. Several dozen receiver manufacturers make AM stereo radios including car radio companies such as Chrysler and GM.

For information about the C-QUAM AM stereo chips, contact Donald Wilson at Motorola, 312-576-0554. For information from Target Tuning contact Dan Flohr at 201-935-8880.

# EIA Drafts DAT Copy Legislation

by John Gatski

**Washington DC** The Electronics Industry Association (EIA) is drafting proposed legislation to require tape copy limiting circuitry on all consumer Digital Audio Tape (DAT) machines produced domestically or imported into the US.

This action follows the recent worldwide agreement to allow consumer DAT

machines to have digital-to-digital recording capability using the new copy limit technology, known as Serial Copy Management Systems (SCMS).

Recording groups and manufacturers agreed to SCMS in late July and, according to EIA Government Relations VP Gary Shapiro, the EIA-drafted legislation would clear the way for consumer DAT equipment to carve its niche into the market.

Shapiro said DAT legislation is likely to be introduced in both the House and Senate judiciary committees, but he is unsure whether they will be introduced before the fall session ends in mid-November.

## DAT controversy

Since 1987, consumer DAT sales have been struggling because of litigation threats made against DAT manufacturers by recording artist groups. The groups fear that widespread tape piracy of CDs and records with DAT's ability to make perfect copies.

The SCMS technology solution would allow DAT players to make digital-to-digital recordings, but not allow the copy to be copied. DAT recordings from analog sources can be copied once.

The copy limit ideally would prohibit

the proliferation of pirated, exact copies of analog or digital sources, SCMS proponents claim.

Any proposed legislation would not affect professional DAT players, which have been able to make digital-to-digital copies without limitation since their introduction on the market several years ago, Shapiro said.

## SCMS supported

The SCMS circuitry has much more support than did the proposed frequency notch for CDs, which many audio experts said affected the CD's sound quality. That option is no longer being considered by legislators.

The Recording Industry Association of America (RIAA), which opposed consumer DAT's unrestrained ability to copy, favors addition of SCMS to consumer DAT and the legislation requiring it, according to RIAA.

Some recording artist groups still are not satisfied with only SCMS and would like to see a royalty paid on each blank DAT to prevent artists from losing money from piracy of their copyrighted material.

For information about DAT, contact Gary Shapiro at 202-457-8711 at EIA or the RIAA at 202-775-0101.

# Lower RF Limit Planned

(continued from page 1)

(ANSI) RF standard, which tentatively has been approved on a two-tier level: 200  $\mu\text{W}/\text{cm}^2$  for the general public and 1000  $\mu\text{W}/\text{cm}^2$  for workers.

The existing ANSI standard is 1000  $\mu\text{W}/\text{cm}^2$  for the general population and station workers.

RF radiation exposure has become controversial in recent years because of scientific studies suggesting that exposure to RF can be harmful.

Seattle area stations and the NAB opposed the Office of Long Range Planning recommendation for the city.

The mayor's 200  $\mu\text{W}/\text{cm}^2$  recommendation, however, encountered less resistance.

"I think it is a good thing. The 200  $\mu\text{W}$  standard is what we wanted up front," KISW-FM CE Buzz Anderson said.

KOMO-AM/TV Engineering VP Don Wilkinson said the mayor's recommendation is more in accordance with the standards-making bodies.

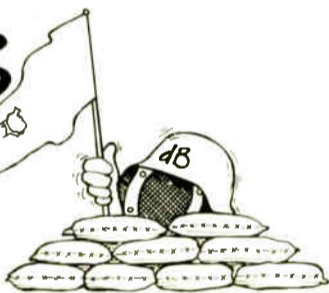
## Scientific doubts exist

But, he added, the lowering of the standard is more political than scientific and doubt remains about whether there is scientific evidence that even 1000  $\mu\text{W}/\text{cm}^2$  has an effect on humans.

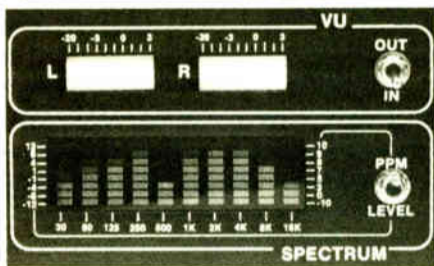
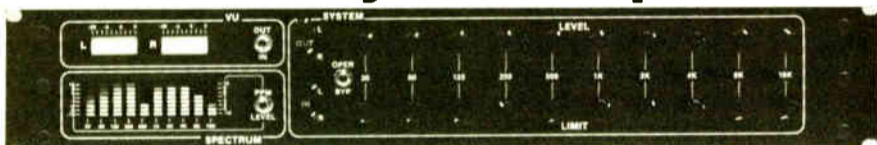
Marks said the nine-member city council could vote on the ordinance by the end of the year and they could choose either the mayor's or the staff's recommendation.

For information, contact Cliff Marks at the Seattle Office of Long Range Planning, 206-684-8056; KISW-FM CE Buzz Anderson at 206-285-7625 or KOMO-AM/TV Engineering VP Don Wilkinson at 206-443-4010.

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Circle 11 On Reader Service Card

# CBS Radio's Sat Scheme

by Alan Carter

**New York NY** CBS Radio will convert its AM stations and the Washington Bureau to a satellite network to transmit voice and data news reports beginning in late October or early November.

The new point-to-point satellite network was developed by Hughes Network Systems Inc. (HNS). The communications system is built around the HNS Gemini very small aperture terminal (VSAT) that will operate from CBS's eight AMs and the Washington Bureau.

CBS-owned AMs involved in the project are WCBS, New York; WCAU, Philadelphia; WWJ/WJOL, Detroit; WBBM, Chicago; KMOX, St. Louis; KNX, Los Angeles and KCBS, San Francisco.

A tenth Gemini terminal will serve as a portable unit, providing CBS with an optional on-the-spot broadcast link anywhere within the continental US, Canada or Mexico.

The Gemini network replaces a former AT&T wire line, serving as the primary transmission system for remote pick-ups and interviews.

The network effectively constitutes the first use of VSAT technology by a radio broadcasting system, CBS said. The new network will operate by converting audio signals to digital data via a special broadcast multiplexor designed by Corporate Computer Systems.

The signals will then travel over the Gemini data channel to CBS-owned AM stations, where a demultiplexor converts the data back to broadcast audio. The Gemini data channel is configured to simultaneously carry a 7.5 kHz broadcast audio channel (compared to 3 kHz voice grade) on the wire line, an interior channel and a data home.

The portable Gemini configured in the system, a ViaSat Portable Satellite Terminal, is designed for easy disassembly into four lightweight pieces that can be checked onto an airline as baggage.

The unit is quickly and easily reconstructed onsite, and it includes a laptop computer and plug-in multiplexor to serve as an announcer's console.

The system will maximize the reporting efforts of each of the CBS AM facilities, according to Anna Mae Sokusky, VP, CBS-owned AM stations. "This elevates the capabilities of our local radio stations by giving them a range of high quality reporting options, from customized one-on-one reports to the simultaneous transmission of interactive reports from multiple bureaus," she said.

CBS Radio Technical Operations Manager Tony Masiello said that in addition to improving audio quality, the VSATs would allow three interactions at once: the main program, data exchange between NewStar computers and data exchange between producers on either end.

The applications for satellite technology are "virtually limitless," said HSN Chairman and CEO Jack Shaw. "... In CBS we have still another creative example of how VSATs can reduce operational costs and enhance reliability," he said.

For information from CBS, contact Helene Blieberg at 212-975-3771; contact Hughes Network Systems by calling Alison Welles at 301-428-7111.

# READERS FORUM

(continued from page 5)

of public and retail sales knowledge. I encountered this myself in my last two attempts to purchase an auto radio for both a new car and in the after-market sector.

I do not find this lack of information too surprising considering the suppressed enthusiasm that domestic auto electronic manufacturers have displayed toward new and potentially useful technology. I think Eric Small has it right when he says that "political" concerns and the NIH (not-invented-here) syndrome have strangled United States industry.

Several months ago at one of the FM improvement meetings dealing with FM multipath, I raised the topic of diversity reception. I stated that I believed there was great potential for improved mobile reception and suggested that a technical review of past data and further study was in order. Perhaps that study could define the potential benefits and resolve some of the implementation problems I was told were so serious.

I'm still saying that. This is a topic worthy of serious technical study in the broadcast industry.

Robert D. Culver  
Lohnes and Culver  
Washington, DC

### On modulation

Dear RW:

Concerning the recent exchange between Modulation Sciences' Eric Small and Bob Orban, I have a few comments based on practical experience. This experience leads me to agree strongly with the premises upon which Mod-Minder is based.

During the period 1972-1978 I was associated with Minnesota Educational (later Public) Radio in engineering operations and management. As early as 1973 we opted to avoid heavy processing, and instead verified our

spectrum occupancy with a storage spectrum analyzer. In loud passages this practice led to recurrent instantaneous deviations of at least 112 kHz (150% modulation) and possibly as much as 150 kHz (200% modulation).

Four points are pertinent:

1. Because of good audio practices, we set the standard for signal quality in the market. Obviously receiver performance was not adversely affected.

2. We operated a 67 kHz SCA sub-carrier service in connection with Minnesota State Services for the Blind. One of the hallmarks of this system was freedom from crosstalk in both directions. Over 3000 SCA receivers were deployed.

3. This service was terrestrially networked by rebroadcast in composite form. The satisfactory performance was preserved in the relayed signals.

4. The city of license is a regional office of the FCC. They were aware of our practices. We were never cited for any modulation violations.

The fears concerning receiver performance expressed by Messrs. Orban and Ogonowski are more hypothetical than real. They will not be borne out in practice. Psychoacoustically, the one millisecond at issue is a very short interval and their grave concern over what happens in it is more related to commercial self-interest than technical reality.

I cannot comment on the current technical practices of MPR.

D. Michael Shields, Pres.  
Ampria Research and Design Inc.  
St. Paul, MN

### Tower-climbing danger!

Dear RW:

I just received my 23 August copy of *Radio World* and was quite surprised to see the cover photo which shows one of the members of the notable team conducting multipath tests at WAEB climbing a tower with absolutely no

safety equipment in sight!

This picture is obviously taken at the base of the structure and I am not going to pretend that I have never run up a tower 20 or 30 feet without all the gear. But as I read further into this article I find this party went one-third of the way up this tower, which judging from the face, must have been at least a couple hundred feet tall!

What is wrong with this picture? No belt, no hardhat, no gloves, inadequate shoes and apparently no radio. Not shown—ground personnel attire.

Just yesterday I was doing some tower work for the local translator association at 12,500 feet. It was a very calm day on just a small 25 footer and I was in the tower-mounted preamp box when the wind kicked up and slammed the cabinet door right on my head. Yes, I had my hardhat on and was virtually not phased; without it I would have been at least KO'd.

Well, I know he wasn't doing the same things I was, but nobody should go to such heights of a tower, even if just to observe, without planning for the unexpected.

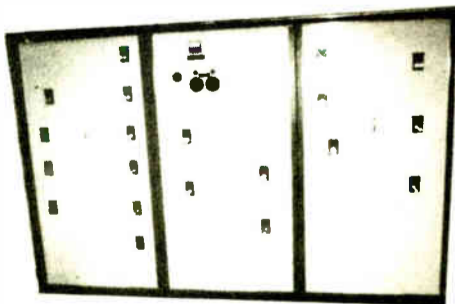
As one of the industry's leading publications I am appalled at such an oversight in living color on the front page. I trust your future articles will be consistent with good safety practices.

R. Michael King, President  
Circuit Doctors, Inc.  
Frisco, CO

### Erratum

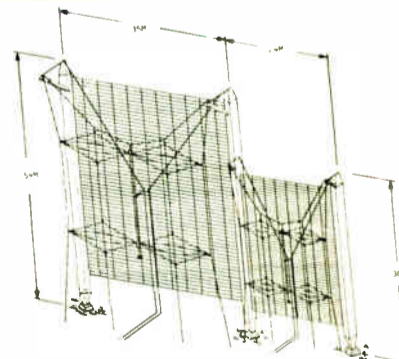
In the original article describing the Howe Tech Model 10K stereo audio console (*Radio World* 23 August) the proper credit for the integrated circuit at the heart of the VCA module was inadvertently omitted. The MTA1537 precision voltage controlled attenuator (manufactured by Harvey Reubens and David Baskind/VCA Associates) is used because of its low noise and distortion performance.

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console in its class, and was less expensive overall. So we  
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two of our other stations as well."

"We bought the light-bar metering version because  
the ballistics and characteristics are more meaningful for what  
the production engineer needs to know. Our producer,  
Bumper Morgan, likes the light bars better than conventional  
VU meters because he can see from across the room if he's  
got one channel a little hot without having to stare at the  
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high-tech look that helps our sales people when they

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types in, because the 400 gives  
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Bumper Morgan, Producer at WYHY says,  
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from night to day. The light-bar display gave me instant  
gratification. I use the foldback modules a lot. I like the range  
of the eq and the very clean overall sound of the board.  
Besides our own work, I do a lot of promos, sweepers and  
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on this board. Even with this heavy workload, we've had  
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day one," he says.

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# Radio '89 A Gala Celebration

## Record Attendance and Hot Products Helped Make Show a Success

**New Orleans LA** A record attendance of 6885 flocked to this city on the Mississippi to celebrate radio and see the latest in studio and RF gear.

Starting with a parade and ending with a star-studded awards ceremony, Radio '89 tackled some of the industry's toughest questions and presented a wide variety of management, sales, programming and engineering views.

the HT-7FM 3-8 kW transmitter with a price tag of \$36,000. Also from Harris is the HT series of low-power solid state transmitters in 250, 500 and 1000 W models.

Allied targeted its message to program directors with the Squeeze Play™ AM-FM cassette "skimmer." The company also showed the Associate Producer self-contained dubbing center.

Gentner introduced a new product as well. The Digital Hybrid II is a replacement for the company's first digital hybrid. Gentner said it's a complete redesign; it includes a record feature (on or

(continued on page 23)



Traffic on the trade show floor was brisk and interest was high.

... a small number of product introductions generated interest ...

On the exhibit floor there were few surprises but a small number of product introductions generated interest among managers and programmers as well as engineering attendees.

### New transmitters

Harris and Allied, exhibiting under one banner, showed a number products that ran the gamut from studio to transmission.

In the wake of the decision to let Class A FMs boost power, Harris introduced

## Denon to Build NRSC Radios

(continued from page 1) programs with stations and retailers to get the word out," he said.

There was also positive news about the certification mark program.

### Promoting receivers

NAB Radio Board Chairman William Sanders announced that EIA and NAB have agreed to join together in a program to promote higher quality AM receivers—those incorporating the NRSC standard—with a certification mark.

The joint program will establish a logo to be used on new AM receivers that comply with a set of specifications, which will include the NRSC standard.

The decision follows a meeting of the EIA/CEG executive committee and is still subject to final approval by EIA/CEG Board of Directors.

Both Tom Lauterback, EIA spokesman and Michael Rau, NAB VP of Science & Technology, expressed optimism that the certification mark program would get final approval of the board.

Rau said participation by the EIA/CEG bodes well for the prospects for marketing new AM radios.

"It means enough of EIA's members felt that such a mark would be beneficial to support the program. They see a market opportunity available," said Rau.

Lauterback agreed that EIA members see the new receivers as marketable. "We certainly believe they are. We wouldn't be involved if they weren't," he said.

Specifications for receivers which will bear the mark have yet to be determined. A letter ballot has been circulated to the NRSC mailing list asking for comment on several parameters. The ballots are due 15 October but Rau pointed out that "You don't have to have received the ballot to provide input." He also said some input has come from receiver manufacturer.

Once the program has received final approval and the specs are defined, Rau said that NAB's role will be to interest

stations in co-promoting new radios with electronics retailers. He said such a campaign could start by late 1990.

Rau also pointed out that receiver manufacturers don't have to wait until the certification mark becomes reality to begin making NRSC radios. He said that companies such as Denon, which market the new radios before the mark program is underway, could adapt their receivers to the program at a later date.

Heiblim said that Denon would take that course of action with its new radios once the mark is established.

For more information call NAB at 202-429-5346, EIA at 202-457-4919 or Denon America at 201-575-7810.



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# NRSC Meets With Controversy

**New Orleans LA** FM issues took center stage at the Radio '89 meeting of the full NRSC as a controversy over one of its subgroups continued to simmer.

The fires of controversy were fanned when it came time for the group to approve minutes of previous meetings.

Modulation Sciences Inc. VP of Engineering Eric Small asked that the minutes of a meeting of the FM composite spectrum working subgroup on 5 April be stricken from the minutes and declared void.

It was at the 5 April meeting, held in St. Louis, that a paper critical of composite clipping, authored by Chuck Adams

of CRL, was accepted by the subgroup. MSI, which manufactures a composite clipper, and its attorney have maintained that acceptance of the paper may violate antitrust considerations.

The paper was also included in materials handed out at the full NRSC meeting in April and later referenced in an industry trade journal.

## Only full committee minutes

At Small's objection, NAB legal counsel Barry Umansky said that the 5 April meeting's minutes were not subject to approval by the full committee and that only minutes from two full committee

meetings, one held 27 April at the NAB spring show and another 6 June at the summer Consumer Electronics Show were to be considered at that time.

Small then asked that those portions of the minutes of the 27 April full meeting which referred to the Adams paper and the composite working group be stricken.

Michael Rau, NAB VP of Science & Technology, said that rejection of the Adams paper "amounted to a suppression of what actually took place," and that the working group had not undertaken any standards setting activities.

Adams agreed, saying "One NRSC subgroup meeting doesn't make a law."

Frank Foti, another vendor of a composite clipper, cautioned the committee that, "Even though one meeting doesn't make a standard, some of my customers got bootleg copies of the paper and were worried." He said that those in the industry not attending NRSC meetings sometimes view the ongoing work as "the word of God."

After some discussion, the two full committee meetings' minutes were approved with only Small dissenting. He then read a statement of objection.

## Antitrust violations?

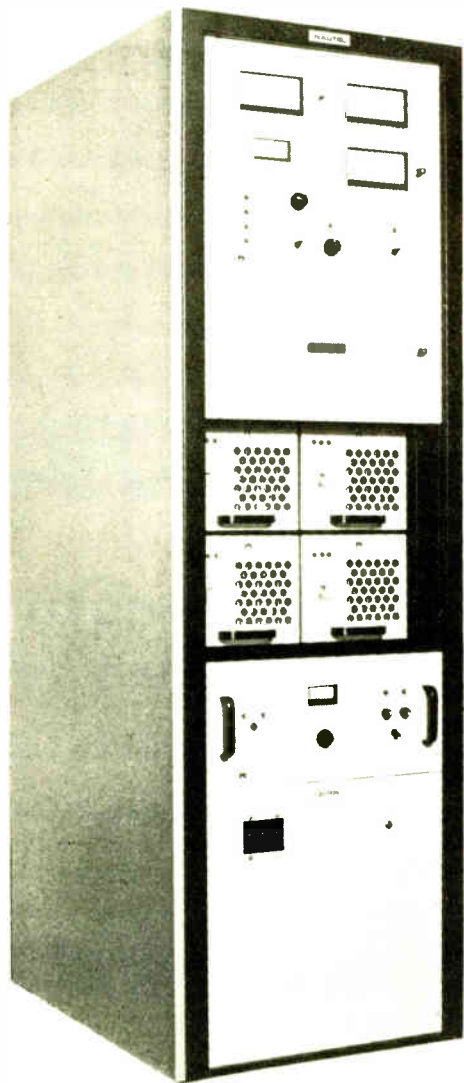
Saying that he believes that the matters considered by the NRSC and its working group "may very likely have violated antitrust laws to the detriment of my company," Small said the committee's refusal to act upon his objections meant that "I



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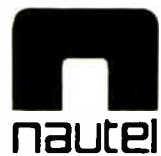
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**"...we have most certainly not ruled out a lawsuit."**

have no choice but to turn this matter over to Modulation Sciences' counsel."

His statement also maintained that "Modulation Sciences is not seeking to frustrate the legitimate activities of the NRSC. But by the same token, Modulation Sciences is not willing to let its own private interests suffer as the result of conduct which appears, on its face, to be inconsistent with the legal guides, procedural and substantive, which are supposed to govern the NRSC's activities."

Rau later maintained that the NRSC had not violated any standards by accepting the Adams paper under its composite working group.

"There was nothing in that meeting that was improper," he said. "I feel we're still in a position to solicit everybody's opinion on this issue and there has been no harm done. I believe it would set a bad precedent to suppress technical information because it was competitive with somebody's business."

Small said after the meeting that he was "meeting this week with counsel and we have most certainly not ruled out a lawsuit."

Rau said that there would be "efforts to work it out before it comes to legal action."

## Multipath tests

On less volatile topics, Harry Simons of WAEB reported on the start of multipath tests at his station. Simons is coordinating the tests apart from NRSC activities but will submit a report to the committee once they are completed.

Simons said that round one of the tests were completed at the end of July with "overwhelming results."

He had praise for the companies cooperating in the effort and he circulated coverage patterns developed by Air System Technologies, which used aircraft-mounted equipment to plot WAEB's antenna performance in real time, from the air.

Simons added that the information gathered was still being evaluated and that no conclusions could be drawn yet.

The first round attempted to characterize multipath in the field under as many different types of conditions as possible. He said the next round of tests, in late October or early November, will "fill in holes in the first round" and include a look at SCA operations under multipath conditions.

# Light at the End of AM's Tunnel

by Liz Darrig

**New Orleans LA** The approximately 100 gathered faithful of the "Long-Suffering AM Believers Society" heard good news at the Radio '89 show from a cast of familiar faces.

Panelists at the "AM Rebound" session said that the payoff is near on many of the ongoing AM improvement efforts started several years ago by the NAB, the EIA, the NRSC and the FCC.

The most promising single prospect noted by the participants was the prospect of wider-bandwidth AM receivers in the wake of the FCC's recent decision to require AM stations to comply with NRSC transmission standards.

NAB Science and Technology VP Mike Rau said "I believe the AM band of the future will sound better."

Ted Snider, former NAB Board Chairman and President of KARN-AM, Little Rock, and the Arkansas Radio Network, outlined NAB's multi-point AM improvement strategy. Snider said "I am more encouraged about AM today than I have been in a long time."

Snider said early meetings with new FCC Chairman (and former broadcaster) Al Sikes indicate a genuine sensitivity to AM's concerns. Representing Sikes at the seminar was newly-named Mass Media Bureau Chief Roy Stewart, who said, "I want the FCC to be responsive to AM problems and speed up the application process."

**A multitude of remedies**

NAB's various AM efforts deal with transmission standards, interference concerns and receiver quality. In addition to continuing support of the conversion to NRSC transmission standards, NAB would like to see more FCC attention to man-made interference.

The association also notes band congestion as a major problem, and has proposed generous "homesteading" provisions for daytimers to go fulltime in the new expanded AM band while keeping their existing frequencies operating until extended-band receivers are widespread in the marketplace.

The NAB and EIA have begun to work on standards for a new "service mark" to denote high quality receivers which meet both associations' reception stan-

dards. Several panelists expressed hope for a major push for a "Super AM" radio campaign to educate the general public about the availability of these radios in the future.



Panelists at the "AM Rebound" session were encouraging about the future of the band.

**Hope for antennas**  
NAB's Rau noted that the antiskywave experimental antenna has been constructed in suburban Washington and testing will begin this fall. The antenna is a directional design which is intended to suppress vertical radiation (skywave) in the null direction, but allow the groundwave to continue to normal non-directional contours.

**transmitter near the center of population in an area which would concentrate a relatively low power post-sunset signal where it counts most. Rau noted the possibility that several, strategically-located, low-profile, low power transmitters could cover a city better at night than a station's main antenna operating at reduced power.**

Since severe coverage restrictions inherent in many AM directional antenna designs are to suppress skywave interference to other AM stations, such a design could allow more generous "close-in" coverage, with more liberal directional patterns, especially for lower-powered regional AMs at night.

Rau also announced that his department has contracted with Dr. Richard Adler of the AGL Group, Pacific Grove,

CA, to develop a mathematical model for a "low-profile" AM antenna for daytimers with night authority. This antenna would be physically small and easy to install and operate near population centers, possibly on the roof of a building or warehouse.

The antenna Rau envisions could allow some daytimers to have a separate

transmitter near the center of population in an area which would concentrate a relatively low power post-sunset signal where it counts most. Rau noted the possibility that several, strategically-located, low-profile, low power transmitters could cover a city better at night than a station's main antenna operating at reduced power.

**More frontiers**  
On another technical front, Rau said he hoped the industry could soon begin looking into improving the science of AM contour prediction methodology. He said many engineers feel that current AM contour prediction methods don't tell enough about interference realities.

**NAB's John David urged broadcasters to actively support New Jersey Congressman Matthew Rinaldo's recently introduced bill, HR-2714, "The Radio Quality Improvement Act of 1989."**

The bill would require radios to receive both AM and FM, and would require AM stereo reception capability if the radio picks up FM in stereo. The bill would

also generally prohibit the FCC from enacting policies which would increase AM interference levels. A companion bill, S-1207, has been introduced in the Senate. (See related stories, this issue.)

Panel Moderator Art Suberbielle, of KANE-AM, New Iberia, LA, stressed the importance of this bill to AM. Suberbielle urged broadcasters to call and write their representatives in Washington in support of the bills, saying, "We've got to be lobbyists on this one."

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Liz Darrig is a freelance writer and radio talent based in Northern Virginia.

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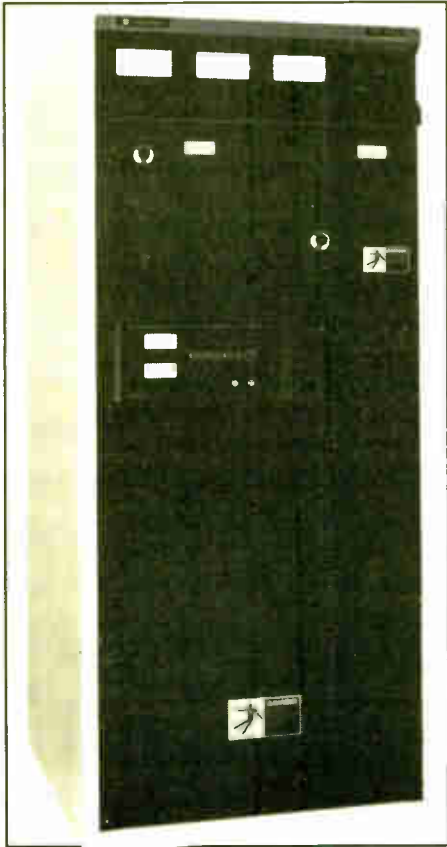
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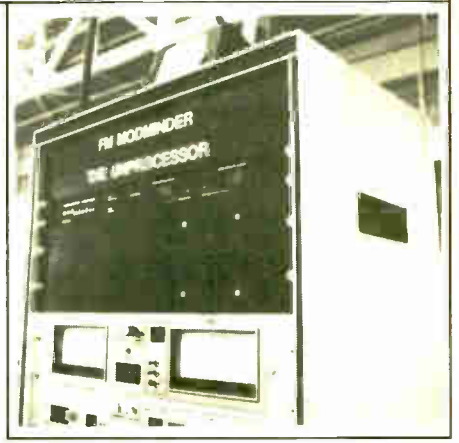
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# Products Take Show Spotlight

Radio '89 show-stoppers include the Digispot touchscreen digital audio system (right); Harris' HT-7 FM transmitter for Class A upgrades (below, left); Arrakis' line of consoles (below, center) and Dataworld's coverage maps (below, right).



Also new were the Audisk digital audio system for satellite format automation (below); Gentner's Digital Hybrid II (below, right); Modulation Science's FM ModMinder (below, far right). Show-goers also enjoyed a walk-around Cajun lunch.



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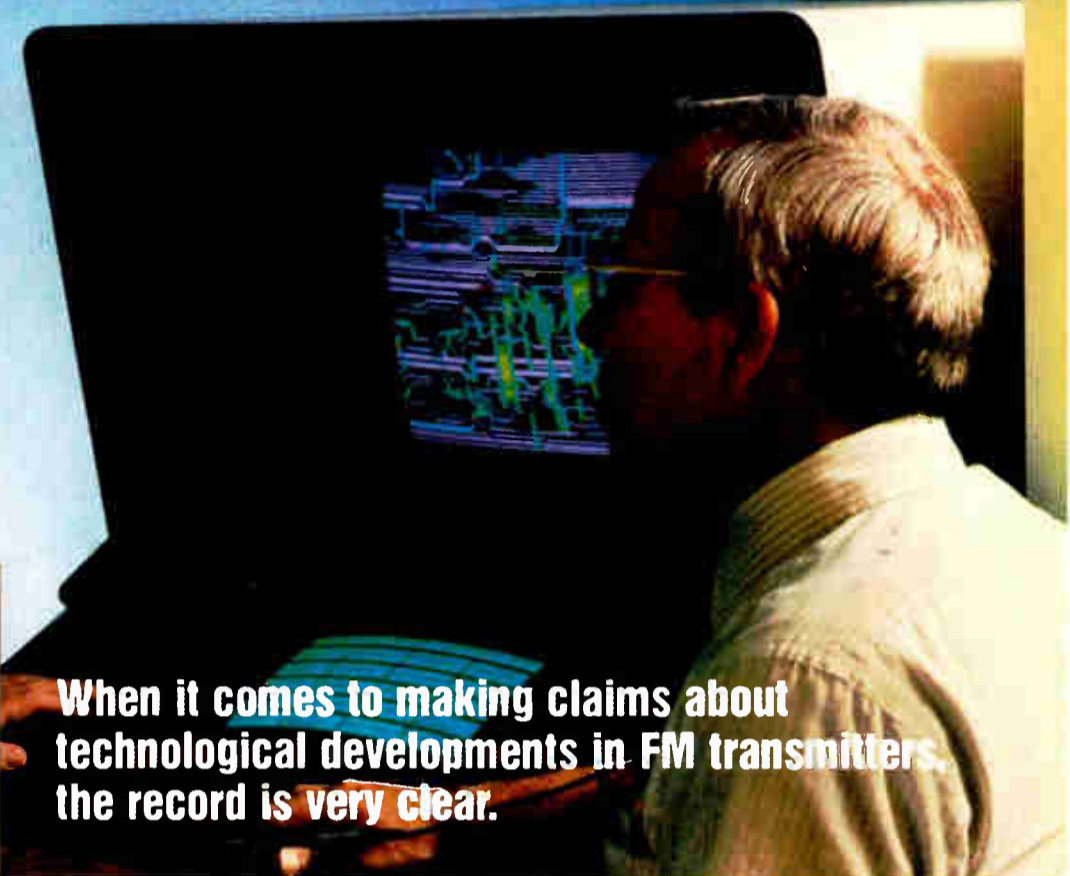
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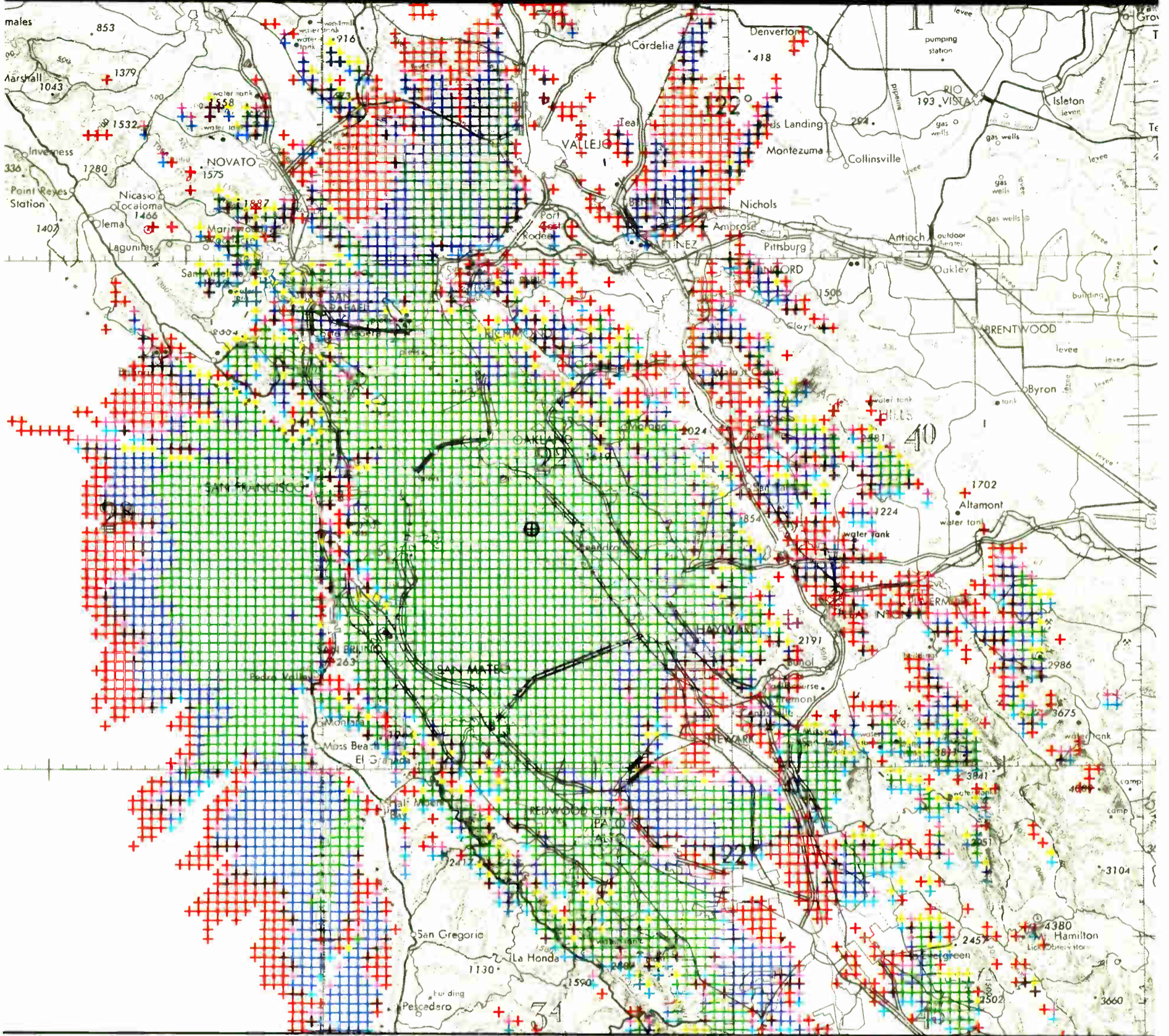
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# Radio Gear Amid the Fanfare

(continued from page 17)

off air) and carries a price tag of \$1795.

Modulation Sciences had generated a lot of pre-show interest in the FM Mod-Minder, a new modulation monitor which ignores short peaks and allows stations to come closer to modulation limits. ModMinder was introduced at the radio show and as expected, drew interest from attendees.

## Digital products

While digital audio editors and storage systems have come and gone in the past few years, there were some product introductions in this area as well.

featured its transmitter remote control watch by satellite service.

Target Tuning, the company that produces personal, frequency-locked radios as promotional items for stations in FM and AM stereo, introduced a table model SCA receiver and announced a personal walkman-type SCA receiver model as well.

And Broadcast Technology Partners, bucking the aftermath of a critical report about FMX, showed two FMX receivers: one from Alpine and a car model from JVC and reported that the number of FMX stations continues to grow.

Attempts to generate crowds in the ex-

hibit hall with carnivals and food giveaways, including a Cajun lunch and a pizza party were successful, for the most part.

The glitter and festivity culminated in the Marconi Awards presentation closing the convention. In addition to star performers and radio personality presenters, 23 awards were presented.

KNIX-AM/FM in Phoenix won for Major Market station and Ron Chapman of KVIL-AM/FM, Dallas won for Major Market personality. Paul Harvey was honored as Network/Syndicated personality and WLS Chicago was named Legendary station.



The Marconi Awards recognize outstanding achievements in radio.



Stan Freberg presents the Marconi Award for Major Market personality of the year to KVIL's Ron Chapman.

AKG demonstrated the pre-production version of its DSE 7000 digital audio workstation which was introduced at the NAB spring show.

A company called MacroMedia showed its Audisk System, an integrated digital audio storage device, switcher and controller aimed to replace carousel-type cart set-ups for satellite music format automation.

## Broadcast Supply West showed a DAT machine from Casio . . .

Digispot, another product introduction, is a touchscreen system which stores, edits and plays back digital audio as well as controlling other audio sources.

And at the Studer booth, now that that company has acquired Integrated Media Systems, the Dyaxis digital audio workstation was on display. Studer is promising future product introductions in this line under the new company formed by the acquisition—Editech.

## Best of the rest

Anticipating interest in DAT in the wake of an agreement over copying capabilities, Broadcast Supply West showed a DAT machine from Casio with a price tag of \$1495.

Radio Systems featured its Rs-DAT for broadcasters at its booth.

National Supervisory Network was a new exhibitor at the show. The company



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SQUEEZE PLAY has several useful applications. The most obvious is skimming a competing station, quickly and painlessly gathering useful information on playlist and rotations. However, a PD might want to skim his own station, perhaps to determine if the all-night jock is really following the music rotation, or just to evaluate the effectiveness of the music-rotation scheme. An enterprising PD might swap skimmer tapes with colleagues in other markets, studying successful stations who employ similar formats.

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# FM Issues Under the Microscope

by Thomas R. McGinley

**New Orleans LA** Recent technical advancements and FCC rule changes have opened up some new options for FM broadcasters.

The FM Engineering panel tackled five leading-edge topics including: changing receiver designs, directional antennas, Class A upgrades, a new FM modulation measurement technique and a look at the first round of FM multipath testing at WAEB-FM.

Rick Zerod, a radio design engineer for the Ford Motor Co. presented a receiver manufacturer's perspective of the many tradeoffs involved in FM receiver design.

**More options**

As better performing consumer electronics gear appears every year, rising expectations have demanded that radios must also get better. More and more CD players are being installed in cars, prompting the receiver designer to deliver a radio which can compete with CD sound quality, according to Zerod.

On the other hand, more crowding and stations using aggressive processing are causing more adjacent channel interference problems, thus receiver designers see the need to incorporate narrower IF bandwidth performance.

"Receiver manufacturers have only reacted to market conditions," claimed Zerod. Bandwidths are becoming narrower and are moving towards the European design which rolls off to -6 dB at 120 kHz.

Typical US bandwidths are down 6 dB at 200 kHz, Zerod said. While the narrower IF decreases interference, stereo separation becomes degraded. Could this be *deja vu*? The AM-ization of the FM band may be well under way.

Bob Surette, the engineering manager at Shively Labs presented an incisive look at FM directional antennas, "past,

present and future."

In the early days of FM DAs (pre-1983) the FCC treated them almost like any omni-antenna. By 1985, criteria were established in the form of policies which were not written rules.



MSI's Eric Small shows his company's FM ModMinder.

Front-to-back ratios of any DA pattern could not exceed 15 dB and the rate of change (slope) could not exceed 2 dB per 10° at any azimuth, Surette pointed out. The V-pol field could exceed the H-pol for commercial FMs but not for NCE FMs.

**New law**

With the adoption of FCC docket 87-121, these policies have now become law. In addition, for determining pattern RMS, the FCC will use the "envelope pattern," taking the maximum of either the H-pol or V-pol fields which must total to within 85% of the theoretical RMS.

Surette observed that new rules mean that any pattern proposing a near zero null or narrow minor lobes will not be licenseable.

Directional FM antennas do not always have to be panel type or bays with tuned parasitic reflectors. Directional patterns can be formed by taking advantage of the distortions caused by the supporting

tower structure and manipulating the mounting orientation.

But Surette is not enthusiastic about most omni stations using a DA. "Going DA to improve coverage in one direction will most likely cause loss of coverage in all other directions," he noted. "With the new DA rules, the FCC has made it more difficult for stations to make worthwhile gains," according to Surette.

Wes Whiddon of Group W Radio updated the session on the recently adopted FCC docket 88-375. This rulemaking provides for Class C3 and a Class A power increase from 3 to 6 kW on a selective basis.

**Some hikes automatic**

On 1 December, 1989, all Class A's which clear minimum spacings (about 500 stations) will be able to go to 6 kW automatically, having only to file FCC form 302 within 10 days after implementation. Another 800 Class A stations could increase power but only with a DA and/or by relocating transmitter sites.

Another 450 stations along the Mexican and Canadian borders will not be able to increase power until treaties are modified. The full power increase to 6 kW means a 40% increase in total area covered or about a two mile extension of the one mV contour.

Some 149 class A stations will be able to convert to Class C3 with an FCC form 301 and an FAA form 7460 filing if their antenna heights increase.

**New mod monitor**

Eric Small of Modulation Sciences introduced his new FM modulation monitor. Small said he has always wanted to make a mod monitor which looked at

the time domain instead of the amplitude domain and the new ModMinder comes as close as current FCC rules allow.

Basically this new concept in modulation measurement ignores the "short" mod peaks as defined by the rules which turn on the overmod peak flasher in existing monitors. And it provides a more accurate count of the longer peaks over a continuously rolling minute so that maximum modulation may be more accurately maintained.

ModMinder derives a baseband signal from any good FM tuner and provides a digital readout of the highest read peak to within 1% every second.

In addition to the rolling one minute count of peaks, ModMinder provides extensive remote control capability and interfacing to a PC via an RS-232 port. An external video screen shows a bar graph for peak values, all overmod hits being counted and shows a modulation histogram which tells the percentage of time a given percentage of modulation occurs.

Small hopes that ModMinder will allow station engineers to use less processing while retaining the same amount of apparent loudness. "ModMinder removes the incentive to overuse clipping and compression and will help to clean up the FM band," he said.

**Defining multipath**

In late July, Harry Simons, CE of WAEB-FM staged round one of the NRSC sponsored FM multipath field testing in Allentown, PA.

Among those providing support equipment and technical assistance for this ambitious project were: Continen-

(continued on page 34)

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# Engineers Discuss Interference

by Barry Mishkind

**New Orleans LA** In one of the more lightly attended sessions at Radio '89, about 20 engineers gathered to discuss interference and how to deal with it.

A panel consisting of Al Resnick of ABC/Cap Cities, Jim Hawkins of the FCC New Orleans Field Office and Moderator Wilson LaFollette, covered many of the whys of interference, as well as possible courses of action.

Resnick covered many of the factors that occur after the transmitter to affect our signals.

## Routine problems

Among the factors he cited were dirty or broken guy insulators, electrical interference from motors (even cab timers) and electronic sources such as calculators or computers.

While some of these may produce only insignificant amounts of noise, buried in the background, others may cause listeners to quickly tune out, Resnick said.

Jim Hawkins noted that the FCC's role in resolving interference problems is minimal at this time. However, he said the local field office can be very helpful in contacting the local power company or landlords to get problems corrected.

Also, he pointed out the local Engineer-in-Charge and his staff may

have experience with many problems unique to a specific area, such as doorbell transformers in the New Orleans area that have caused interference to a number of complainants.

Hawkins also noted that while the FCC is getting more and more com-



(from left) Al Resnick, Jim Hawkins, and Wilson LaFollette discuss the problem of interference.

plaints dealing with interference, the rules are not too clear on exactly what comprises "harmful" interference.

Often, the best way for a station to deal with complaints is as an exercise in public relations. While not at fault, assisting listeners may make them happier and appreciative of the aid, he said.

Hawkins pointed out that there were rules dealing with blanketing within the first year after station construction or

power increase but that residential encroachment on an existing facility really has not mandated solution.

One member of the audience mentioned that traps to prevent FM interference on TV sets, even with high gain amplifiers can be purchased for \$3 to \$3.50

generation of people that originally found and dealt with problems are retiring. There is a danger that some of the knowledge may be lost.

## Along the borders

One very positive note was sounded in dealing with international RFI. LaFollette said that cooperation from Mexico has been excellent of late, with several markets reporting quick and decisive response to problems along the southern border.

On the other hand, he noted the FCC-FAA relationship has been deteriorating, with a lot of bureaucratic infighting that tends to make locating transmitters near airports very difficult.

In fact, it was mentioned that the FAA's program is so restrictive that for one 80-90 breakdown channel in Hawaii, there is no site where the FAA will permit a tower.

The lone bright spot there appears to be a new FAA policy that allows a move if the predicted interference will not be increased.

All in all, as modern technology expands, station engineers need to be vigilant to spot and deal with interference before they cost the station lost listeners.

■ ■ ■

Barry Mishkind, in addition to being a regular *RW* columnist, has covered industry conventions for many years.

## Clean up

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.

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World Radio History

# Attention Focused On Dial-Up Remote



Dial-up remote control session panelists presented their views on use of the technology.

by Tom McGinley

**New Orleans LA** When Gentner Electronics introduced its VRC-1000 dial-up system over three years ago, the technology of broadcast equipment remote control suddenly became very different and very modern.

This year, Gentner has introduced the second generation of that product, the VRC-2000, complete with computer based accessories and just about every feature any remote control would ever need to provide.

Panel member Kelly Hannig, the VRC product specialist for Gentner, traced the evolution of the dial-up R/C which ultimately forced the FCC to issue Public Notice #88-194 last September.

## Clear on the clarification

Jim Hawkins, EIC for the New Orleans FCC field office, reiterated the key points of that document which cleared the technology as fully legal if used properly, but which reaffirmed several basic requirements that were never deregulated.

"Some stations apparently think R/C meter readings no longer have to be taken," said Hawkins. The operator log and the readings are still required, but now the station determines the time interval between readings.

The minimum parameters which still need to be monitored at all stations include output power, modulation, tower light status and DA parameters if AM directional. All readings need to be calibrated as well.

Control requirements include the need for all R/C stations to employ a designated operator at a fixed location, a separate method to turn off the transmitter apart from the remote control if it is a dial-up system and all EBS functions must be able to be executed by the duty operator.

All the panelists agreed that EBS is the main sticking point for "unattended" remote control operation away from the studio.

## Remote via satellite

Beyond the telephone dial-up system, yet a new level of technological sophistication has entered the business of remote control.

A group of Colorado chief engineers contemplated how efficiently K-Mart and 7-11 type chain stores are using a Ku-band satellite link and packet communications to streamline their sales, accounting, and inventory management. Why not adapt the same idea to broadcast remote control on a centralized multi-station basis? Thus the National Supervisory Network was born this past July.

NSN President and panel member Bill

Sepmeier outlined the basics of this radical new approach. A central control point supervises many stations via small Ku-band satellite links using a packet switch network with computers and existing dial-up remote control units.

The bidirectional packet switching standard uses X.25, developed in ham radio and used by many familiar data communications systems, such as CompuServe. The telemetry and control data for each station is scrambled within three levels, so security is assured.

At present NSN has adapted software for all of the popular dial-up R/C systems, including Gentner VRC, Burk (AMD) TC-8 and ARC-16, and Moseley MRC-16000. The system accommodates eight separate functions of EBS control, which is probably more comprehensive and reliable than most disk jockey operated local systems.

## Service plus

All operators at the central control point in Colorado are competent engineers or technicians who have training and background in the business. Every month, each subscribing station receives a performance data sheet, showing continuous graphs of the monitored parameters chosen by the local engineer.

NSN also monitors the national WeatherBank storm tracking system which allows the central operator to alert local areas of approaching thunderstorm and lightning activity.

In situations when alarms are received simultaneously from numerous stations, the duty operator acts according to a priority schedule of relative seriousness. A station's engineer is auto-dialed or paged for non-routine events and alarms which cannot be remotely corrected. NSN employs toll-free incoming lines. The system can also be used as a packet subsystem to exchange data (other than R/C info) among stations within a group.

Sepmeier worked closely with officials from the FCC and FEMA to insure that the system would fully comply with all applicable regulations. Jim Hawkins confirmed that to his knowledge, NSN is fully legal.

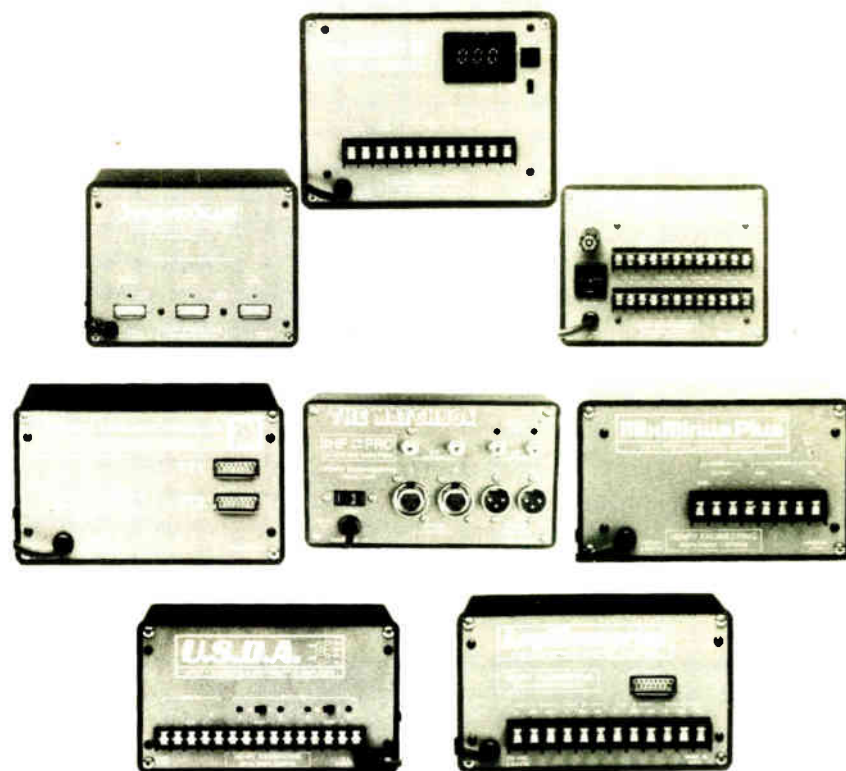
The basic station contract starts at \$800 per month for five years or \$990 per month for three years, which covers the \$20K worth of leased satellite, computer, and control I/O equipment.

Group and co-located discounts are available. As of NAB showtime, ten stations were under contract and approximately 250 more were seriously discussing going on-line, according to Sepmeier.

■ ■ ■

Tom McGinley is RW's technical advisor and DE for Cook Inlet Stations.

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Circle 36 On Reader Service Card

# Prospects for License Reform

by Barry Mishkind

**New Orleans LA** Three congressmen from the House Telecommunications Subcommittee of the House Energy and Commerce Committee were the panelists in an NAB workshop on license reform and technical improvement.

Addressing the NAB Radio '89 Convention in New Orleans were Congressmen Matthew Rinaldo (R-NJ), Joe Slattery (D-KS) and J. Roy Rowland (D-GA). Rinaldo is the chief sponsor of the bills, HR-1136 (the Senate version is SB-1207) and HR-2714. He is the ranking Republican on the House Telecommunications Subcommittee.

As the title of the session indicated, the 40 or so in attendance were keenly interested in the "Prospects for License and Technical Reform in the 101st Congress."

## At a crossroads

Moderator David Hicks of Hicks Broadcasting Corp., Kalamazoo, MI, started the program by noting that radio is at a crossroads, with increasing band clutter and interference on AM, as well as being "increasingly held hostage by license challengers . . . whose purpose is extract payoffs from licensees."

The congressmen were present primarily to discuss the two bills cur-

rently before the House of Representatives to address these problems. The NAB is supporting both HR-1136 and HR-2714.

Rinaldo began by mentioning that the license renewal bill (HR-1136) now has over 142 bipartisan co-sponsors. He feels that this is a very positive sign for eventual passage.

The technical improvement bill would mandate AM stereo on all FM stereo radios, direct the FCC to investigate and



Representatives J. Roy Rowland, Joseph Slattery, Matthew Rinaldo and moderator David Hicks at the Radio Only Legislative panel.

report on the problem of interference, allow daytimers priority on 1605-1705 kHz and prohibit FM translators from importing signals to markets with local stations.

However, among the other issues that must be dealt with before the subcommittee can handle the ones under dis-

cussion is the the pending bill on the Fairness Doctrine.

That bill, HR-315, will precede any other broadcast laws, according to Rinaldo.

## Spirit of cooperation

In broadcasters' favor is a sense of renewed cooperation between the FCC and Congress. Each of the congressmen pointed to Chairman Sikes' attitude as being better than his predecessors.

While recognizing that there is a hard fight ahead, Rinaldo said that it would be "virtually a dereliction of our duty to let AM radio wither away."

Rinaldo told the audience that "we must work together and keep pushing to fashion a package that broadcasters can both live with and support."

Congressman Slattery echoed the feeling that the FCC has in recent years "not gone in the direction that Congress wanted it to go, but instead sought to avoid its responsibility to implement the laws. "This hostility seems to be easing now," he said.

Slattery said it was his "strong feeling that Congress has not yet focused on the AM issue," and would be more supportive if broadcasters helped their representatives understand the situation. He feels that action should come on the bills by the first of the year.

Reflecting on his trouble receiving a clear signal while driving home, Slattery expressed support for AM stereo being required in FM stereo receivers, as well

as for interference reduction.

Congressman Rowland drew from his own listening experience with AM radio and spoke of his desire for it to recover and grow, in stereo, as a vital local service.

Questions from the audience went back to possible roadblocks to action on the bills. Other than the Fairness Doctrine, the congressmen saw opposition from receiver manufacturers as well as attempts to add anti-trafficking rules onto the bills.

## Comments come back

One other impediment was noted by Rinaldo. "Some congressmen are still smarting from pay raise comments made by some (radio) talk hosts . . . that members felt were insulting and demeaning." This hostility was the biggest impediment to getting more co-sponsors for the bill.

And, when asked about the section relating to FM translators, the congressmen said that they wanted to reduce the number of distant signals coming into an area. Low power FM had no support.

Rinaldo said that there was "clearly now an unacceptable level of interference that hurts broadcasters as much as listeners," and there was no need to further crowd the dial. He noted that a primary goal of the section on translators was to "keep stations within their service area," Rinaldo said.

Slattery said "we should do everything we can to preserve the small local stations." He added, "we cannot let the marketplace dictate the demand for stations . . . the public is not served by such a policy." Rowland also focused on the need to preserve local public service.

Summing up the views of the panel, Rinaldo raised the question of "what else Congress can do for AM radio." His view was that "we're going to do anything where there is a consensus on what we should do." He sees a more constructive and productive working relationship with the FCC benefitting the industry.

Barry Mishkind is RW's Eclectic Engineer and the cornerstone of RW's convention coverage.

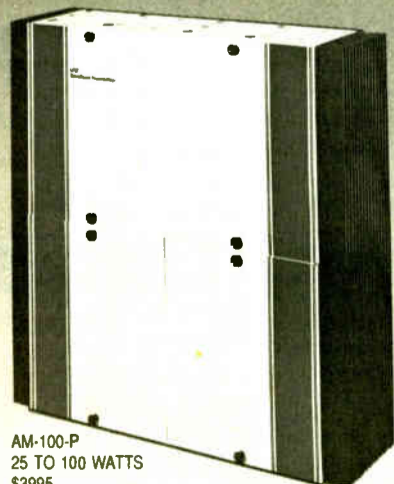
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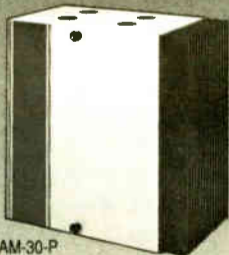
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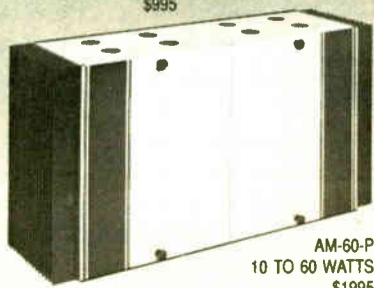
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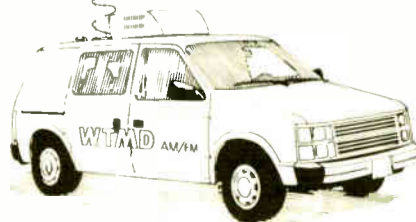


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# New Ideas in AM Engineering

by Barry Mishkind

**New Orleans LA** A good deal of information was presented during the AM Engineering session at Radio '89 to give AM stations hope for the future.

The topics of discussion ranged from the NRSC-1 preemphasis standard to on-going antenna studies and means of measuring splatter to prospects for new, higher quality receivers.

Bill Ammons of CRL pointed out that conversions to NRSC-1 have proved beneficial for many stations. On the other hand, there have been a few problems noted in the field.

## ... conversions to NRSC-1 have proved beneficial for many stations.

Ammons said CRL has found that spectrum analyzer checks show most stations can meet NRSC-1 easily.

### Some minor snags

But some installations have not been so successful, Ammons said.

Problems that can appear include a poor audio path to the transmitter, a poor transmitter input network or a poorly matched or maintained transmitter and antenna.

Ammons explained ways to deal with each of these problems, stating that a clean audio path with the limiter at the transmitter is a good first step to NRSC-1 success.

Getting the audio into the transmitter also requires care, as input filters can cause a station to lose up to half of its modulation—frightening some stations into dropping NRSC until they are educated.

Referring to older systems, Ammons said it was not possible to just "jam" high frequencies into the antenna. In fact, on some older systems, he said, narrowing the transmitted bandwidth may help a lot.

Another impediment to NRSC implementation is fear of becoming more vulnerable to splatter from an adjacent station. Ammons said the opposite is actually the truth.

When a station goes NRSC-1 by concentrating the signal in a narrower bandwidth, Ammons said it actually increases the SNR against the other station, improving it by as much as 3 or 4 dB.

### Antenna project status

Michael Rau, NAB VP of Science & Technology, discussed the status of the Prestholdt anti-skywave antenna study, now under way on a site owned by Howard University.

Rau said that some of the Prestholdt data was to be presented to the IEEE at its symposium the following week in Washington, DC.

Less publicized, but equally valuable, according to Rau, was the Christman counterpoise, or elevated ground system, also being tested as part of the project. It would reduce the need to bury extensive and expensive amounts of copper in the ground.

The Christman ground system is be-

ing used in conjunction with the Prestholdt antenna and an ambitious testing program has been designed to test both systems, Rau said. He added that the hope is to offer tangible results in a year or two.

In addition, the NAB is also looking at designs for a low profile antenna to help daytimers with night authority. Rau said the NAB has contracted with Dr. Richard Adler of AGL, Inc, to develop a model for such an antenna.

The working specification is a maximum height of 50 feet, a minimal ground system, NRSC compatibility and a driving point impedance characteristic that

provides stable and efficient operation on AM band. It also has to be economical.

Using NEC (numerical electromagnetic code) program, he said, a model has been produced but the 50 foot limit currently seems to limit use to above 1000 kHz.

Using a variation of a design by Carl Smith and J.D. Musselman, the model has a theoretical base impedance of  $9.2 - j171$  ohms, and radiated at approximately 10% of the efficiency of a standard  $1/4$  wave antenna.

Rau said the next step would be to perform more tests on the Smith-Musselman design. He added that the NAB also needs to petition the Commis-

sion to waive minimum power restrictions before low profile antennas would be allowed.

In an important part of the session, Robert Highbloom, exec VP of Denon America, expressed Denon's interest in making higher quality AM receivers.

Referring to a "golden marketing opportunity," Highbloom stated that Denon will include NRSC-1 deemphasis in all new models, including seven models for cars, due out in March. (See related story, this issue.)

Barry Mishkind, RW's Eclectic Engineer, has been a mainstay of convention coverage.

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**NEW NEW NEW**

# Ten Stations Win Crystal Kudos

## Awards Recognize Local Community Service Commitment in Radio

by Liz Darrig

**New Orleans LA** Ten stations which best showcase radio's local community service commitment took home NAB Crystal Awards from Radio '89 in New

Orleans.

In an era when much of the media and trade press attention goes to large market entertainment-oriented stations and megabuck station deals, this award was instituted by NAB Radio in 1987 to recognize the less-glamorous, but vital contributions many broadcasters make through their ongoing local news and service efforts.

While service-oriented programming has traditionally been the province of

AM radio and seven of the Crystals went specifically to AM stations of a two-station combo, it is interesting to note that none of the stations on the winners' list was a standalone AM with no co-owned FM affiliate.

### The winners are:

The winners were announced to a near-capacity luncheon crowd Thursday. WJON, St. Cloud, MN was recognized for a "highly creative variety of effective



Consultant Wally Johnson accepts a Crystal Award for station WDBC.

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programming to a diverse audience, bridging the gap between urban and rural cultural interests."

WLBK/WDEK, De Kalb, IL was recognized for 42 years of award-winning news, local service and entertainment.

KABC, Los Angeles got its award for the area-wide impact of the various projects of the station's Community Relations department.

WDBC, Escanaba, MI was honored for its heavy news commitment and Upper Peninsula severe weather coverage and for a special fundraiser for Armenian earthquake victims.

WGST, Atlanta was recognized for several local projects, including the only skybox coverage by an Atlanta radio sta-

### The winners were announced to a near-capacity luncheon crowd Thursday.

tion at the Democratic National Convention, the "Homeless Hotline", and raising \$250,000 to buy bullet-proof vests for local police.

### News and weather

KNCO-AM/FM, Grass Valley, CA was recognized for local service including a station meteorologist to cover the microclimates of the Western Sierra slope region and around the clock, commercial-free coverage of disastrous forest fires in 1988.

WTCT, New Brunswick, NJ received an award for the overall excellence of this Class IV AM's nine-person news staff, including New Jersey radio's only full-time political reporter.

WTLC-FM, Indianapolis was honored for having the largest FM news staff in Indiana, for community-oriented call-in shows and for feeding 20,000 homeless people last Thanksgiving.

KSEN, Shelby, CT was recognized for excellence in regional small market news and severe weather reporting.

WSM, Nashville received its award for its news commitment. The station received the Peabody, the Scripps-Howard Award and the Edward R. Murrow Award, all in a twelve month period. Also for its "I Love Life" program; a daily, local program featuring people who have overcome adversity.

Each station receives a wooden plaque with a multi-faceted glass crystal. The award name, of course, is taken from the word commonly used to describe the RF-detection circuitry found in many early radio receivers.

■ ■ ■

Liz Darrig is a freelance writer and radio talent based in northern Virginia.



# Shedding Light on Shortwave

by H. Robert Newman

**New Orleans LA** It's not often that a seminar is convened with major players in attendance. Nor would you think that an obscure broadcasting service—shortwave broadcasting—would generate enough interest to fill a Hilton meeting room before Radio '89 opened in New Orleans. Yet this was the outcome of the "Technical Aspects of Shortwave Broadcasting" seminar September 12, in New Orleans.

Chaired by Ralph Carlson, President of KUSW Worldwide in Salt Lake City, attendees were guided by the well prepared panel through the maze that surrounds the successful operation of privately owned shortwave radio stations.

Engineering Consultant George Jacobs began the seminar by discussing the history and licensing of shortwave stations in the United States.

**Limited history**

A veteran of Voice of America, Radio Liberty and a consultant to numerous international broadcast operations, Jacobs was effective in shedding light on the

casting as a natural extension of their network operations.

There were no US government shortwave operations until we were drawn into World War II and all commercial operations were appropriated for Voice of America.

Since World War II private use of

aspects of audio processing in shortwave broadcasting.

Because the shortwave bands are so congested, broadcasters are limited in bandwidth, have difficulties with fading and suffer from international interference. As a result, many shortwave receivers have an audio response not

stations: WSHB, WCSN, and WHBI.

Just try to imagine WSHB, just one of his facilities, with two 500 kW transmitters, two dual band curtain antennae, three 750 kW generators and room for more. The entire WSHB facility is controlled by a computer network that not only monitors transmitter operations, but also changes transmitter frequencies, and calculates maintenance schedules. Quite an impressive facility.

**Who's listening**

While getting the signal on the air is certainly important, the essential question to be answered is: who is listening? Without an international ratings book, stations must rely on letters received and estimates of total shortwave listenership.

Ted Haney with Far East Broadcasting did an admirable job of providing worldwide listenership figures. BBC estimates total world listenership at approximately 150 million people (they receive about 500,000 letters per year). Voice of America estimates aren't quite as high, but are still an impressive 127 million total listeners.

Following the seminar, the group was treated to a tour of WRNO Worldwide, New Orleans' own shortwave station. Put on the air in 1982, WRNO was the first commercial shortwave radio station to be licensed by the FCC after World War II.

The seminar "Technical Aspects of Shortwave Broadcasting" was a successful and informative seminar. With a mixture of business and engineering topics, the seminar took a balanced view of the international broadcasting service.

The United States is one of the only countries in the world that allows private ownership of international broadcast stations. Only in a country like ours can private ownership and operation of the service thrive.

H. Robert Newman is President of H. R. Newman Service Corporation, specializing in business planning, and is a former broadcaster. He can be reached at 805-496-2527.



A tour of WRNO facilities was part of the Shortwave Seminar.

shortwave has been slow to revive, until recently. Since 1980, privately licensed shortwave stations in the US grew from four to 15 stations. Most of this growth can be attributed to religious broadcasting, although commercial operations have been slowly developing as well.

**The how-tos**

Getting down to the practical aspects of putting together the transmitting facility, Larry Blum of antenna manufacturer TCI, examined how frequency bands and antennae are selected for international broadcasting services. Antennae discussed ranged from a modest log periodic to a rotating curtain antenna for the facility with unlimited budget.

And lest you think that audio processing concerns only AM and FM, Gary Clarkson with CRL examined the unique

much better than a telephone. (Does this sound familiar?)

Attendees were not only treated to the technical side of shortwave, but business aspects as well. Ralph Carlson of KUSW Worldwide shared many of his entrepreneurial views of private sector shortwave broadcasting and how his station is achieving a worldwide presence.

Joseph Costello of WRNO Worldwide related how his commercial station was called upon by the US State Department to alert the worldwide public of tampered bottles of Tylenol during the tampering scare of 1982. This after Voice of America refused to report the Tylenol incident due to its "commercial nature."

To bridge the gap between start-up and state-of-the-art, Ed Evans, Station Manager of the Christian Science Publishing Society shortwave stations, presented his



WRNO's Joseph Costello leads the tour inside the shortwave station.

unique problems that confront shortwave broadcasters.

It was interesting that the major private shortwave station owners in the 1930's were NBC, CBS, GE, Crosley and the religious broadcaster Worldwide Broadcasting Foundation. At that time, the networks saw international broad-



Beaven Els, Chief Engineer, WFAA-TV Dallas

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# Radio Promo Gains Momentum

by Barry Mishkind

**New Orleans LA** The NAB announced further details in what it called Phase II and Phase III of its ongoing efforts to promote radio.

During the Management luncheon at the NAB Radio '89 Convention in New Orleans, Jerry Lyman, Co-Chairman of the Radio Futures Committee unveiled the plans.

The promotion, entitled "Radio: What Would Life Be Like Without It" started this past spring with the famous 30 seconds of silence spot. According to Lyman, some 8000 stations participated in the spring promotion and over 135 million people hearing it.

In Phase II the RFC has nearly \$900,000 committed to advertising radio in newspapers and trade magazines, according to Lyman.

The ads are designed to gain the attention of management and emphasize the relationship between consumers and radio in a way that highlights the value of radio to advertisers.

Noting that the first ad was run in the 15 September *Wall Street Journal*, Lyman said "The print campaign links our broadcast theme directly to the advertisers and advertising agencies."

Then Lyman introduced a video illustrating how radio stations wouldn't take one bumper sticker to a remote, or one coffee mug, or place just one ad in the

local media.

Instead, he said, the industry needs to have a continuing promotional effort designed to keep radio in the minds of decision makers.

Lyman then went on to unveil Phase III of the promotion. In early October, format specific jingles and music beds will be shipped to stations with a plea

**...Phase III includes a contest for the most creative use of the materials.**

for their use.

To generate further interest from stations in using the beds to create local ads for radio Phase III includes a contest for the most creative use of the materials. Stations will be invited to submit the final products they produce, with winning entries being distributed nationally next February for air play in the spring.

Lyman said "Our mission is to increase awareness of the value of radio" and noted that with solid support 'it will work for all of us.' A red, yellow and black bumper sticker is being distributed as well to increase visibility of the campaign.

Also at the management luncheon, D. Wayne Calloway, Board Chairman and

CEO of Pepsico was awarded a new NAB "Public Service Award."

And Ray Livesay, perhaps best known for heading the Daytime Broadcasters Association, was the recipient of the "National Radio Award." Livesay, a broadcaster for over 50 years was active on the US Radio Industry Advisory Committee to the FCC and State Department.

Attendees were also told that this convention, Radio '89, had record high attendance for the fall show.

Barry Mishkind is RW's Eclectic Engineer and has a long history of covering industry trade shows.



Jerry Lyman outlines the next phases of the NAB's radio ad campaign.

## Technology, FCC Rules Open Options for FM

(continued from page 25)

tal, ERI, TFT, Air Systems Technologies, Radio Design Labs and others. Delco and Ford provided various car radios for evaluation and Ted Schober of RadioTechniques was the technical consultant. Delco also came with a field van loaded with specialized test equipment.

According to Simons, "The receiver manufacturers were primarily interested in characterizing what multipath does to FM reception in the real world and to then develop better receiver designs to minimize the problem."

The ERI 4-bay antenna used by WAEB was refurbished and optimized at the factory. Tom Becker of Air Systems Technologies flew the pattern several times in a fixed-wing aircraft using an FIM-71 field meter and computer to evaluate pattern circularity and axial ratio performance.

The other primary mission of this first effort was to evaluate the effect of changing levels of transmitter ICAM (synchro-

nous AM noise) on multipath as perceived by various receivers at selected fixed locations.

The Continental transmitter was pulsed on and off with 1 kHz to allow the Delco field van to measure reflections and characterize the magnitude of received multipath.

Preliminary conclusions reveal that in areas of severe multipath or very low multipath, changing ICAM any amount by detuning the transmitter's IPA had no effect.

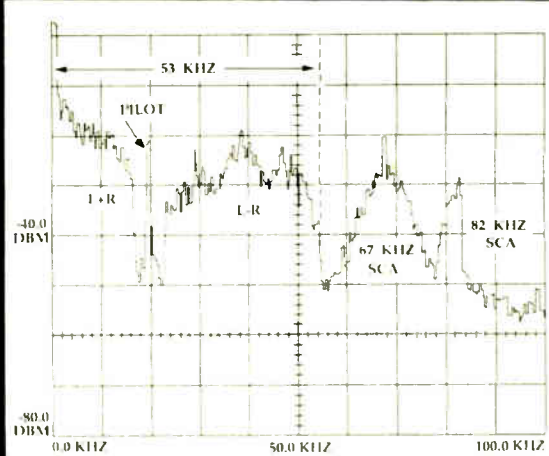
But, in areas of moderate multipath, improving ICAM by about 20 dB will noticeably clean up the reception. Only 10 dB of change did not produce conclusive improvement, according to Simons.

He said the next field tests, scheduled for November will evaluate the effects of audio processing, overmodulation and SCA operation on multipath.

Tom McGinley is RW's technical advisor and DE for Cook Inlet Stations.

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# Fined For Failure to Know FM Efficiency

by Harold Hallikainen

**San Luis Obispo CA** It was a full summer for me including a 20 year high school reunion (which was great!) and my first trip to New York City. I got started in radio while in fourth grade, building a Knight kit AM transmitter (a pair of 50C5s and a 12AX7) that cost me \$12.95. This summer I got on the air in NYC (OK, it was only an ID on an AM station operating in the experimental period ...).

## INSIGHT ON RULES

One intriguing aspect of radio is the FCC inspection. This month, let's look at the results of an actual FCC inspection (April 1988). The FCC and station correspondence provide some insight into the rules.

### Operator to know FM efficiency

During the inspection of KYLO-FM on 13 April 1988, no one at the station was able to tell the inspector what the efficiency of the FM transmitter was. This resulted in a \$200 fine for violation of 73.267(c)(3). Further, there were no limit charts or instructions for the operator to determine the operating power (violation of 73.1860(c)), resulting in another \$200 fine.

In its reply, the station argued that the transmitter efficiency factor was on the door of the transmitter. The station further argued that the operator does not need to know how to determine power by the indirect method, since the station uses the direct method.

Finally, the station argued that 73.267(c)(3) does not require the station to have an operator that can determine power by the indirect method, it merely specifies how to determine power by that method. The station has, however, instructed operators on this method.

The station was not cited for over-power operation, but for use of untrained operators. The station said the operators have been instructed, but they forget.

### FCC responds

The Commission responded that the problems (inability to specify transmitter efficiency factor and concomitant lack of skill/knowledge of the transmitter duty operators) are not trivial problems.

Rather, the FCC said, the problems reflect the real-world concerns about the degree of management commitment to excellence of operation as well as requirements of skill levels of the people whom we allow to operate a radio transmitter at a broadcast station.

The Commission further stated that "the efficiency factor of the transmitter is of prime importance in operation of an FM transmitter since in the vast majority of transmitters inspected in our collective experience the transmission line meter is not calibrated in sufficient detail as specified in Section 73.267(b) of the rules and therefore determination of power by

the direct method is not proper."

Without records demonstrating the calibration procedure, the Commission holds the station to be operating by the indirect method.

It is interesting to note that the rules allow the use of the direct method even if the output power meter has been calibrated using the indirect method, relying on the efficiency specified in the transmitter manual (although preferred methods include use of factory test data for that specific transmitter, power and frequency, and the use of station determined efficiency, using a wattmeter or calorimeter).

### The direct method

So, if you want to determine power by the direct method, log your calibration procedure in the station log and put a calibration sticker on the meter. That sticker (showing the calibration date) will make it easy for you to dig back through the logs to find the actual calibration data and procedures.

Note also that 73.267(c)(3) requires the efficiency factor to be determined and a record kept. Although this section is a subsection of the section on determin-

### The station said the operators have been instructed, but they forget.

ing power by the indirect method and *may* not apply to those stations determining power by the direct method, it is common practice for the FCC to determine power by the direct and indirect method during an inspection to check meter calibration.

To do this, the efficiency factor must be available. The operator on duty should know what the efficiency factor is. During this inspection, the transmitter efficiency factor was on the transmitter door, but no one at the station knew this.

The inspector will not search the station looking for the information. The inspector will ask station personnel at the time of inspection and expect it to be furnished or conclude that it is not available.

### Common denominator in violations

The Commission fined the station for two violations that were caused by the operators not knowing the efficiency factor. One violation was based on there being no record (presented when asked for) of the efficiency factor (73.267(c)(3)). The other related violation was improper operator training, since they could not determine the power.

The station also argued that these picky violations were "precisely the kind of regulation that the Commission has been eliminating, and for good reason."

The Commission responded that the "reregulation" in no way downgraded the technical performance requirements. The responsibility for insuring that the

(continued on page 49)

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# Musical Workstation Recording

## Compose Your Own Music Beds for Spots, Promos and Other Uses

by Bruce Bartlett

**Elkhart IN** There's an easy way to create instrumental music for spots, promos, news intros and so on: use a musical workstation. With one of these, you can recreate the sound of a group of musicians by playing all the parts yourself on a piano-style keyboard.

A musical workstation is a complete MIDI studio in a single package. That is, a workstation might include a piano-style keyboard with a built-in synthesizer, samples, drum machine and sequencer—all in one portable chassis. This is everything you need (except monitor speakers) to compose, perform, and record instrumental music.

Samples are digital recordings of the notes of real instruments—drums, bass, piano, etc. A sequencer is a group of computer-memory chips that records your performance on the keyboard. A multitrack sequencer lets you record several different performances of different instruments, all in sync with each other.

With the sequencer, you can record the performance of one musical instrument

at a time and overdub other instruments until you have the effect of a band playing. You might start with drums, then add bass, then piano, then flute. You play along with the previously recorded parts to keep in time with them.

## LINE OUT

Figure 1 shows a keyboard musical workstation plus a pair of monitor speakers and a 2-track recorder that records the final audio mix.

### Storing sounds

To store sound parameters and performances, some workstations use a built-in disk drive; others use plug-in RAM cards.

The all-in-one workstation keyboard is compact and simple because it omits wires and costs less than a group of connected equipment. However, separate components are generally more flexible and powerful. But you can create full musical productions using nothing but a workstation.

Although a workstation keyboard seems complete, you also might need a multitrack tape recorder or recorder-mixer to record vocals and acoustic instruments. The tape tracks are kept in

sync with the sequencer tracks by an FSK (Frequency Shift Keying) sync tone recorded on one track of the multitrack tape recorder. (Tape sync methods will be covered in detail next month.)

### Typical products

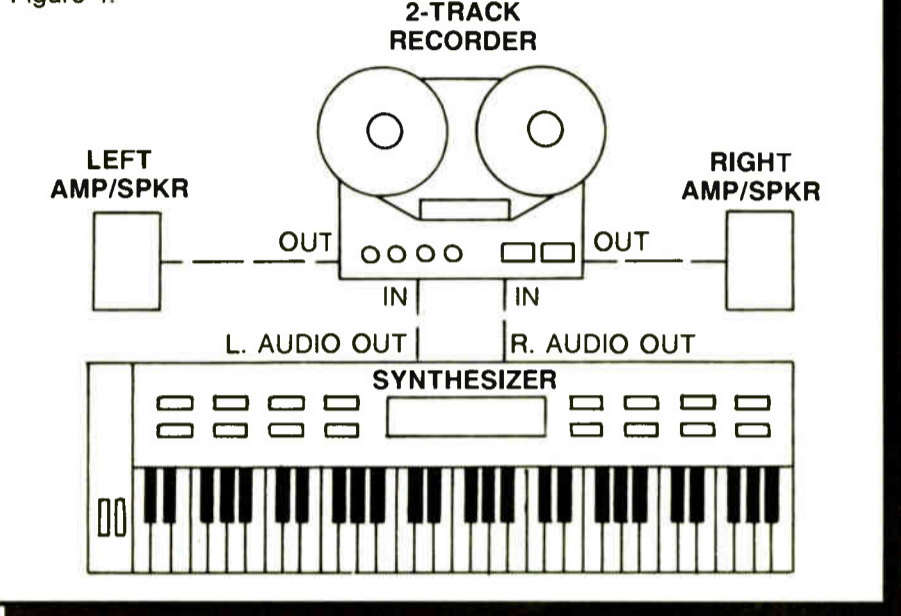
Two examples of workstation keyboards are the Roland W-30 and the Korg M-1. Some other prominent models are the Roland D-20 and D-50, Kurzweil

Eight individual polyphonic outputs are provided so that each patch can be processed individually.

The Korg M-1 has a 61-note keyboard and a playback-only sampler with 200 megawords of ROM. The M1 uses multisamples of acoustic and electronic instruments, waveforms, and attack transients as sound sources.

It provides normal synthesizer parameters and digital multi-effects.

Figure 1.



K250, Ensoniq EPS and SQ-80, and Emu Systems Emulator III.

The Roland W-30 includes a 61-note keyboard, a ROM (Read Only Memory) with frequently used sounds, a sampler with 512k RAM (Random Access Memory), a 16-track sequencer, a 3.5" floppy disk drive, and a large LCD display. Each track of the sequencer can play up to 16 MIDI channels for a total of 256 independent, simultaneous parts.

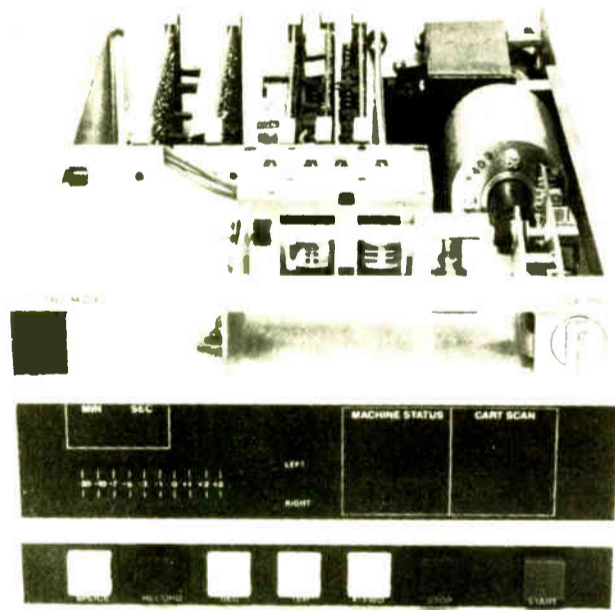
Up to 16 voices can play at once. The W-30 can layer (mix) parts or independently play eight parts at the same time.

Built-in sounds include 100 programs (with four drum kits) and 100 combinations of those programs. More sounds are available on plug-in ROM (Read Only Memory) cards.

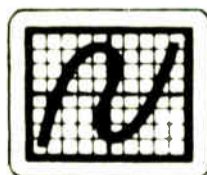
The M-1 can play up to 16 voices at once. Four polyphonic outputs are available with stereo panning. A powerful 8-track sequencer permits looped patterns. The programs, combinations, sequences and effects can be modified in detail. For example, the M1 allows event editing so that you can fix individual notes.

(continued on page 38)

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# Catching Up on Digital Ideas

by Mel Lambert

**Studio City CA** With two major pro audio and broadcast conventions on the immediate horizon, starting with the New York AES Convention and followed back-to-back with the SMPTE Convention in Los Angeles, it's appropriate that our attention turns to digital technology.

As we are all becoming increasingly aware, there are workstations, DAT recorders and processing hardware in every broadcaster's future and we all need to keep up to date with the new vocabulary of digital systems.

## DIGITAL DOMAIN

Controlled from a central high-speed master controller—usually an Apple Macintosh, IBM AT/PS-2, or a custom-developed engine—the present generation of workstations offer two-channel record capability, with up to four or eight simultaneous digital/analog outputs. Internal mixing of an unlimited number of stereo and mono tracks also is available.

There are more powerful designs out there, including several that offer up to eight or more channels of simultaneous input and output, but for the moment I'll consider designs more appropriate for a "typical" radio production suite.

### Non-destructive editing

Although it's often overlooked, in reality our edit decisions do not affect the original digital sound files recorded or stored to hard disk.

As we spool through the program material and locate areas of interest—using either a dedicated scrub wheel, mouse or cursor keys, and/or study a graphic representation of the signal modulation on a video monitor—we are simply capturing timecode, feet/frames or h:m:s designations of the audio edit locations.

Stored in a separate "Edit File" during playback, these "pointers" command the audio processor to "knit together" the digital bitstreams coming from the hard disk, to produce the edits, with cross-fades, we expect to hear.

Obviously, because the original soundfiles are untouched, we can repeat the process as often as we need, or re-edit a basic set of music cues, for example, to produce a batch of customized station promos with alternate outro tag lines.

And of course these new, edited soundfiles can also be re-recorded to hard disk, for later use as component soundfiles during a subsequent editing session.

It would be possible to simply re-configure the original Edit Files. Quite often, however, it makes more sense, space-wise, to off-load or even delete the original soundfiles used to prepare the master mixes, and replace them with the edited version(s), before starting over on a subsequent project.

### Real-time signal processing

Because of the sheer brute-force number-crunching power required to perform digital signal processing on mono or stereo signals, first-generation systems offer a compromise. For relatively simple functions, like level adjustment and pan-

ning (which, in reality, comprises relative level adjustment between the pair of output channels), we can perform real-time—or "on-line," to use the jargon—processing.

For even simple equalization changes, as well as dynamic gain changes (compression, limiting, gating, etc.), system designers often elect to perform these functions off-line, by re-recording the processed files to hard disk as new material. The conversion process usually runs at four, eight or more times real-time play speed, which means that we need to go off and check the wire machine, or whatever, while the workstation does the math.

The majority of digital workstations present a graphical view of the soundfile(s) being edited, along with a "Now Line" that represents the equivalent position of the "digital playback head." As the pattern that represents the audio track moves from left to right (or right to left, to mimic the playback head's view of the tape, rather than ours), the Now Line displays the timecode, feet-frames or h:m:s of the event being replayed.

We can stop and start the playback to capture a course edit location, and then by using the mouse, trackball or dedicated controller, scrub the graphic past

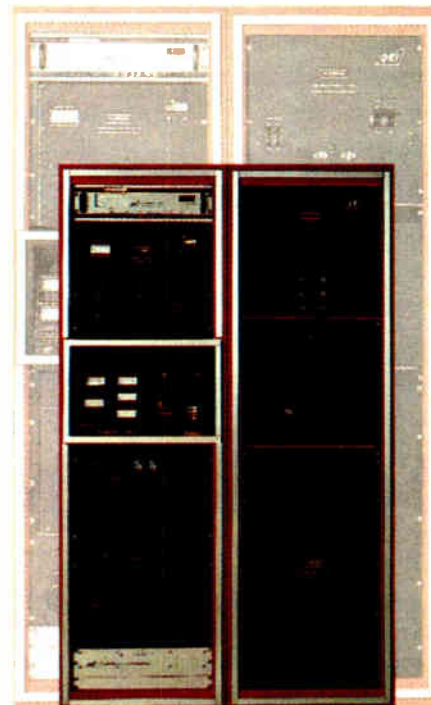
the Now Line to more precisely locate the edit point. (It also goes without saying that we can "Zoom In" towards the Now Line to more precisely locate the edit point. (It also goes without saying that we can "Zoom In" towards the Now Line to increase our resolution, and possibly locate the exact digital sample at which we wish to make the edit.)

Having located the exact edit point we want to use, most workstations allow the operator to select a variety of crossfade times and profiles, that allow audio to be faded down under an incoming mu-

(continued on page 39)

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One final item to get you thinking: All top-rank manufacturers have a 24 hour major parts and service line. QEI's major parts depot, however, is just half an hour from a major airport—Philadelphia International. When minutes count, that could be important.

If other manufacturers can't solve these dilemmas, talk to the people who can. Call us at 800-334-9154, toll-free, for complete information on QEI's "New Reliables" field-upgradeable transmitters—the FMQ 3500/5000/10000 and the new FMQ 20000B/30000B.

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World Radio History

# Workstations as Musical Tools

(continued from page 36)

With the M-1, plug-in RAM cards are used to save and load sequences and sounds. Sequence memory is limited to 7700 notes, and you must save and load all your songs at once.

To get around these limitations, Korg offers the Frontal Lobe by Cannon Research Corporation. It is an add-on unit which features increased memory, a disk drive, and many other functions. Also, Korg's T-Series of musical workstations include more memory and a disk drive, as well as different keyboard options.

To illustrate how you might record a song with a workstation's built-in se-

quencer, I'll describe how it's done with the Korg M-1 musical workstation.

First note that there are three ways to record: real time, step time and punch-in. With real-time recording, the sequencer records your performance as you might play it on stage, in real time, and plays it back at the same tempo.

With step-time recording, you enter one note at a time (specifying each note and its duration). The music plays back at a normal tempo.

With punch-in mode, the sequencer goes into record mode only during a specified spot in the song—say, for three measures starting at measure 17. In this

way you can record over musical errors and replace an old performance with a new one.

## Recording techniques

Multitrack real-time recording with the M-1 is simple. The basic procedure is as follows.

Press SEQ (for sequencer) on the front panel. A sequencer menu appears on the LCD screen. You can move a cursor to select various parameters (described below) and press the up or down buttons to set the value of each parameter.

Set the time signature (in the Initialize menu) and select the song number.

Set the tempo (in the sequencer play/real-time record menu).

Select the track number (track #1 to start), then select the program number for the desired sound (say, #9 for a drum set).

Press REC (record) and START. Listen to two measures of metronome clicks, then start playing. When you're done, press STOP. To hear what you just played, press START. If you want to rerecord the part, press REC and START and play the part again.

To record the next track, set the track number to the desired track (in this case, track 2).

Select the program number for the desired sound (say, a bass). Press REC and START. As you listen to track 1 playing the drum part, play a bass part on track 2.

Continue this procedure (steps 6-8) up

## You can easily correct mistakes in each track by punching in.

to 8 tracks, adding a new instrument each time.

You can page up to the effects menus to set overall effects: hall reverb, chorus, flanging, echo, distortion, and so on. Press "8" on the numeric keypad to get to the effects menus.

Save the completed song to a plug-in RAM card or to an external sequencer and disk drive. The sequencer recording might have to be done one track at a time with other tracks muted.

## Punching and step recording

You can easily correct mistakes in each track by punching in. To use this technique, first play the song to find the measures needing correction. Select punch-in mode.

"Page up" one page; set the punch-in measure and the punch-out measure; page down one page. Set the measure number to a point a few bars before the punch-in.

Press REC and START. You'll hear the song playing. When the punch-in measure comes up, play the corrected part. Press STOP when done.

Here's the basic procedure for step recording:

Select the track number and the measure number where you want to start. Press REC and START.

Set the length of the note (1/32 to 1/1). If necessary, specify triplets, dotted notes, key dynamics, style of playing and rests.

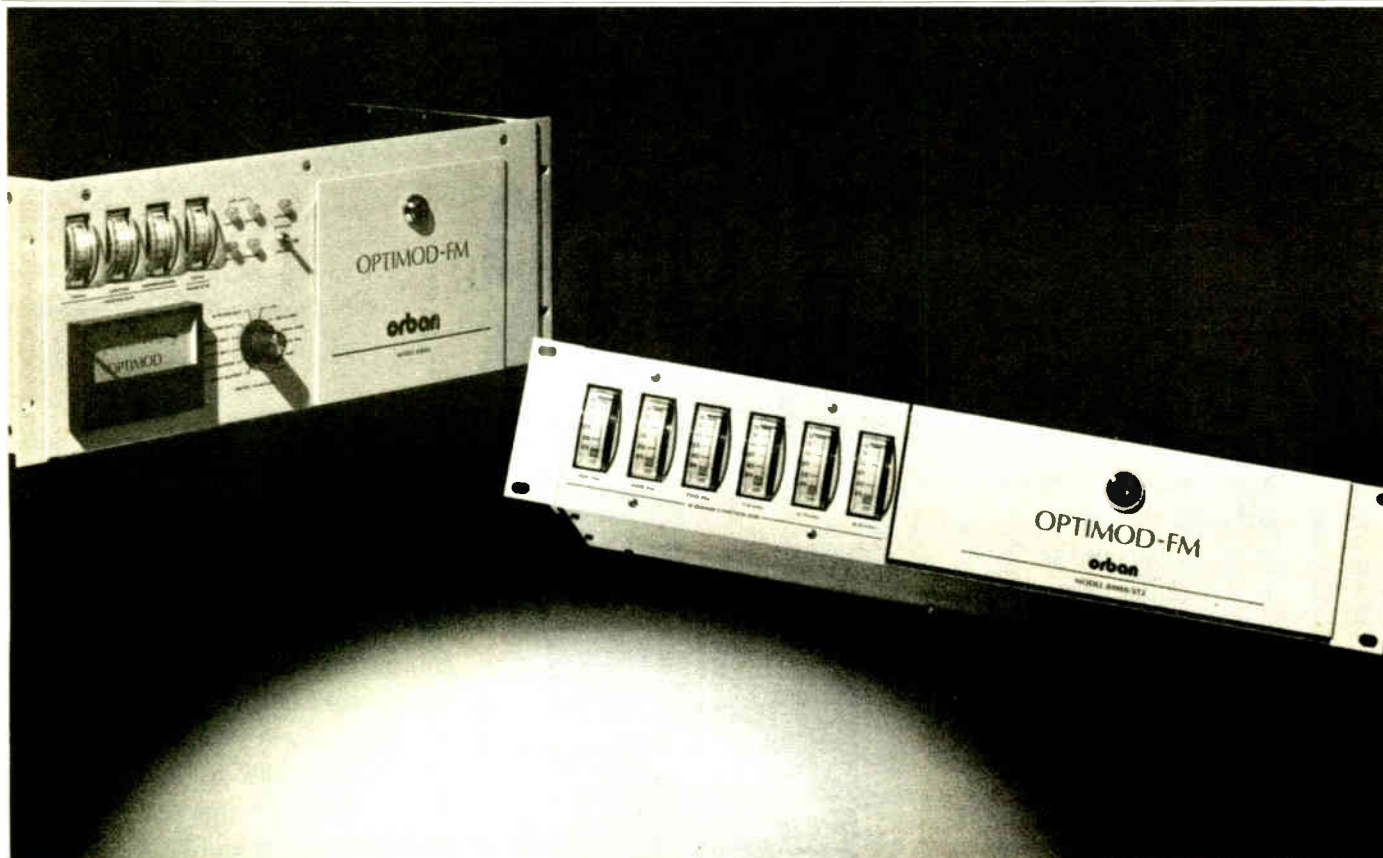
Press the desired note or chords on the keyboard. When you release all the keys, the recording proceeds to the next step. After entering all the notes, press STOP.

In addition to these basic operations, you can also bounce tracks, edit each note event, or create and copy patterns (say, for a drum or bass part). You can likewise modify track and song parameters, insert/delete/erase measures and modify sounds and effects (in great detail).

Clearly, the musical workstation is a highly convenient device to compose and record original instrumental music for your station.

■ ■ ■

Bruce Bartlett is a microphone project engineer and technical writer with Crown International. He can be reached at 219-294-8000.



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# A Rundown of Basic Digital Concepts

(continued from page 37)

sic cue for example, or for one sound effect to butt hard up against the next. We usually have the choice of "Insert Editing" or "Assemble Editing."

During the former, we are replacing material that already exists in the Edit File—or simply shortening a file by deleting material—while the latter technique involves building up the edited track piece by piece from beginning to end. (As will be readily appreciated, most "fix-it" edits are done in the insert mode.)

On workstations that can handle more than a pair of data tracks, as we build the material into a mix, a second, complementary "Mix Window" comes into its own. Here we can audition, for example, dialog

**... most "fix-it" edits are done in the insert mode.**

edits that are occurring over a continuous music track, or where we have a series of effects tracks that cross fade beneath a primary dialog and music balance.

### Digital format conversion

If a workstation is equipped to handle a variety of digital IN/OUT formats, it's often possible to move from one format to another. This format conversion can either be done in real time, or by recording to hard-disk and then offloading the soundfiles via the appropriate ports.

For example, a suitably-equipped system might be able to transcode between, let's say, AES/EBU, S, SDIF-2 ("1610/1630" compatible), EIA-J (PCM-F1/601-format), Yamaha Stereo (a useful format that enables direct connection to any Yamaha digital console or signal processor) and ProDigi (for direct interface to the DUB "C" ports of Mitsubishi and Otari PD-Format machines).

Here I'm considering digital IN/OUT using the same sampling frequency. If we need to change the sampling frequency—possibly to convert a stereo DAT soundfile recorded at 48 kHz to 44.1 kHz for input to a workstation—then the necessary sampling frequency conversion is a task usually allocated to a custom-designed unit able to perform the high-speed math functions in real-time, or assigned as an off-line task for a conventional workstation.

### Track minutes/hours

Although the storage capacity of a hard disk system is usually expressed in terms of Mbytes, it

is more convenient to talk of a workstation's capacity in terms of track minutes or hours of digital audio.

The sums are pretty easy to perform, using the following formula:

$$M = (D \times 1000) / (F \times 2 \times 60)$$

where:

M=the audio capacity, in minutes.

D=the total hard-disk capacity, in Mbytes.

F=the sampling frequency, in kHz.

For example, a 320-Mbyte hard drive will hold just over 30 minutes of stereo audio:

$$M = (320 \times 1000) / (44.1 \times 2 \times 60) = 320,000 / 5292.0 = 60.5$$

In more convenient audio terms, at a sampling frequency of 44.1 kHz we can store one minute of 16-bit mono digital data per 5.3 Mbytes of hard-drive capacity. It should be

remembered, however, that this storage capacity is freely assignable, so that if the workstation is capable of manipulating a total of eight soundfile tracks, then the total duration of this multitrack balance will be correspondingly shorter.

Because we also need to store the Edit File on disk, along with the digital data, the actual audio capacity of a hard drive will be slightly less than these totals;

such edit-location files and other directory files are usually so small in comparison, that the difference is only 1-2%.

■■■

*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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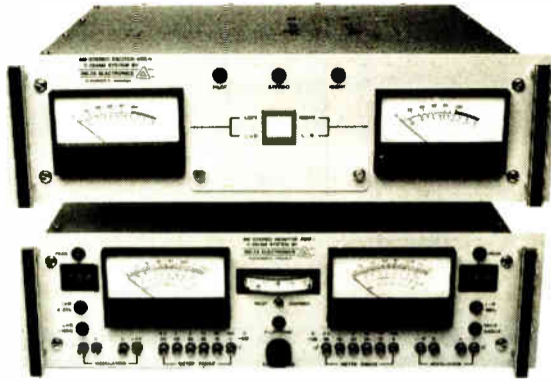
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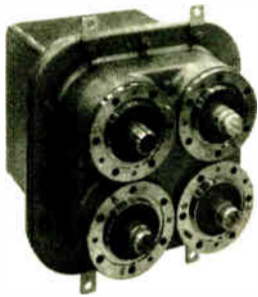
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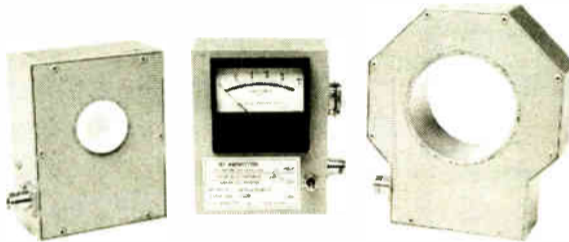
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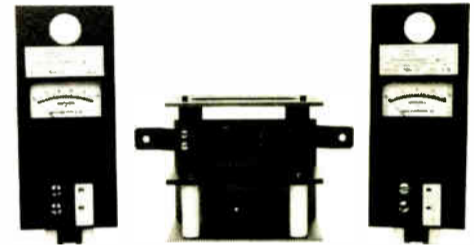
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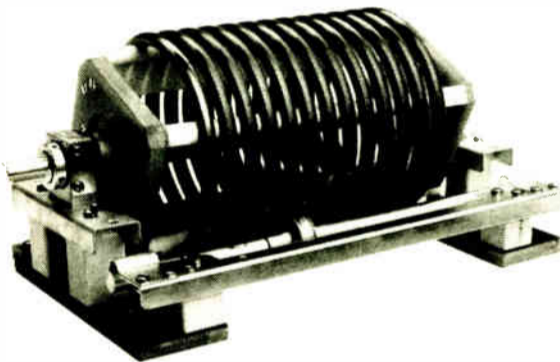
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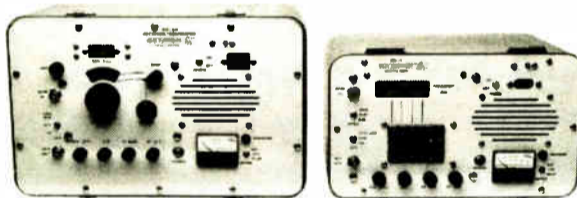
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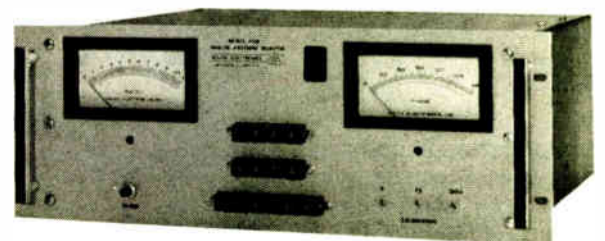
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Circle 83 On Reader Service Card



# Memories of Towers And Service Areas

by George Riggins

**Long Beach CA** How about getting a pair of towers for a total cost of \$285? Seems that KIEV, Glendale, CA was able to purchase the "set" of towers from KNX in Hollywood in 1931 for that paltry sum.

The cost, as broken down, was \$250 for the towers and \$35 to a local blacksmith to move the towers. The foundations for the towers and the erection of the towers was done by the blacksmith and Reed Callister.



Callister and David Cannon were the first owners of KIEV, selling the station to the father of the present owners of 1961. According to further information in an article from the *News Press* (5 May 1989) KIEV went on the air in the spring of 1931 from the basement of the Glendale Hotel. The space was traded for advertising time.

**On service area**

Herbert Hoover spoke about service area at the Fourth National Radio Conference. "Service area . . . by 'complete service area' I mean the territory within which the average set can depend on getting clear, understandable, and enjoyable service from the station, day or night, summer or winter.

"I do not include radio golf around the edge of these areas in our conception of public service—that game is an exercise of skill and the efficiency of your set plus a gamble of the radio weather, but we are not here concerned with it. Actual operation of high-powered stations has proven advantageous in broadening the 'complete service area,' but this area is much more limited than many expected.

"Subjected to the test of positive and reliable service at all time and all weather, it will be found that the real effectiveness of a station falls within a comparatively small zone."

To go further into the subject of service area we can examine the Report of Committee in the matter of WLW and its application for continued authorization for the super high power.

Quoting from the report, the Commission engineers noted "the primary daytime service area of a broadcast station is limited principally by noise level. There is no skywave or fading problem during the daytime and no secondary service area.

"At night, in addition to the limitation by noise level, the primary service area is limited by the so-called rapid fading zone. During both day and night there are areas within the normal primary service area wherein the noise level is sufficiently high in comparison with the field intensity to render reception of a station unsatisfactory."

The area of rapid fading is described as beginning at a point where the ground wave is three times the intensity of the sky wave. Further comments by the technical staff point out that under most conditions the power of the transmitter has little to do with the location of the rapid fading zone.

Conditions of propagation will influence the service area more than brute force power, to paraphrase some of the comments. Ground conductivity is listed as one of the major factors in the primary service area of a station.

In his address, Hoover also listed the number of stations that were able to increase power in the year between the Third National Radio Conference and

(continued on page 49)

## 58 YEARS AGO

### MORE "STUNTS" ARE IN STORE FOR LISTENERS

Washington. "Stunt" broadcasts, so popular with listeners, are to be more numerous. Soon there will be scarcely any place from which a description of the event may not be sent to listeners.

Even a parachute jumper can narrate his experiences and describe his feelings, by talking into a microphone posed in front of his nose, and generating radio frequencies from a short-wave transmitter strapped to his back. It has been done.

Also, broadcasts have brought to listeners the descriptions of air maneuvers, the descent of submarines, the penetration of caves and other exotic events that delight the radio fans. New thrills, however, will be provided under the enlarged program.

**Frequencies Assigned**

The Federal Radio Commission has lent assistance to these endeavors. The two large chains, the National Broadcasting Company, which is an RCA subsidiary, and the Columbia Broadcasting System, which is 50 per cent. owned by Paramount-Public, have frequencies allotted to them for just such portable short-wave remote broadcasting. The wave is picked up at the key station and after detection is modulated on the regular broadcast wavelength.

The ranges allotted to the National Broadcasting Company are 1,584 to 2,392 kc (189 to 125 meters), while Columbia has

1,544 to 2,476 kc (194 to 121 meters), independent channels being allotted from 1,564 to 2,363 kc (192 to 127 meters).

Foreign programs will be brought in on short waves and retransmitted on regular broadcast waves, as heretofore, but these do not require any extra licenses. For the portable short-wave transmitter, for domestic stunts, more licenses are to be sought by the two large chains.

**Only for Emergencies**

The Commission's order specifies that such short-wave facilities may be used only in event wire facilities are not available. The procedure usually is for the portable transmitter to be located near to the "pick-up" receiving set, which feeds the program to the network or the regular broadcasting station. The distance to be covered by the short wave portable usually is small, so that the signals picked up will be of sufficient strength and crispness to be amplified with good quality over the broadcasting network.

The Commission also has set aside frequencies of the same character for motion picture companies under extraordinary circumstances. Short-wave channels may be used for communication between the home studios and parties "on location," when wire line facilities are not available, and to expedite the production of the pictures.

Reprinted from Radio World, July 1931.

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.

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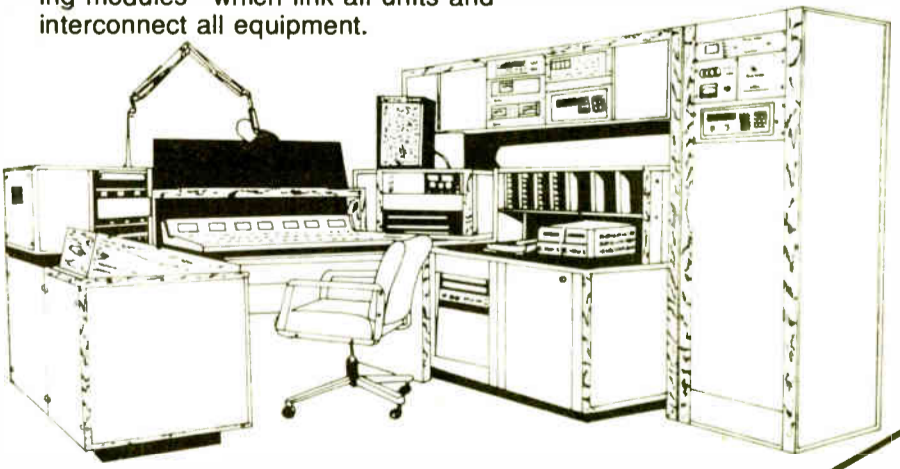
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# Choosing an FM Booster Site

by Martin D. Hadfield

**Seattle WA** Boosters have been heralded by some as a "savior" to FM signal coverage problems by correcting maladies such as multipath, signal fades, locally strong RF intermodulation problems, and structurally (and/or topographically) induced signal degradation.

Depending on the circumstances, FM boosters may be called for, though the installation of one could cause a significant increase in undesired interference if certain conditions are not met.

FM boosters must be located within and not extend the predicted service contour (using the FCC 3-16 km HAAT vs. ERP method) of the primary station. It is important to note that it is the "as built" contour of the primary station, *not* the maximum contour distance for the station class. (See Table 1 for FCC maximum facility parameters).

The rules require that a booster not cause interference to the signal provided by the primary station within the boundaries of the principal community to be served and the booster may not be collocated with the primary station (this could, effectively, increase the primary station beyond its class, since the output powers would be additive).

The maximum permissible operating power of a booster is 20% of the class maximum, regardless of the actual "as built" power of the primary station.

An interesting anomaly regarding this rule is that it is possible for an FM booster to operate with a higher ERP than its primary station. As an example, a Class A facility operating at a reduced ERP due to a HAAT greater than the class maximum could be transmitting with, say, 450 W ERP. An FM booster for this station could operate with up to 600 W ERP.

Due to current international agreements, a booster built within 320 km of the Mexican or Canadian border is limited to 50 W ERP.

While the matter of proper remote control operation is somewhat unclear, it appears that if the TPO of the booster is greater than 10 W, a conventional remote control system for monitoring operating parameters may be required (under 10 W TPO could be handled similarly to "unattended" FM translators).

I believe the FCC will handle these on a case by case basis, but why not ask for unattended operation?

## Choose a location for analysis

You, your station GM/owner, or PD may find a location that could be served by an FM booster. The first task is to determine that the location is within the primary station predicted service contour based on the FCC HAAT model.

Calculating the HAAT along the bearing (from the main transmitter site to the community of interest) may yield a contour distance quite different from that on

the station's original coverage map.

This is especially true if the radial of interest is half way between any of the eight "cardinal radials" used in the original FCC filing.

Once it is determined that the community is within the contour, it is necessary to calculate the maximum permissible power the booster may send toward the protection contour and not extend that contour.

the regulatory requirements will be met. The rest of the matter is covered by the questions of FCC Form 349P.

## Real world

It is necessary to formulate a picture of the primary station's actual signal strength in the community of interest. In the real world, VHF signal propagation is a statistical phenomenon and difficult to accurately predict and measure.

Table 1 FCC Maximum Facility Parameters

Station Class	Primary Service Contour — Distance		Primary ERP — HAAT		Booster Max ERP
A	60.0dBu	24kM	3kW	100M	0.60kW
B1	56.9dBu	45kM	25kW	100M	5.00kW
B	54.0dBu	65kM	50kW	150M	10.0kW
C3	60.0dBu	39kM	25kW	100M	5.00kW
C2	60.0dBu	52kM	50kW	150M	10.0kW
C1	60.0dBu	72kM	100kW	299M	20.0kW
C	60.0dBu	92kM	100kW	600M	20.0kW

This is done by first calculating the HAAT of the radials from the site selected for the booster toward the primary station contour. Once that is known, measure the distance from the proposed site to the protection contour. Then, using the 47. CFR 73.333 Figure 1 F (50,50) curves, determine the ERP required based on the distance and height.

This will yield the maximum power to be radiated toward the primary station protection contour. If you want the booster to operate with an omnidirectional antenna system, this power figure will be your maximum ERP.

If you intend to use a directional antenna system, the ERP we calculated above will be the maximum permitted toward the protection contour, not necessarily the "main lobe" maximum (the main lobe power will probably be limited by the criteria in Table 1). However, you may wish to operate with less than maximum facilities to permit minimizing the effects of signal overlaps in adjoining communities.

An FM booster must also meet the requirement that the signal of any first adjacent channel station must exceed the signal of the booster station by 6 dB at all points within the protected contour of the first adjacent channel station(s). This can be accomplished by running an appropriate FM channel interference study and determining if further power or antenna limitations are indicated.

After these matters have been decided, you draw a coverage map of the proposed facility, based on the overall HAAT and power(s) to demonstrate that

There are several recognized statistical models for predicting signal strength based on the transmission losses of free space field for a given transmitter power, reduced by the signal attenuation resulting from plane earth propagation loss, diffraction due to irregular terrain and propagation losses caused by buildings.

Although these models are useful tools in initial stages of defining likely areas for booster operations, a thorough examination of the local environment is necessary to determine whether other influences may have a bearing on the success of a particular installation (e.g., primary station signal reflections from nearby hillsides or buildings into the booster area, or booster reflections out of the booster area, into primary coverage areas).

An analysis of the terrain between the primary station and the target area yield obvious obstructions (or a lack of) which may be an advantage in shielding considerations. It is important to determine that the area exhibits low signal levels and that the area is not just suffering from multipath interference disturbances.

The distinction between these two types of signal aberrations is that low signal areas can be improved through the operation of a booster, but multipath may not.

Problems begin to arise when there is inadequate or spotty reduction of the primary signal, leading to unsatisfactory desired/undesired signal ratios and the attendant "overlap interference zones."

(continued on next page)

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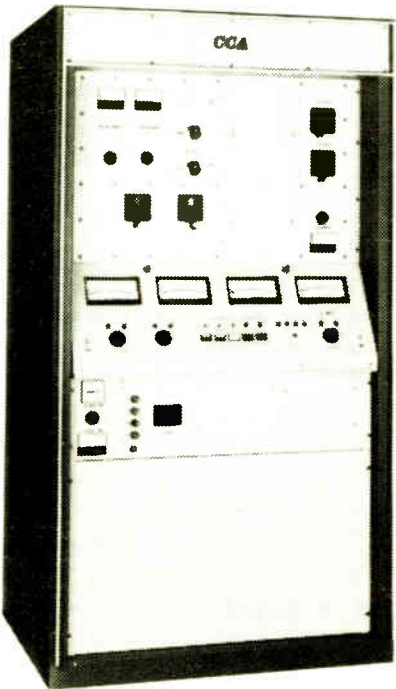
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# Decision Making in FM Booster Location

(continued from previous page)

Using current technology, for clean stereo reception, it has been found necessary for the FM booster to have an RF carrier ratio advantage of about 10 to 20 dB over the primary station (or vice versa). That may not seem like much, but in terms of received signal strength, 20 dB can translate into the difference between 1 mV/m and 10 mV/m.

Overlap interference results when two frequency-modulated transmitters are near to each other in frequency and cause partial or complete overlapping of the spectra in a receiver. With wideband FM, when the RF carrier ratio between the signals is high, the so-called "capture effect" permits only one demodulated signal to be presented to the listener.

When the carrier ratio is decreased to about 6 to 10 dB, distortion in the detected

depends on the relative phase relationship between the two signals. In other words, each source has its own half wavelength null and peak locations being presented to the receive antenna. If the carriers are equal in level and "in phase," the resultant amplitude is the sum of the two individual carriers. If the carriers are completely "out of phase," the signals cancel.

Between completely "in phase" or "out of phase" locations, the resultant amplitude and phase relations can be derived by the equations in Figure 1.

As the mobile receiver switches between signals, the listener hears a "picket fence" noise. Note that this effect is present whether or not the carriers are locked. In the case of stationary receivers, the capture effect will effectively eliminate this problem.

The worst case situation occurs when neither of the carriers is strong enough to bring the receiver into limiting. When this happens there is no capture effect and the variation in the phase of the resultant carrier(s) is detected by the discriminator. If the audio doesn't mute, this appears as noise in the output.

## Equation 1.

$$A_r = [(A_c + A_i \cos W_i(t))^2 + (A_i \sin W_i(t))^2]^{1/2}$$

and

$$\phi_r = \arctan \frac{A_i \sin W_i(t)}{A_r + A_i \cos W_i(t)}$$

Where:

- $A_r$  = Resultant Carrier Amplitude
- $A_c$  = Main Carrier Amplitude
- $A_i$  = Booster Carrier Amplitude
- $W_i(t)$  = Angle between  $A_i$  and  $A_o$
- $\phi_r$  = Resultant Carrier Phase Angle

audio output of the FM receiver increases rapidly. Within this window of carrier ratios rapid fluctuations in received signal quality will be experienced.

In a controlled environment, this 10 dB window may seem easy to predict and contour to fit specific coverage needs. But in a world where received signal strength is subject to so many conditions, the picture becomes *very* different.

## Drop in received signal

At every half wavelength (180°) of the carrier frequency from each signal source, the received signal drops to a minima. You may have observed this phenomenon when listening to an FM station in your car. As you stop at a traffic light the signal may get noisy. If you had a signal strength meter connected to your car antenna, you might see a 20 to 40 dB change in carrier level as you go through the null.

The automatic gain control in the car radio RF stages compensates for the change, trying to keep the signal within its range of distortion-free processing.

Some radios mute the audio output when signal level falls outside a preset AGC window. If you roll ahead about 0.75 meters, the reception probably improves. This problem is exacerbated when the second carrier from the booster station is present. As in multipath reflection situations, we now have two signals from different sources at different (or possibly the same) signal strengths.

The amplitude of the received carrier

## Terrain and booster antennas

Using an elevation database (derived from the US Defense Mapping Agency, Topographic Center terrain elevation database), or topographic maps, you should generate various views of the area of interest.

This will be helpful in getting a "feel" based on terrain loss. If it looks promising, a series of signal strength projections, based on the previously mentioned VHF signal vs. terrain effect, will lead us to determine if field strength measurements are warranted.

Well made and properly interpreted measurements can reveal, with a good level of confidence, the impact and limitations of a booster installation.

If it is determined that a booster will indeed properly serve a community, antenna patterns and power levels are then selected to shape the coverage area.

Due to the power levels available, it is a common mistake to think of a booster in terms of a regular "full class" type facility. The idea of "... let's put it up on the hill (or tall tower) and really cover the whole area" has been discussed more than once.

The problem with this approach is that, from a propagation standpoint, VHF signals can be difficult to control. Coverage vs. antenna height must be carefully weighed. Using the FCC F(50,50) distance curves you can see that an antenna transmitting 1.0 kW at 20 meters HAAT has the same coverage as an antenna transmitting 10 watts (0.01 kW) at 300 meters HAAT (in both cases the 60 dBu contour is 10 km).

Under most circumstances, a single booster mounted in an elevated location should not be employed to serve spread-out communities. This technique has been found to cause more coverage problems than it cures. Remember, we are trying to create an area which will have 10 to 20 dB more signal strength than

(continued on page 46)

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# AM Stereo Phasing Problems

by John "Q" Shepler

**Rockford IL** AM stereo has given AM stations the sonic benefits that FM stations have enjoyed for many years. Right along with those benefits come all the headaches of keeping two channels matched and synchronized.

A few mornings ago I heard a strange commercial on a favorite AM station. Everything was crisp and clear until, suddenly, the next spot sounded terrible. The voice and music bed were low in volume, distorted, and very thin sounding. It was like the cart machine or tape had gone bad.

"Oops, bad cart," I thought.

Then, the music ended and the tag line by one of the station's announcers sounded just fine. The rest of the set was just fine.

Then it dawned on me. They can't hear the problem at the station because they're monitoring in stereo. It probably

problem as I had been.

FM station engineers faced this situation 25 years ago. Stereo audio is three

times as difficult to maintain as mono. You have two channels that must be aligned for frequency response, levels, and distortion. But you also have to keep these channels in phase with each other over the entire audio band.

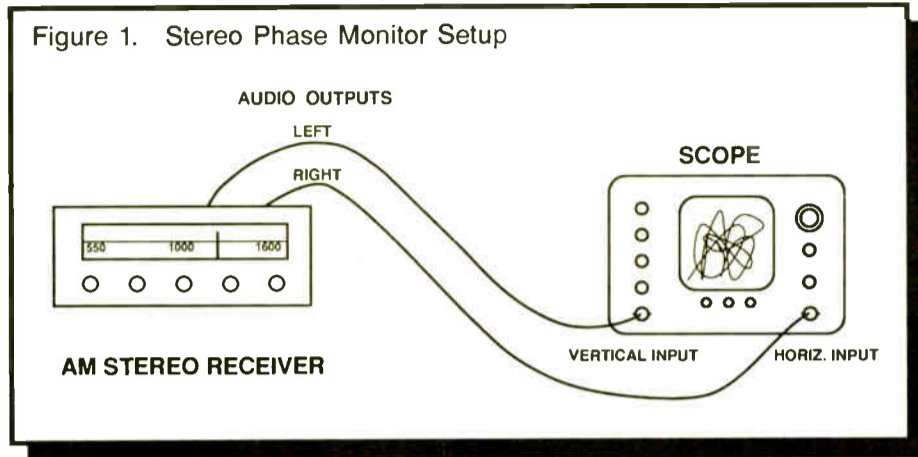
ing catch-up in the stereo game. AM stations have to sound great to compete for stereo listeners.

As an AM stereo engineer, you can use two techniques to make sure your audio sounds great in both mono and stereo.

First, you can have the studio operators monitor the on-air signal in mono rather than stereo. They'll probably resist, since the stereo sounds better through their headphones and monitor speakers. What you can do is to install a mono monitor speaker in the studio in addition to the left and right speakers. If this speaker goes dead or sounds weak and fuzzy it will alert the announcer that something is wrong.

You can also install a L-R meter on the

Figure 1. Stereo Phase Monitor Setup



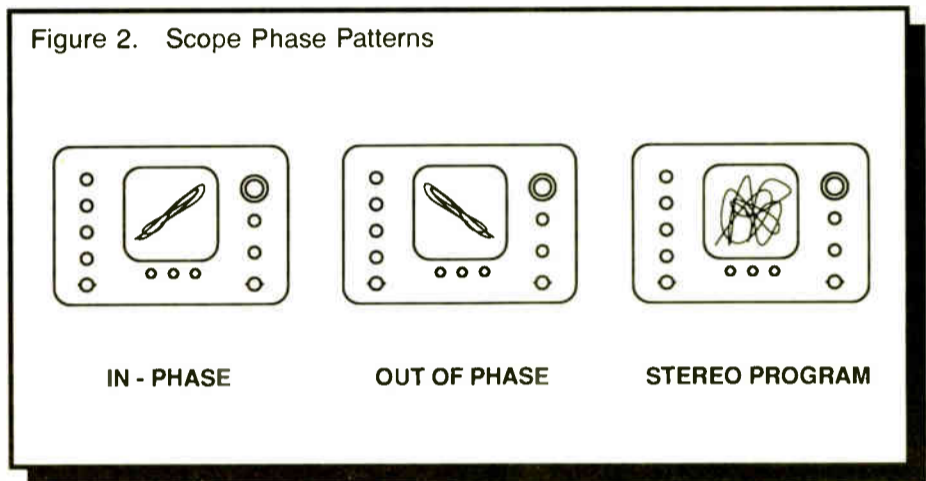
sounds just fine in stereo. But, I'm listening to a mono alarm clock radio.

Normally, you would never be able to tell whether the station is mono or stereo unless you had a stereo receiver. However, as soon as the station broadcasts material that is out of phase, the mono listeners will think it sounds terrible.

Stereo listeners, however, will never know the difference. In fact, in stereo, out of phase programming sounds like it has phenomenal separation.

I passed these thoughts on to the owner, who was as surprised at the

Figure 2. Scope Phase Patterns



times as difficult to maintain as mono. You have two channels that must be aligned for frequency response, levels, and distortion. But you also have to keep these channels in phase with each other over the entire audio band.

### Audible in mono

That's what is required to keep stereo and mono compatible. If you get sloppy or your tape equipment is worn, stereo listeners won't notice much. But the mono listeners will think your signal is terrible.

Ironically, AM stereo stations have the least experience with phasing problems, though accurate phasing is far more important for AM than FM. First, most FM receivers are stereo while most AM receivers are mono. Second, AM is play-

board. Normally, the L-R meter will read zero for mono material and bounce quarter to half scale on peaks for stereo. When the meter is above half scale and steady, you have an out of phase source.

The announcers may or may not pay attention to this meter. Perhaps you can build a threshold detector that will flash a light when there is too much L-R audio. That should get somebody's attention.

Second, you can build yourself a mono/stereo monitoring setup.

You should have an AM stereo tuner, mono receiver and a scope. You can also connect an L-R meter and warning light or buzzer. Monitor the station in mono in your shop or office. If something sounds funny, look at the scope pattern. You'll be able to tell quickly if you have a phasing problem.

The accompanying figures show some examples. A 45° line to the right is pure balanced mono. A 45° line to the left is out of phase stereo. A fuzzy ball is high separation stereo.

### How to fix bad stereo

If you have phasing problems, isolate them to a particular recorder, player or even a particular cart. If a machine is bad, it simply needs repair or alignment.

Bad sources coming in from agencies or other producers are a tougher problem. First, try to get a good dub from the supplier. Maybe you just got a bad tape. If you can't come up with a good dub, there are still a couple of ways to save the program.

The easiest fix is to dub from only the left or right channel of the source into both channels of your board or cart recorder. This will clean up the sound, although you'll be missing music or

(continued on page 48)

## Q-TIPS

"OK, bad agency dub. They'll get it fixed tomorrow."

Well, the next day the same thing happened and kept happening. Now, I knew this couldn't be just a fluke. This particular station is fussy about its sound and would never replay a bad dub. Is the morning announcer asleep or what?

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STATEMENT OF OWNERSHIP, MANAGEMENT AND CIRCULATION

1. Title of Publication	2. Issue Date
3. Issue Frequency	4. Number of Issues Published Annually
5. Annual Subscription Price	6. Annual Circulation
7. Total Number of Copies	8. Total Number of Copies (continued)
9. Total Number of Copies (continued)	10. Total Number of Copies (continued)

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Circle 43 On Reader Service Card

World Radio History

# Smoke Signals to Satellites

by Dee McVicker

**Dallas TX** As the story is told today, Bill Bragg's third grade classmate, Bobby Lewis, brought a telegraph sounder to show-and-tell. Bragg remembered seeing one just like it in a Gene Autry movie the week before.

Bragg doesn't recall the name of the movie, but he does recall with clarity the telegraph sounder. "You could see the operator on one end. And then they cut to a tight shot of this telegraph sounder reacting to the clicks from the keys. I wondered how that worked, thought it was a neat deal."

## A lost legacy found

The rest, as they say, is history. It was this spark of curiosity that kindled the National Museum of Communications. Bill Bragg, a veteran television and radio engineer, founded the museum with little more than the childhood telegraph sounder he swapped a catcher's mitt for in grade school.

Bragg learned to run a camera and engineer a radio station about the time his collection of artifacts outgrew his home.

to broadcasting's lost legacy. He rented a building in downtown Dallas and set up the then Texas Broadcast Museum

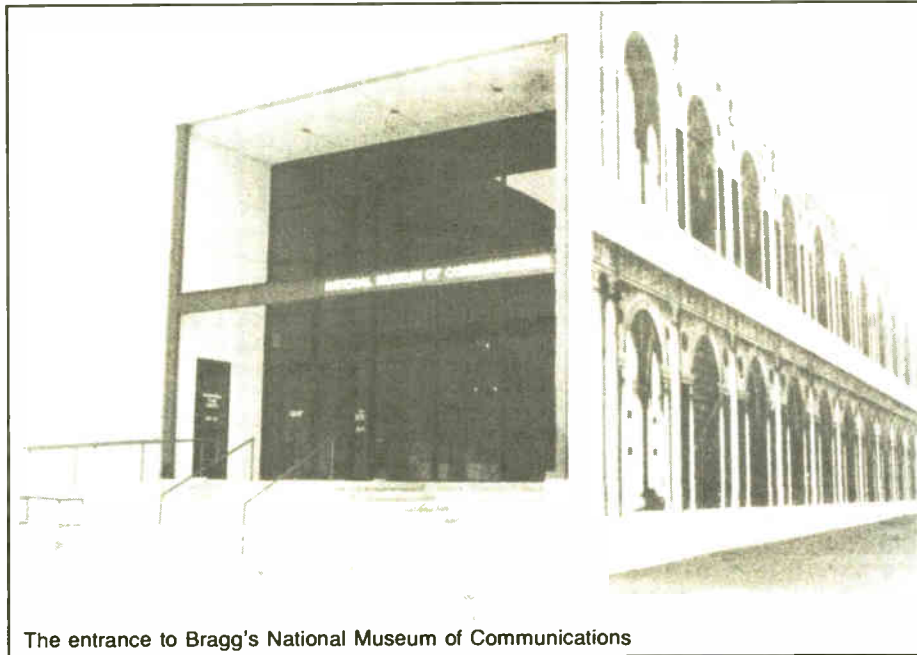
which later changed its charter and name to the National Museum of Communications.

By 1983 Bragg had some weighty artifacts on his hands and no place to put them. The lease on his building had terminated. It was 2 December, 1983—ironically, Bragg's birthday—and Bragg closed the doors, moving his yesteryear valuables to a warehouse for a princely sum of \$10,000. It took 21 moving vans and 30 days to move.

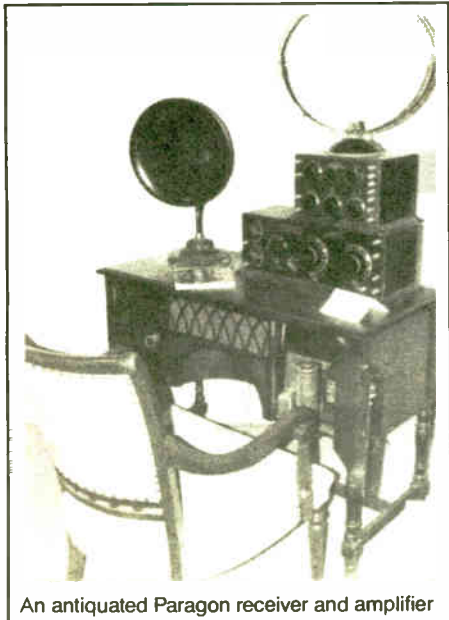
Bragg began wheeling and dealing to keep his avocation alive. He cut a deal with the Nostalgia Channel to transfer films to videotape and in exchange they linked him up to an audio subcarrier. The Yesterday USA Superstation was born.

Yesterday USA is now a museum fundraiser that runs old-time radio shows 24 hours a day, 7 days a week on an audio subcarrier of the Shop at Home satellite program.

Bragg also managed a new home for  
(continued on page 48)



The entrance to Bragg's National Museum of Communications



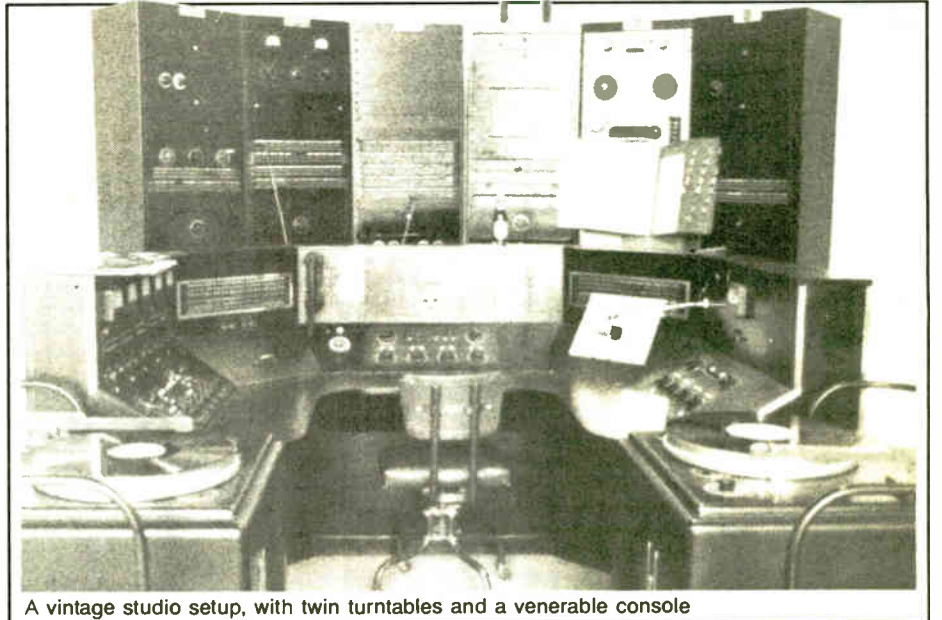
An antiquated Paragon receiver and amplifier

He was working full time as a television engineer and part time as a radio engineer, with every spare moment spent in the avocation of restoring Edison phonographs. Those scant hours between jobs produced 46 artifacts and Bragg was running out of room.

So was the television station at which he worked. Recalled Bragg, "I'd go down to the basement of Channel 4 and see all the old equipment that was collecting dust. We had an old guy there, a red-headed guy and he loved to throw stuff away. He'd go down to the basement when the boss wasn't looking and he'd clean up."

The radio station was also pitching valuables. "They'd throw records away—78 records. They'd call the high school and say, 'Bring a pickup truck, you can have all our 78 records.'"

In 1979, Bragg decided to put an end



A vintage studio setup, with twin turntables and a venerable console

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## FM Booster Site Criteria

(continued from page 43)  
the primary station.

A significant improvement in the area of signal overlap control may be experienced by utilizing an antenna system which operates contrary to conventional methods. Such an antenna system provides a signal null toward the horizon while fully "illuminating" the community of interest. This may be accomplished through various schemes of phased antenna arrays and beam tilt techniques. Such antennas can be built with mixed power ratios as well as various polarity options.

Boosters are not always the proper answer to coverage problems. However, with careful analysis and proper site selection, a booster may be successfully implemented to provide service into a previously unavailable or underserved market area.

■ ■ ■  
Martin Hadfield is a consultant based in Seattle, WA. He can be reached at 206-823-2085.



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# Keeping Alive the Heritage of Radio

(continued from page 46)

his large family of artifacts. At the Dallas Communications Complex, where films such as "Robocop" and "Silkwood" were shot, Bragg and fellow volunteers moved the collection out of storage and on display. The history of broadcasting had finally arrived where it would be most appreciated, at the hub of Southwest film and broadcasting activity.

## Hands-on history experience

The National Museum of Communications is now one of the largest communications museums in the world. It boasts over 35,000 sound recordings and is home to such relics as Walter Cronkite's lapel mic and a Bell & Howell 1927 hand-crank movie camera used by Charlie Chaplin.

One of its most alluring attractions is a VOA master control console, circa 1956 and custom built by Gates. This 70-foot console was once an emissary to the world, simultaneously broadcasting two programs in 28 languages.

Another console, almost as bulky at six tons, is one that retired from San Antonio station WOAI after more than 40 years in service. "This console was custom made in 1938 and was in service until 1979, when I cut the wire and brought it to Dallas," informed Bragg.

These relics, like most of the artifacts at the museum, aren't exactly rusting at the hinges in the mummified environment of a typical museum. They are at The National Museum of Communications, founded by an engineer who liked to tinker as a kid and still does as an adult.

Bragg has restored most of the artifacts for the curious fingers and minds of patrons. Visitors can preside over the VOA console, where five US presidents have presided before them and turn big crys-

tal knobs as VU meters kick to the old-time recordings of Jack Benny, Fred Allen or Burns and Allen.

There are buttons to push and levers to pull. You can strike floor chimes with the familiar notes that became synonymous with NBC radio in the '30s, or tap out messages on a teletype machine. You can recreate the galloping sound of the Lone Ranger's horse with coconuts and sand, or flip a switch on a turntable and

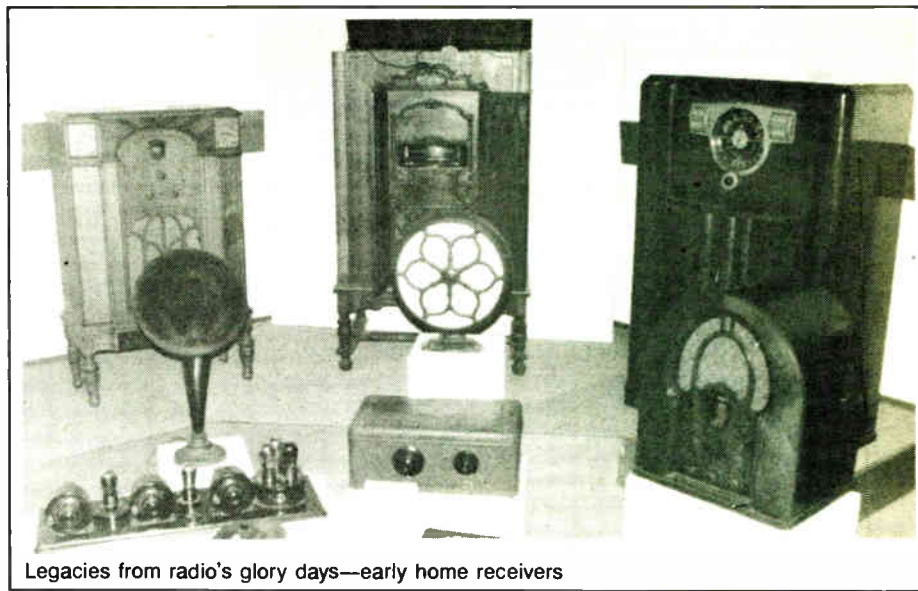


Ageing gramophones include an Edison model, at top

listen to bopmaster Woody Herman.

Or, you can just take in the museum's rich heritage of communications. Thomas Edison's personal microscope is there, the one he used to inspect diamond needles. So is a 1940s AM station which includes a giant, air cooled 5 kW transmitter that put KDFT in Wichita Falls on the air.

All the recording mediums are there, including '40s vintage wire recordings which bear the inscription: "The fidelity was poor, editing was nearly impossible and if the wire broke, the resulting snare was nearly impossible to untangle." Next to this display are the first tape



Legacies from radio's glory days—early home receivers

recorders developed by the Germans during World War II, which used rolls of paper to capture sound.

There is a prototype of the first transistorized radio showing off its absence of vacuum tubes through a clear plastic covering, and a radio transcript of man's first walk on the moon. There is Bill Haley's hollow-bodied electric guitar and many more treasures.

The museum has "everything from smoke signals to satellites," Bragg likes to say. Including its own satellite service.

## Linking yesterday to today

Around the clock seven days a week, Bragg and companion Big Bird automate old-time radio shows for an audience listening in on a Shop at Home audio subcarrier. On Monday nights, from 9:00 to 10:30 PM EST, Bragg and his talking parrot sit behind the mic to read the week's program schedule, which runs the full old-time spectrum from Westerns to Comedies.

The Yesterday USA Superstation was Bragg's brainchild. He clinched his first satellite deal when the museum was still fostering in the streets of Dallas and funds were low. Bouncing his philanthropic message from satellite—the technological offspring of the very industry he was trying to preserve—seemed the perfect answer.

And it has paid off. The service brings in precious dollars and many loyal fans, although Bragg likes to complain that Big Bird has a bigger fan following.

Bragg conceded that funding for the museum is an ongoing concern. His latest fundraiser is what broadcasters can only liken to a remote broadcast. "I'm going to start going live (on satellite) from a bicycle," said Bragg.

With typical enthusiasm, Bragg described the cellular phones he will be using and a new gizmo called the cell jack. As he runs through the technical details of his new find he almost resembles that small kid in the back of the theatre staring with rapt interest as an urgent message is played out before him on a telegraph sounder.

To pick up Yesterday USA, set your satellite receiver to pick up SATCOM-4, transponder 15. Then tune into the service's audio subcarrier at 6.2 MHz. If you have questions regarding the National Museum of Communications or Yesterday USA, call Bill Bragg at 214-644-2473. Bill works full time for KDFW-TV and is one busy fundraiser, so you might have to wait for the tone and leave a message for him to get back to you.

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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## Phasing for AM Stereo

(continued from page 44)

sound effects on the unused channel.

What if each channel has separate announcers? Now you've got a bigger problem since you can't just throw away a channel. You may still be able to save the tape by adjusting the playback head azimuth for better phasing. Don't forget to realign your play head later. You might also try a phase adjusting amplifier, like a Howe Phase Chaser, to see if that will align the channels close enough for acceptable mono.

Stereo certainly demands more attention than mono, but the clarity and depth of a good stereo broadcast are really astounding. Good stereo can fool a lot of listeners into thinking that the AM stereo station they are enjoying is really on the FM band.

John Shepler is an engineering manager, broadcast consultant, writer and regular RW columnist. He can be reached at 815-654-0145.



# What the FCC Looks For in an Inspection

(continued from page 35)

station meets the highest technical standards of operation is squarely on the station licensee and management.

According to the FCC, "The station licensee is now required to exercise as much or more diligence in compliance than was accepted in years past, since responsibility for operator qualification and training has now devolved on the licensee directly.

"The Commission did not lower the performance standard for persons who are allowed to operate a radio transmitter, but just provided a different method of certification and licensing."

## Ops first, DJs second

Perhaps stations should have a qualification test for transmitter operators (try to get that past your program director). The Commission expects transmitter operators to be qualified. If a station wants to hire a "hot shot DJ" who doesn't know or care about transmitter operation,

that's OK, as long as there is a transmitter operator on duty who *does* know and care about transmitter operation.

The majority of the correspondence related to this particular inspection reminds us that 73.1860(c) requires the station licensee to fully instruct operators and ensure each is capable to perform all required observations and adjustments. Instructing the operators is not enough ("they forget").

The operators must truly be able to perform the required duties. Further, the operators may, at the discretion of the station licensee and chief operator, be employed for other duties if such other duties do not interfere with the proper operation of the broadcast transmitter (73.1860(d)).

I'll look forward to your comments.

■ ■ ■

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

# Memories of Early AM Technical Problem Areas

(continued from page 41)

November 1925. At the time of the conference in 1924, there were 115 stations with equipment to use 500 watts or more. In 1925, that number had increased to 197, an increase of over 70%.

In 1924 only two stations had in excess of 500 W. In 1925 there were 32 with power of 1000 W, 25 with 5000 W, and two with higher power for a total of 59 that had power of 500 W or greater—a 250% increase.

Among the fears expressed about higher power were excessive blanketing—i.e., the blotting out of smaller competitors—and the creation of large areas into which no other signals could enter. Some even warned that tubes would explode.

Even in 1925 there was a desire by some to expand the broadcast band from 150 to 200 meters. Reasons for not considering this further included the lack of receivers to cover the band and the fact that amateurs were using this part of the spectrum for experimentation, and that the "American Boy" needed the opportunity for development (into this fine hobby).

Could some of Hoover's remarks have been prompted by the fact that his son, Herb Jr., either was or soon would be an amateur operator and later president of the ARRL?

## Recommendations

The committee on interference made several recommendations. One of the concerns was with the radiating receiving sets. There was concern about sets already in operation and how to eventually eliminate the re-radiation that was happening.

The thought was to use persuasion to eliminate problem sets already in use, to publicize methods of operating sets to

suppress the re-radiation and to eventually discontinue the manufacture of these receivers.

According to the committee, "A re-radiating receiver is defined as a receiving device which generates oscillations of frequency within broadcasting limits in the receiving antenna so as to produce radiation therefrom of an intensity sufficient to cause noticeable interference in other receiving sets of average sensitivity."

Other considerations of the committee were frequency stability, non-radio electrical interference, spark transmitting sets, arc transmitting sets, high power stations and ship radio.

Miscellaneous suggestions included not granting further licenses until some action could be taken to expand the broadcast band and having the Department of Commerce provide additional personnel and equipment to carry out the "numerous and arduous duties pertaining to the regulation of radio in the United States."

## MITS computers

In an earlier column, I made a comment regarding MITS Computers and Southwest Technical Products. I have been corrected about the statement.

There were two different companies involved and the MITS computers were not manufactured by Southwest Technical Products. A complete story on the companies and products involved will be done as soon as all the facts can be gathered.

■ ■ ■

*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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**Crown C-40**, mint cond, \$175. C Volpe, 540 Stemmers Run, Essex MD 21221. 301-391-6927.

**Yamaha CA810** amp, 85 W per chnl, \$300. B Feinberg, Totaltape Publishing, 800-874-7599 X337.

**LEL DA-8**, new 8 chnl out mono or 4 chnl out stereo, individual level adjustments (8) avail, \$150. G Walden, KYW, 5th & Market, Philadelphia PA 19106. 215-238-4893.

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**Crown D75** power amp, excel cond, \$400. G Gilbreath, 702-454-2085.

**Carver PM 1.5** 450 W per chnl at 8 ohms, excel cond, 2 rack space, 24 pounds, \$650. B Fisher, KPOK, Box 477, Bowman ND 58623. 701-523-3883.

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**QSC 1400** 200 W per chnl at 8 ohms, 300 W per chnl at 4 ohms, mono bridging, octal accessory sockets, fan cooling, \$500. R Hoover Ross, The Auditory Perception Lab, 88 Sherman 2nd Fl, Brooklyn NY 11218. 718-965-2420.

**Fender CBS Rhodes FR 7221** (2) solid state, main & slave for Rhodes cabinets, \$40/both. P Russell, Bowdoin College, AV Services Sills Hall, Brunswick ME 04011. 207-725-3066.

**Vital AA-1A** (11) audio dist amps w/track mount main frame, one input by 6 output. G Mundkowsky, 12918 Smalley, Grandview MO 64030. 816-966-0731.

**Bogen TCB 250** solid state 250 W PA amps (2), some repair, complete, \$225 ea or \$400/both; Altec 1590C 250 W PA amp, needs some repair, complete, \$300. J Sigmon, WBZK, POB 398, York SC 29745. 803-684-4241.

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**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.

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**Shivley 6813** 3 bay, 92.1 MHz, 14 mos old, \$1500. K Austin, KFXI, POB 433, Lawton OK 73502. 405-658-9292.

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**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, WMWV, POB 2008, Conway NH 03818. 603-447-5988.

**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.

**Flanged helix**, 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 line section 50 ohms, J Kramden, WRBL, 3342 Perry, Marsellus NY 13215. 315-673-9049.

**ERI FML2E** 2-bay circular end fed antenna tuned for 100.9 MHz, \$2000; CBS FM Volumax peak leveller, mint cond, \$500. P Athanas, WRCC, Box 529, Richland Ctr WI 53581. 608-647-2111.

### Want to Buy

Used tower from 800-1100' tall prefer one already on the ground but will consider tower still standing. K Austin, KFXI, POB 433, Lawton OK 73502. 405-658-9292.

**UHF TV translator antennas** on old chnl 70-83 band, Bogner B4, B8, B16 or B24, Emcee D-10 corner reflectors. J Powley, 1536 Logan, Altoona PA 16602. 814-944-8571.

**UHF TV bdc/translator antennas**, Scala parapanels, 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.

**AM towers**, 210', will arrange shipping to Northern Virginia. P Hahn, WLPY, 769 E Main, Purcellville VA 22132. 703-338-6200.

**UHF TV bdc/translator antennas**, Scala parapanels, 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.

**UHF TV bdc/translator antennas**, Scala parapanels, 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.

**UHF TV translator antennas** on old chnl 70 thru 83 band, Scala SL-8 or Parapanels, Bogner B4, B8, B16 or B24, Emcee DGA-10 corner reflectors. J Powley, 1536 Logan, Altoona PA 16602. 814-944-8571.

**Air helix**, 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, Electrocom, 2104 N Claiborne, New Orleans LA 70116. 504-947-4743.

## AUDIO PRODUCTION

### Want to Sell

**Shure SE-1** phono preamps (2), power supply, \$150/lot; Altec 1592B mixers (3), rack mounted, \$325 ea; CBS 4440A volume leveler, \$225. W Slaten, Audio Intl, 424 Grant, Scotch Plains NJ 07076. 201-322-4466.

**UREI 537** 1/3 octave band EQ (2), \$500 ea or \$800/both. G Gilbreath, 702-454-2085.

**Orban 424A** stereo comp/limiter/de-esser/gate, excel vocal processor, \$689/BO; Orban 674A stereo para-graphic cross-EQ, \$899/BO, both in new cond. J Loether, 202-298-9550 voice mail.

**dbx equipment** including (4) dbx pwr supply mainframes, (12) 942 dual chnl decoders, (2) 941 encoders, (3) 904 noise gate units, (3) 903 compressor/limiter units & 906 flanger unit. B Giordano, WODS, 30 Winter, Boston MA 02108. 617-426-2200.

**Orban 245** stereo synthesizer, like new, owners manual, \$250. Chuck, 615-968-9532 aft 6PM.

**JVC VP-101** digital audio processor, allows to record digital audio on the video head of any video deck w/sub-carrier input, in CD quality, \$2500/BO. R Lawrence, Moonshadow Video Prod, 4280 Reston Rd, Roseburg OR 97470. 503-679-8966.

**TTM124/Telcom C4**, TTM frame holds & powers 24 Dolby, dbx, or Telcom cards, comes w/16 Telcom C4 cards, \$1500. R Rhodes, POB 1550 Radio City Station, NNYN 10101. 212-245-5045.

**Gates LE-2** line EQ, like new w/book, \$150. P Schneider, KPMJ, 1280 S Oxnard, Oxnard CA 93034. 805-985-8346.

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**Soundcraft RP-10-12** 10 band graphic EQ w/8" API VU meter, 600 ohm in-out, in dark wood-grain cabinet, \$90. L Beigel, On-Cue Recdg, POB 85042, Los Angeles CA 90072. 213-466-3595.

**Comrex TCB-1** telephone coupler; EV in-line low-pass mic filters & mic pads, Luxo mic arm clamps & springs, 4" x 4" muffin fans & RCA DR-2000 Numitron tubes for ESE timers, BO; Dorough Electronics 40A (3) loudness meters in case; DAP 310 AM&FM limiter boards & pink noise board, BO. B Royster, KQM, 1019 Cordova, San Diego CA 92107. 619-223-3413.

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Gaines Audio 1237 E Main St. Roch, NY 14609 800-442-0780

**Shure SE30** mixer/limiter, rack mtg, clean & perfect, \$150/fir; Shure M625/M625AM voice gates (4) in rack shelf, clean & working, \$75. E Davison, 135 N Illinois, Springfield IL 62702. 217-787-0800.

**Audiobal TD-2** degausser, will handle 2" tape w/timer & fan, \$200 pls UPS; Altec 1591A compressor, mint, \$175. J Kreines, 5330 Kennedy, Millbrook AL 36054. 205-285-6179.

## WANTED

**PULTEC EQ'S**  
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**TTM-124** frame, 24 slots, 2/16 Telcom c4 cards, \$1500. R Rhodes, POB 1550, NNYN 10101. 212-245-5045.

**Shure M610** (2) feedback controller, 8 band EQ, BO. G Mundkowsky, 12918 Smalley, Grandview MO 64030. 816-966-0731.

**Henry Mix-Minus**, never used, \$185. T Drigger, 818 Quail Ct, Headsburg CA 95448. 707-433-9370.

**Howe 2100** Phase Chaser phase correction unit, excel cond w/manual, \$600/BO. C Osgood, WMWV, POB 2008, Conway NH 03818. 603-447-5988.

**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/ & recdg std, w/Sansui match box & manuals, \$700; Dolby 334A/FM stereo audio processor w/Type 66FM peak limiter module, manual, \$800. E Stolz, KWOD, 1425 River Park, Sacramento CA 95815. 916-929-5000.

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**Realistic 12** band graphic EQ, stereo, & a stereo parametric EQ, \$100/both. R Coates, Lakes Recdg, 110 W 11th, Spencer IA 51301. 712-262-3113.

**UREI 527A** 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.

**dbx 142 NR** units, w/manual, need I/O plugs, \$150 ea/BO; CRL SPP-800 stereo preparation processor, no manual, \$200. M Tosch, KIFM, 5125 Convoey Ste 304, San Diego CA 92111. 619-560-9800.

**UREI 546** parametric EQ, \$500. B Musser, WMID, Ohio & Murray, Atlantic City NJ 08401. 609-344-5113.

**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.

**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.

### Want to Buy

**dbx 904** noise gate. R Burton, Audio Rents, 7237 Santa Monica Blvd, Hollywood CA 90046. 213-874-1000.

**Pultec EQ's**, 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-Max 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.

**Older headphones & cards**, call or write. J Taylor, WGCA, Box 467, Quincy IL 62306. 217-223-7700.

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Revox A700 stereo 2 trk, \$800; Pioneer 2022 & 2024 2 trk & 4 trk, \$850; Onkyo TARW99 dual cassette, \$200; Technics M227X cassette w/dbx NR, \$100. G Ernst, Bayside Studios, POB 166, Linda City OR 97367. 503-996-6020.

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**Ampex AG-440/B** in vgc, \$500/BO. J Davis, WWQM, 5024 E Lacy, Madison WI 53711. 608-271-6611.

**Ampex 440 mono (2)** in Rustang roll-around cabinets, gd cond, \$750 ea; Telex 6120 R-R module, like new, BO. D Flynn, Continental Recordings, 1 Thompson Sq Ste 501, Boston MA 02129. 617-241-5150.

**Revox floor stand** for Revox PR-99, in box, never used, \$150. E Welch, WKCL, POB 809, Ladson SC 29456. 803-553-5420.

**Tascam Portal**, 2 yrs old, excel cond, but FF & RW do stick, \$450. B Howard, KOFO, Box 16, Ottawa KS 66067. 913-242-1220.

**Telefunken M15A 24/32 trk w/autolocator**, both heads, all documentation & varisped, \$25,000; Teac 80-8 trk w/dbx, rack mount, \$1100; Telefunken 15A 2 trk, 7.5/15, in console, \$3,000; Revox A77 1/4" 1/2 trk, make offer. R Rhodes, POB 1550 Radio City Station, NYNY 10101. 212-245-5045.

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**Crown 722/724 1/2 or 1/4 trks**, new heads w/light case, mint cond, \$800; Otari 5050-III 8 trk, mint cond, \$3000. C Volpe, 540 Stemmers Run, Essex MD 21221. 301-391-6927.

**Ampex 600 (3)** for parts, BO. B Oostenburg, KCKY, POB 6, Coolidge AZ 85728. 602-963-9390.

**Revox PR 99 (2)** gd cond w/maye sensor E.O.M.'s, PB only, \$1500/pair. B Wynn, KVIN, Box 419, Vinita OK 74301. 918-256-7224.

**Technics RS-1506 1/4 trk R/P, 1/2 trk PB**, 3.75-7.5 ips, wireless remote unit, owners manual, vgc, \$795 pls shpg; Nakamichi RM100 wired remote for 480/480Z series, excel cond, \$25 pls shpg. S Hofmann, Cameron Univ Theater, 2800 W Gore, Lawton OK 73505. 405-581-2428.

**Remote recording trailer 16" w/Quad 8 console**, isolation xformer, will run on 110/220 VAC, 24 trk ready, \$5700/BO. B Petruzzi, Rouse St Prod, 804 E Old Hickory Blvd, Madison TN 37115. 615-868-8516.

**Ampex 440-C FT** recently re-cond, w/variable speed osc, mounted in roll-around cabinet, \$1295. W Hanlon, WKFD, 19 Updike, Wickford RI 02852. 401-295-8808.

**Otari MK III/4 1/2" 4 trk**, never used, BO. D Day, WOXY, 1001 Howard 42-F, New Orleans LA 70113. 504-525-9600.

**Otari MX 5050-4 4 trk 1/4" recorder** in portable case/configuration, vgc, \$1200. B Petruzzi, Rouse St Prod, 804 E Old Hickory Blvd, Madison TN 37115. 615-868-8516.

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**Pentagon 1100 high speed duplicator**, R-R & cassette, (2) cassette master units, mdl CM1140, (2) dual position slave units, mdl CS1140, R-R master unit, mdl RM1140, R-R slave unit, mdl RS1140, manuals & spare parts, \$2100/BO. M Gellos, Pensacola Christian College, 904-478-8480 X5041.

**Teac X1000-R 10.5" 1/4 trk 7.5-3.75 ips**, dbx, rack mountable, stereo auto-reverse, remote capable, \$500. L Domnitz, 754-46th Ave, San Francisco CA 94121. 415-750-0431.

**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.

**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.

**Technics 1520 isolated loop R/P w/remote control** in fair cond, \$500. R Sanchez, KUCV, POB 83111, Lincoln NE 68501. 402-472-3611.

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

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**Crown motor, capstan**, Dale HMR 50-6, for bi-directional, Crown player, new, BO; Tapeathon 702-7 & 702-10 portable tape players, bi-directional, auto reverse, call for details & prices. E Davison, 135 N Illinois, Springfield IL 62702. 217-787-0800.

**Stancil Hoffman CRM-7 logger system**, M Young, WJON, POB 220, St Cloud MN 56302.

**Ampex AG-440C 1/2" 4 trk** in factory roll-around cabinet, manuals, heads have very little wear, spare set of R/P electronics & other spare parts, vgc, \$1000 pls shpg. B Mountjoy, WIDD, 610-1/2 Hattie, Elizabethton TN 37644. 615-543-5849.

**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.

**Scully 270-2 (2) 14" stereo rack mt reproducers**, 3.75-7.5 ips; also (6) new Scully capstan motors, BO; Ampex 350 stereo PB only w/Schafer electr, excel cond, many spare heads, parts, relays for 350 & 440B decks, BO; PR&E Multisync MDA motor drive variable speed amp for Ampex & Scully decks, BO. B Royster, KQM, 1019 Cordova, San Diego CA 92107. 619-223-3413.

**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.

**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 roll around floor console, \$1795. G Liebisch, WPTF, POB 29521, Raleigh NC 27626. 919-876-0674.

**Pioneer 1020L 10.5" reels & (8) reels of tape**, stereo 1/4 trk w/quad repro capability (4th), excel cond, \$400. 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.

**Ampex MM1000 16 trk 2" recorder w/remote**, \$6000; Technics 1520 2 trk mix down, 1/4", \$1000, both in excel cond. J Maestro, FM Studios, 1351 Brook, Bayshore NY 11706. 516-666-4560.

**ITC 750 (3) PB R-R**, just rebuilt, \$600 ea or \$1500/all. M Harris, WNN, POB 549, Fuquay-Varina NC 27526. 919-552-2263.

**AEI 700A continuous loop tape machines (2)**, \$700 ea/BO. Jim or David, 407-778-5192.

**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.

**Scully 280-1 (2)**, ea in Rustang 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.

**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.

**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 440 FT** in console, hardly used, \$1500. B Blynder, TVA Inc, 11024 SW 112 Ave, Miami FL 33176. 305-595-9898.

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

**Magnecond P-90** in fair cond, BO; Telex 1422, needs motor to operate at slower speeds, BO; Ampex AG600 portable, fair cond, BO; J Keller, WKOK, POB 1070, Sunbury PA 17801. 717-286-5838.

**Scully 280 solid state electr**, 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/disk brake assemblies & solenoids, excel cond, \$100 ea; Scully capstan motor, 7.5-15 ips, excel cond, \$75. J Newman, 404-239-8046.

**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 Kremer, 301 SW 16th, Ft Lauderdale FL 33315. 305-524-5652.

**MCI/Sony capstan & reel motors**, any cond., recdg 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.

**Magnecond 728/748 or 1028/1048** for parts or to make one of ours into parts. NE Stephany, WACK, POB 1420, Newark NJ 14513. 315-331-7100.

**Tascam 388 8 trk recorder/mixer** in gd cond. M Sokol, JMS Prod, 121 E Baltimore, Hagerstown MD 21740.

**Inovonics 355 & 900 pwr supply**. L Beigel, On-Cue Recdg, POB 85042, Los Angeles CA 90072. 213-466-3595.

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

**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.

**CONSOLES**  
Want to Sell

**Collins 212-E-1 mono 8 pots**, gd cond, \$200 plus shpg. B Watson, KCHZ, 1551 Amar, W Covina CA 91792. 714-946-6249.

**Howe 7000 stereo**, 12 inputs, aud/pro gm & headphones switchable, standard VU meters plus LED air, (2) control button groups for tape machines, (2) ESC time counters, rotary pots, \$4500/BO. S Kopper, Starfleet Comm, 25 Beacon, Hull MA 02045. 617-925-0234.

**Collins 212T-2 16 chnl audio control board**, bg cond, \$500/BO. J Davis, WWQN, 5024 E Lacy, Madison WI 53711. 608-271-6611.

**BE Spotmaster 5S-100A**, stereo w/5 inputs, ea switchable for total 10 in, w/padded road case & all in & outs brought to an XL snake box, \$700/BO. S Kopper, Starfleet Comm, 25 Beacon, Hull MA 02045. 617-925-0234.

**Logitek CAS-8S stereo**, 8 inputs, 3 chnls w/EQ, dig clock & dig timer, (2) TT start switches, monitors & headphones have treble/bass control & switchable, slider pots, \$3200/BO. S Kopper, Starfleet Comm, 25 Beacon, Hull MA 02045. 617-925-0234.

**Yamaha MQ1602 16x2 PA mixer w/2 sends**, dual 9-band graphic EQ, gd cond w/road case & manual, \$975 pls shpg. S Hofmann, Cameron Univ Theater, 2800 W Gore, Lawton OK 73505. 405-581-2428.

**Cetec 2007 8 stereo input**, 2 stereo output, mint cond w/slepper pots & padded edge, 4 yrs old, \$2500. D Prentice, 1001 Sunflower, Rio Rancho NM 87124. 505-891-0502.

**Soundworkshop 1280-B 12** in stereo w/super EQ, mint cond, low hrs, \$2000. C Volpe, 540 Stemmers Run, Essex MD 21221. 301-691-6927.

**Harris Stereo-5 modified w/5534's**, no documentation, \$600/BO. J Claybrook, VMJJ, 530 Beacon Pkwy, Birmingham AL 35209. 205-943-9800.

**Ampro AC85 32 input**, 8 chnl stereo, BO; McMartin B-802-51 stereo, 28 input, 8 chnl, BO. M Black, WEOS, Geneva NY 14456. 315-789-8970.

**Rusco 505 5 pots w/Q & push on-off switches**, 2 internal TT PQ's & pwr supply, pot 5 has 5 inputs, mono 19x5x8, \$600. L Beigel, On-Cue Recdg, POB 85042, Los Angeles CA 90072. 213-466-3595.

**Interface 104L 16x8 monitor mix console**, 3 band, 3 freq EQ, gd cond; Yamaha PM-700, 12 in stereo out prod console, 3 band EQ on ea input & output, snake avail, \$900. B Petruzzi, Rouse St Prod, 804 E Old Hickory Blvd, Madison TN 37115. 615-868-8516.

**Gates Stereo Statesman** currently in use, avail in mid July, \$1200/BO. B Anderson, WTGY, POB 9, Marshall Rd, Charleston MS 38921. 601-647-5600.

**Ramko DC8MS 8 chnl 20 input stereo board w/2 LC4 remote control accessory**, excel cond, \$5500. R Trumbo, KNLF, POB 117, Quincy CA 95971. 916-283-4144.

**Sparta Centurion II 8 chnl**, 3 inputs ea, stereo, 3 output busses, monitor amp, gd cond, \$1100/BO. R McDaniel, KJRG, Box 567, Newton KS 67114. 316-283-5150.

**UREI MOH-410**, 4 chnl expandable to 9, pwr supply included, gd cond, BO. B Pirtle, Terrell Bldg, 203 Brookhollow, Terrell TX 75160. 214-563-7708, before 9AM/alt 9PM.

**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.

**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.

**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. 333-565-1212.

**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.

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

**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.

**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, KPCK, Box 477, Bowman ND 58623. 701-523-3883.

**Ramko DC8MS 8 chnl stereo**, excel cond, all manuals & extras, \$5500. R Trumbo, KNLF, POB 117, Quincy CA 95971. 916-283-4144.

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

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

**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.

**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.

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

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

**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.

**Want to Buy**  
**Auditronics 110 Grandson modules** needed, 110IME, 110BIME, 110SSF4, F2R & F1R, any or all, clean, reasonable, cash. D Payne, WZPL, 1440 N Meridian, Indianapolis IN 46202. 317-637-8000.

**API 550A, 560 EQ's**, cash/trade; Neve input modules & compressors, cash/trade. J Pines, 217-367-3530.

**RCA BC-7 meter panel**. C Gill, POB 371, Indianapolis IN 46206. 317-923-2800.

**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.

**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.

**DISCO & SOUND  
EQUIPMENT**  
Want to Sell

**Klipsch La Scalla's speakers (2)** \$800/pr pls shpg; (2) Nak MRI's, \$700 ea; Tandberg 320 cassette deck, \$300. B Feinberg, Totaltape Publishing, 800-874-7599 X337.

**EV Sentry 500 time coherent studio monitors**, \$700. G Ernst, Bayside Studios, POB 166, Linda City OR 97367. 503-996-6020.

**Community Light & Snd RS440 4-way speakers** (one pair) w/Community VB790 bass bins, in Anvil cases, excel cond, \$2200 plus shpg. J Kreines, 5330 Kennedy, Millbrook AL 36054. 205-285-6179.

**LIMITERS**  
Want to Sell

**Thomson-CSF 4500 Presence EQ**, new, \$595; Ramko portable mixer PM-42, \$450; ESE ES-214 audio level meter, \$95. H.M. Dyer Electronics, 2982 Wixom Rd, Milford MI 48042. 313-685-2560.

**Optimod 8000A** just factory redone, \$2000/firm; Optimod 8100A, \$4000; XT-2 6 band, \$1800; Studio Chassis for 8100A, \$500. B Watson, KCHZ, 1551 Amar, W Covina CA 91792. 714-946-6249.

**Orban Optimod 8000A stereo generators (2)**, \$1500/ea; various CBS Labs 44 Audimax III (2), \$100 ea; CBS 400 Volumax, \$75; CBS Audimax II, tube, BO; Harris Solid Statesman, \$175; Gates Sta-Level, tube, BO. M Hurst, WICO, POB 909, Salisbury MD 21801. 301-742-3212.

**Orban Optimod 8000A** recently removed from service, clean in gd cond, \$1500. C Genaro, Roberts Bldg, 1018A E Main, Merrill WI 54452. 715-536-6262.

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**MOTORS**

**LIMITERS . . . WTS**

**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 69361. 308-635-2690.

**UREI 1176 LN** excel cond, schematic, silver face mdl w/LN module installed at factory, \$300. R Jordan Jr, Southland Recdg & 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.

**PR&E Multilimiter FM/AM**, new matched stereo pairs, also AM Multilimiter, \$250 ea; Orban 418A stereo compressor/limiter, switchable pre-emphasis, front end of 8000A, BO; CBS Labs 4\*0, 411, 4300, excel cond; (2) new CBS Labs dynamic presence EQ's, simline, \$100 ea. B Royster, KQM, 1019 Cordova, San Diego CA 92107. 619-223-3413.

**Aphex Aural Exciter Type B** in excel cond, \$100/BO. R Pollard, KSKG, 1217 S Santa Fe, Salina KS 67401. 913-825-4631.

**Trade new Valley Intl Gain Brain 2 for Valley Intl Maxi-Q**. J Pines, 217-367-3530.

**RCA BA-6A** tube limiter, rack mnt, vgc, \$450/trade. J Pines, 217-367-3530.

**CRL FM System** including SPP-800, SEP-800, SMP-800, SG-800 & CC-300A, \$4500; Orban Optimod 8000A, excel cond, \$1800. B Musser, WMID, 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.**

**Urei BL 40** mod/limiter, \$295. K Crosthwait, WTNN, 13206 Buttermilk, Knoxville TN 37932. 615-531-2297.

**Modulation Sciences CP-803 (2)** new composite clippers, \$950. R Jesse, KLTO, 3645 South, Springfield MO 65807. 417-887-9650.

**Want to Buy**

**CBS Volumax 400** manual, copy OK if legible & schematics included, will copy your manual & return it, will pay postage both directions, T Wheeler, RRI Box 215, Carlock IL 61725. 309-376-7721.

**Fairchild 660** tube, fair price/trade; Aphex/B&B CH-1 compressor/noise gates, cash or trades. J Pines, 217-367-3530.

**Orban 8000A Optimod**, new or used, preferably refurbished, price negotiable. J Schindler, Family Stations, 290 Hegenberger, Oakland CA 94621. 415-568-6200 X240, 217-367-3530.

**MICROPHONES**

**Want to Sell**

**RCA ribbon mics** including BK-11, \$400; 74-B, \$250; (2) SK-46, \$250 ea; Shure 330 ribbon, \$250; Dynamics (2) Shure 555W, \$60 ea; EV 611, \$50; EV 630, \$25; Astatic DN-HZ, \$180. Tracy Eaves, 615-821-6099 (PMS).

**RCA 77D or 77DX** original shock mount, silver, \$150. E Kovach, 14269 Jackson, Taylor MI 48180. 313-285-9710.

**Sony ECM-30** condenser lavalier in box, BO. B Royster, KQM, 1019 Cordova, San Diego CA 92107. 619-223-3413.

**AKG 451E (2)** w/AKG pwr supply, \$450/pr. R Sanchez, KUCV, POB 83111, Lincoln NE 68501. 402-472-3611.

**AKG C-60** tube condenser mic systems, mint, tube 451e w/AC701K w/cardiod capsules, pwr supply & cables (4), 2 pairs, will trade, \$800/pr or \$1525/all. J Pines, 217-367-3530.

**RCA 44, \$750; Sony AC148A 2 mic** pwr supply, BO. R Rhodes, POB 1550, NYNY 10101, 212-245-5045.

**RCA SK-46** program velocity ribbon, new, \$325. D Miller, Airborne Audio, 11647 W 83rd Terr, Lenexa KS 66214. 913-492-8822.

**Neumann TLM-170**, new, blk finish, \$1250/trade, AKG D-1000E, vgc, \$75. J Pines, 217-367-3530.

**Vega 66 RCV-77TX (2)** wireless w/Dynex II, gd cond, \$1000 ea. D Scales, Scales Film Snd, 3142 Market Pl, Bloomington IN 47403. 812-339-4446.

**B&K Omni mic**, w/AK accessories, never used, still in wooden case, \$1000. B Ford, Spunk Prod, Box 1052, El Granada CA 94018. 415-726-4786.

**Vega R-41** wireless w/Dynex II, like new, \$1500. D Scales, Scales Film Snd, 3142 Market Pl, Bloomington IN 47403. 812-339-4446.

**Nady 501 VRLT** wireless mics (2) w/lav body packs, 185.15 & 215.15 MHz, \$800/both. TFG, Box 9, Wethersfield CT 06109. 203-527-2972.

**Shure 5B**, antique ring & spring type w/table stand, gd cond, \$385. R Cane, 6142 Miramar Pkwy, Miramar FL 33023. 305-962-8111.

**Neumann U-47 Nuviator (2)**, Kinura Records, Box 660236, Miami Springs FL 33166. 305-887-5329.

**Neumann U47let (2)**, mint cond, w/leather box, warranty, \$995/ea. Klaus Heyne, 415-664-0163.

**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 Chubbick, Canonsburg PA 15317. 412-746-3455.

**Neumann KMR 82** shotgun, like new, leather case & windscreen, \$650. D Scales, Scales Film Snd, 3142 Market Pl, Bloomington IN 47403. 812-339-4446.

**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.

**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.

**Want to Buy**

**RCA 77DX** ribbon mics; RCA 44BX ribbon mics. R Kaufman, PAMS Prod, POB 462247, Garland TX 75046. 214-271-7625.

**Neumann KM-56, U-64, U47, M-50, M-250, AKG C-12, C-12A, C-24, C-28, Telefunken U-47, ELAM-251, KM-56**, trade of cash for gd cond. J Pines, 217-367-3530.

**Vintage ribbon mics**, RCA 77s/44s & tube condenser mics, especially Neumann/Telefunken. Jes, 5330 Kennedy, Millbrook AL 36054. 205-285-6179.

**Any condenser shotgun** in working cond, prefer Sennheiser or AKG but interested in others. H Biller, 125 Lee Ste 2, Takoma Pk MD 20912. 301-270-1448.

**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.

**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.

**MISCELLANEOUS**

**Want to Sell**

**Electro Impulse DPDC-25K 25 kW FM** dummy load or reject load, like new cond in original box, \$2500. Goodrich Ent. Inc, 11435 Manderson, Omaha NE 68164. 402-493-1886.

**Comprehensive Video production library**, 8 music discs, \$300. A McPeck, POB 444, Rogersville TN 37857. 615-272-4827.

**Free 3-bay relay rack cabinet**, excel cond, pick up only. P Schneider, KPMJ, 1280 S Oxnard, Oxnard CA 93034. 805-985-8346.

**TRS-80 Mod-1**, expansion interface, (2) B/W mon, (3) disk drives, 5 meg hard disk, 14" wide printer, billing software, vidext & modem, eng software & more, \$600/BO. F Vobbe, GNBC, POB 5031, Lima OH 45802. 419-228-4199.

**Gates V-22** volume indicator panel, like new w/book, \$150; Atlas MS-25 floor stands, new in boxes (2), \$50 ea; Gates BC1J high voltage transformer, like new, \$250; Collins 20V2 modulation transformer, like new, \$150. P Schneider, KPMJ, 1280 S Oxnard, Oxnard CA 93034. 805-985-8346.

**Alphone NEM-40A** intercom master, 40 station pwr sply, handset, BGM adp, 10 W amp, \$650/lot. W Slaten, Audio Intl, 424 Grant, Scotch Plains NJ 07076. 201-322-4466.

**IGM equip racks**, 19" w/AC strip & removable rack-rail, 22x25x70, two side panels, one door, black, \$300. L Vidoli, WEEI, Schraffts Ctr, Boston MA 02124. 617-242-5900.

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**Stancil Hoffman CRM-7** logger system. M Young, WJON, POB 220, St Cloud MN 56302. 612-251-4422.

**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.

**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.

**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.

**Want to Buy**

**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.

**RCA On-Air lights**, OKI telephone interface. K Anderson, 2358 S Man St, Salt Lake City UT 84115. 801-466-3196.

**111-C coils (4)** needed. L Thomas, KMTC, POB C, Russellville AR 72801.

**Harris, RCA, Allied, etc.** product catalogs; 4th & 6th editions of NAB Engineering Handbooks. C Gill, POB 371, Indianapolis IN 46206. 317-923-2800.

**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.

**MONITORS**

**Want to Sell**

**Nems Clarke 8** tower directional antenna monitor, BO or trade for AM or FM mod mon. F Vobbe, GNBC, POB 5031, Lima OH 45802. 419-228-4199.

**Jennings RB7-A** vacuum relay, 7 kv, 14 A DPDT, \$120. J Cunningham, KHKC, Rt 2 Box 113B, Stonewall OK 74871. 405-265-4496.

**TFT 730A** 2.5 yrs old, SCA mon, excel cond, \$1000. D Starkey, WWHF, POB 2423, Clarksburg WV 26301. 304-624-5525.

**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.

**Gates GTM-88R** FM RF amp, working when removed, \$100. R Huckleby, KJLF, POB 336, Butte MT 59703. 406-723-4006.

**Want to Buy**

**McMartin older mdl TBM4500A** in any reasonable cond. Goodrich Ent. Inc, 11435 Manderson, Omaha NE 68164. 402-493-1886.

**FM mod mon**, working or repairable, reasonably priced for subsequent donation to classical station, older unit OK. E Reihl, 1715 Illinois, Northbrook IL 60062. 312-272-7125.

**Manuals & parts for McMartin TBM 3000 & TBM 3000A** freq mon; TBM 3500 & TBM 3700 mod mon; TBM 2200 stereo mod mon; TM 45-T remote metering panel. C Gill, POB 371, Indianapolis IN 46206. 317-923-2800.

**MOVIE PROD EQUIP**

**Want to Sell**

**RCA 400** Senior portable 16mm projector, (2) cases, optical & magnetic sound, BO pls shpg. R Norman, RNP, 11 Glenwood, Toms River NJ 08753. 201-349-8569.

**Eiki SL-0** 16mm slot load projector, \$450; Maurer 05 body, 3 mags, no motor, \$750; B&H 70 DR w/Anvil case, 1" Comat, instructions. \$325. J Kreines, 5330 Kennedy, Millbrook AL 36054. 205-285-6179.

**Want to Buy**

**Arriflex S Model** camera & any accessories wanted for Arri-S; also C mount lenses & editing equipment. H Biller, 125 Lee Ave Ste 2, Takoma Pk MD 20912. 301-270-1448.

**Mitchell 35 & 16mm** cameras & access, other prof 16/35mm cameras, Zeiss 9.5mm Distagon, reasonable, need not be mech mint. J Kreines, 5330 Kennedy, Millbrook AL 36054. 205-285-6179.

**RECEIVERS & TRANSCEIVERS**

**Want to Sell**

**Johnson ST4**, like new, 91.1 67 kHz, 92 kHz, \$75. C Peterson, Showround, 5405-A Southern Comfort Blvd, Tampa FL 33614. 813-884-1462.

**Johnson ST-4A** SCA rcvr's (2) less X-tails, test-ed, \$50 ea/BO pls shpg. K Smith, 118 Barstow, Gorham ME 04038. 207-892-8776.

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<p><b>Radio Shack TRS-80 Model II</b> includes 3 drive expansion unit, Okidata 82A lineprinter, \$500/BO pls shpg; Extel AF teleprinter, needs some work, includes service manual &amp; 79 rolls of printer paper, cond unknown, \$150/BO pls shpg. D Kelley, KISZ, POB 740, Cortez CO 81321. 303-565-1212.</p>	<p><b>Moos 902 VCA</b> w/pwr supply. R Robinson. 203-269-4465.</p>	<p><b>Supply of RCA</b> replacement parts &amp; 7, 8, &amp; 9 pin brand new tubes, write or call for list. J Thomas, WLEW, Bad Axe MI. 517-269-9931.</p>

**RECEIVERS . . . WTS**

GE portamobile units wchargers (2); Motorola base unit; base antenna, all 26 MHz band; CB base antenna; (2) RCA stereo TT EQ preamps, look similar to BA 26B. H. Canada, WHOO, 1 Radio WHOO Rd, Orlando FL 32808. 407-295-3990.

ICOM IC 02AT hand held rec & trx, 140.400-162.900 programmable, tone encoder, 38 tones 67.0-250.3 all sid equip includes book & shipping carton, new cond, \$300. B Boyer, WMOP, POB 3930, Ocala FL 32678. 904-732-2010.

Microdyne 1100-FFC-X1-RD(R) SCPC rcvr, also Cal Microwave demod shell & Mod Associates cue alarm, \$800/all. S Icenogle, KTRS, 251 W 1st, Casper WY 82601. 307-235-7000.

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Anchorage AK 99524  
(907) 345-2630**

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.

**Want to Buy**

Motorola 2-way radios to be used on my repeater freq, 462.675 & 467.675, list avail radios & write. C Hoffman, 251 174 St, Ste 404, Miami Beach FL 33160.

Aerotron 7N20 44-54 MHz 12 W FM radio, need manual or schematic, also units for parts/operation. M Starin, WJYY, 457 Varney, Manchester NH 03102. 603-625-1165.

25-50 MHz FM monitor rcvr tube types preferred, crystal-controlled. M Starin, WJYY, 457 Varney, Manchester NH 03102. 603-625-1165.

GE ET-72A/ER-46A Executive 30 W FM radio, need manual or schematic, also units for parts/operation. M Starin, WJYY, 457 Varney, Manchester NH 03102. 603-625-1165.

McKay/Dymek AM-10, 8. 7 AM tuner. wide band, working cond only, also service manual. P Madnick, DTG, 5743 Corsa Ste 207, Westlake Village CA 91362. 818-706-3338.

Sequerra 1 FM tuner wscope, working cond only, also service manual. P Madnick, DTG, 5743 Corsa Ste 207, Westlake Village CA 91362. 818-706-3338.

Group home radio club needs ham receiver & xmtr. USB, DSB, LSB, LW, must be gd cond, call or write, I Dechowicz, WHBI, 696 Wood, Avenel NJ 07001. 201-602-1242.

Scientific Atlanta 7300 dual 7.5 kHz audio card, T Shinn, WKSF, POB 6447, Asheville NC 28816. 704-257-2700.

Manual for R-391 receiver. S Daitch, PSC 1 Box 362, APO San Francisco 96286.

**REMOTE & MICROWAVE EQUIP**

**Want to Sell**

Comtech RCY-360 satellite receiver, \$1000. W Hanlon, WKFD, 19 Updike, Wickford RI 02852. 401-295-8808.

TFT 7610-C remote control, 3 yrs old, clean, works perfectly, \$2400/BO. R Koltz, KKRVR, POB 995, Kernville CA 93238. 619-376-3701.

Moseley SCG-8 subcarrier generators one tuned to 67 kHz & one tuned to 92 kHz, \$595 ea. M Hurst, WICO, POB 909, Salisbury MD 21801. 301-742-3212.

TFT 7610 digital remote control system, configured for 4 wire operation, 5 yrs old, P Baillon, KMCM, 1218 Pioneer Bldg, St Paul MN 55101. 612-222-5555.

Moseley MRC-1600 (2), \$1500/ea. A Kord, WWRX, Box 325, Westerly RI 02891. 401-596-7728.

Drake ESR 2240 satellite rcvr, P Baillon, KMCM, 1218 Pioneer Bldg, St Paul MN 55101. 612-222-5555.

Advanced Micro Dynamics TC-8 w/speech dialup option, \$2600/BO. M Black, WEOS, Geneva NY 14456. 315-789-8970.

Marti STL-10 dual system, 4 yrs old, \$2995. T Mensendiek, KSSC, POB 409, Carthage MO 64836. 417-358-4049.

Wegener 1601 tuned to Transtar's AM only, complete package ready to go on the air, 18 mos old, doesn't include dish or LNA, \$3295. T Mensendiek, KSSC, POB 409, Carthage MO 64836. 417-358-4049.

Modulation Associates BP72 includes main chassis, pwr supply & (2) demods, one is switchable between 76.7 & 77.9 MHz, the other 64 & 76.7 MHz, does not have the down-converter, BO. D Gander, KDUZ, Box 10, Hutchinson MN 55350. 612-567-2140.

Marti STL-8 (2) xmtrs, (2) rcvrs, xmtr combiner, rcvr combiner, in gd cond, \$2600/BO. R Pollard, KSKG, 1217 S Santa Fe, Salina KS 67401. 913-825-4631.

TFT 7610 digital remote control system, configured for 4 wire operation, in service, 5 yrs old. P Baillon, 612-222-5555.

Fairchild Dart 384 75 kHz dual program card, excel cond, \$675. D Kelley, KISZ, POB 740, Cortez CO 81321. 303-565-1212.

Moseley SCS-2, status control system for phone line & new TSK-3 temperature sensing kit; also spare parts kits for PCL-303/C, 505/C & TRC15 remote control, BO; McMartin TBM-250C (2) FM RF amps & pre-selector; rack mount fixed tuned AM rcvr, BO. B Royster, KQM, 1019 Cordova, San Diego CA 92107. 619-223-3413.

Drake ESR 2240 satellite rcvr, receives audio & video signals. P Baillon, 612-222-5555.

Moseley PCL-101 STL system, crystallized at 950,000 MHz, operational when removed, no manual, \$1050/firm, pre-paid, UPS, insured. D Peluso, KFM, POB 15223, Las Vegas NV 89114. 702-732-7753.

Moseley TRC-15AW (2) complete systems, working when removed, telephone line, can be converted for STL, \$1000/BO ea. R Huckebey, 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.

Wegener satellite rcvr & decoder for SMN, country & Starstation (AC) formats, includes all the electr you'll need for both, plus auto-lock switches for both formats, \$3200/all. D Silver, KNKK, Layton Hills Mall, Layton UT 84041. 801-973-7759.

QEI 7775 ATS, will sacrifice, BO. J Katz, KJUG, 717 N Mooney, Tulare CA 93274. 209-686-2866.

Fairchild Dart 15 kHz card, fits Fairchild Dart 384 receiver, call for price, P Baillon, 612-222-5555.

Secode DTMF 5 chnl decoders (2), Vega data control telemetry system includes xmtr & rec units, FS keying, BO. R Juckebey, KJLF, POB 336, Butte MT 59703. 406-723-4006.

Data Signal MTI-700 modular telephone interface, BO. KDKB, POB 6184, Kingman AZ 86402. 602-753-KDKB.

**Want to Buy**

Marti RMC-15S, high speed, whole or studio unit, used or new. F Bonnet Jr, WOYE, POB 1718, Mayaguez PR 00709. 809-834-4384.

Marti RPT-15 or RPT-30 for sports bdcts, prefer UHF. P Baillon, KMCM, 1218 Pioneer Bldg, St Paul MN 55101. 612-222-5555.

Macom MA-2B or 6B, working, repairable or for parts. Also consider other 2 & 6-7 GHz, all solid state gear, sub-carrier modules also wanted, R LaFrance, WTW5, 216 Broad, New London CT 06320. 203-444-2626.

Marti RPT-15 or RPT-30 for sports broadcasts, prefer UHF. P Baillon, 612-222-5555.

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.

**STATIONS**

**Want to Sell**

SW MO 1 kW AM/3 kW FM in Joplin, excel real estate & equip. Will consider selling stations together or separate, stations are dark, serious inquiries to Great Radio Group, Kevin Checkit, POB 409, Carthage MO 64836. 417-358-4049.

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.

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.

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.

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.

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.

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.

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.

**Want to Buy**

Looking for AM, FM or LPTV, problem stations, turnarounds, daytimers, dark, etc. OK, bdctr 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.

**STEREO GENERATORS**

**Want to Sell**

Moseley SCG-3T stereo gen, BO. KDKB, POB 6184, Kingman AZ 86402. 602-753-KDKB.

Moseley SCG-4T subcarrier gen, like new, may be retuned. J Kramden, WBRL, 3342 Perry, Marsellus NY 13215. 315-673-9049.

**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 Buy**

Telemation TSE-200VS service manual & operators manual. W Steinbrecher, USBP, Fletc, Bldg 64, Glynco GA 31524. 912-267-1862.

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**

Fuji 621 1" 60 min plus 30M, 3/4" 5 min, 10 min, 15 min, 30M, 60M, gd cond. J Workman, Maritz, 600 W Lafayette, Detroit MI 48226. 313-963-1200.

Belacam tape, 20 min & 30 min, also metal SP Belacam, 20 min. J Workman, Maritz, 600 W Lafayette, Detroit MI 48226. 313-963-1200.

Background music on 10" reels, 3.75 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.

Records, 78 rpm, vintage MOR & Big Band, also Classic 16" comm transcription discs, BO. D Kelley, KISZ, POB 740, Cortez CO 81321. 303-565-1212.

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.

Columbia Masterworks etc. classical pre-recorded tapes (16), 7" reels, 7.5 ips, original boxes, BO pls shpg. S Delahoyde, Box 33063, Phoenix AZ 85067. 602-937-9088.

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Fidelipac 300 (34), vgc, 4, 5.5, 7.5 lengths, \$1 ea plus shpg. M Saady, First City Recd, 141-60 84 Rd 3E, Briarwood NY 11735. 718-846-2062.

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.

Approx 100 10.5" NAB reels, oldies. J McDonald, 303-669-3442.

Fidelipac NAB-300 carts, vgc, \$2 ea & (215 red) Master carts at 75 min long, \$2 ea/BO. R Pastorik, WCMY, 216 W Lafayette, Ottawa IL 61350. 815-434-6050.

Audiopak A-2 (1270) music length, gd cond, \$.75 ea. L Kolk, WSNX, 675 E Summit, Muskegon MI 49444. 616-733-2126.

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Beautiful Music/Big Band/Nostalgia bdct tape library on 10" reels, mono OK, stereo preferred. K Hill, WHCB, POB 2061, Bristol TN 37621. 615-878-6279.

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.

LP records, Easy Listening, Buck, KBUX, POB 1, Quartzsite AZ 85346. 602-927-5111.

**TAX DEDUCT EQUIP**

Christian Bdctrs seek donation of radio equip. MTD Comm, POB 2083, Ashland KY 41105.

Engineering student desiring donation of old broadcast equipment (anything) in repairable condition, will pay all shipping charges, Electrical Engineering student at Purdue, C Gill, POB 371, Indianapolis IN 46206. 317-923-2800.

Non-profit educ sta needs donation of STL system & cart machines. R Moughton WNLE, Rt 2 Box 705A, Yulee FL 32097. 904-261-7841.

FM xmtrs needed for charitable organization, will pay for transportation & give receipt for fair market value. T Hunt, SOS Radio Network, 702-731-5452.

Equipment rack, studio furniture, tone generator, mic arm needed. K Haas, Penna Public Radio, POB 224, Uwchland PA 19480. 215-458-0780.

High School FM station is in need of carts & EBS monitor, will pay shipping. S Tressore, Kearns H.S., 5525 S 4800 W, Kearns UT 84118. 801-964-7500.

Non-profit station w/501C status seeks donations of all equip necessary to start up new FM. CSRA Public Radio, 1518 Tara Ct, Augusta GA 30906. 404-796-2865.

Non-profit Radio Reading Service for the blind & print-handicapped in Connecticut needs (2) R-R's & (2) cart machines in gd cond, will pay for shipg or pick-up. Cynthia Clark, CRIS Radio, 589 Jordan, Wethersfield CT 06109. 203-246-3579.

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 xmitr, will pay shipping. J Counter, YSLE, 5484 San Patricio Dr, Santa Barbara CA 93111. 805-967-8410.

Comm College has CP for new stereo FM, need: 3 kW xmitr, antenna, iso-coupler, mod mon, compressor limiter, RT machines, TC machines, TT's. J Gaboury, Arizona Western College, 602-344-7695.

Bdct Eng student at New England School of Bdctg in Bangor ME seeks any & all old bdctg 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 evs).

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.

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.

**TEST EQUIPMENT**

**Want to Sell**

Philips PM3055 oscilloscope, 60 MHz, dual time base w/probes & manual, never used, \$800; Riser Bond 2901B time domain reflectometer w/soft case & manual, never used, \$500. T Eifer, POB 1576, Eugene OR 97440. 503-345-5193.

Potomac Instruments FIM-41 field intensity meter, less than 1 yr old, mint cond, \$1950; PI AT-51 audio test set, gen & analyzer w/TC-51 case, never used, \$2950. T Eifer, POB 1576, Eugene OR 97440. 503-345-5193.

Fluke DMM 8050A, excel cond, \$325. J Claybrook, WMJJ, 530 Beacon Pkwy, Birmingham AL 35209. 205-943-9600.

ADC patch panels w/jacks (2), ID panel in a rack mount case. Ed, 808-847-4300.

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Houston Instruments DMP29 8-pen plotter, A/B test, 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.

3M 210 SG/CB signal/color bar generator, BO. R Hodges, POB 1550, NYNY 10101. 212-245-5045.

Interstate Electronics F-34 rack mount/desk mt 3 MHz function gen; Fidelipac w/ & flutter meter; Harris stereo gain set; Heathkit SM-128B factory wired freq counter; Bird Thru-line & 43 slugs, 4275 sampler, 8080 25 & 50 W dry loads, BO. B Royster, KQM, 1019 Cordova, San Diego CA 92107. 619-223-3413.

Delta 01B-3, almost new in-line bridge & RG-3, \$4000. J Battison, 2684 State Rte 60, Loudonville OH 44842. 419-994-3849.

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/output Z, requires external audio source, \$250. R Cone, FM Unlimited, 6731 N Hermitage, Chicago IL 60626. 312-743-5850.

Leader LSG-231 FM stereo signal & generator, brand new, \$400. D Agnew, KKNB, 5601 S 27th, Lincoln NE 68512. 402-421-2223.

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.

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 Dailch, PSC 1 Box 362, APO San Francisco 96286.

Delta 01B-3 & RG-3, gd cond, \$4000/BO. J Battison, 2684 State Rte 60, Loudonville OH 44842. 419-994-3849.

General Radio 1606A impedance bridge, excel cond w/ittings & manual, \$800/firm. F Shields, KERV, POB 2187, Kerrville TX 78028. 512-895-1230.

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.

RCA WF48A AM freq meter, 1070 kHz, gd cond, BO; Nems Clarq 108E phase oscillator, 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.

Tek 1L20 spectrum analyzer, 10 MHz-4.2 Gmz; Tek 547 oscilloscope, BO. C Springer, KSEC, POB 890, Lamar CO 81052. 719-336-2206.

**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 Background Music, 135 N Illinois, Springfield IL 62702. 217-787-0800.

**TRANSMITTERS**

**Want to Sell**

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.

McMartin B-910 FM stereo exciter tuned & tested to your frequency. Goodrich Ent Inc, 11435 Manderson, Omaha NE 68164. 402-493-1886.

Continental 814-R1 2.5 kW FM w/exciter. ERI 3 bay antenna & 250' 1-5/8" coax at \$35 MHz, antenna & coax on tower, like new w/extra tubes, make offer. W McCan, KBHT, 101 S 4th, 3rd Fl, Crockett TX 75835. 409-544-9694.

Harris TE-1 FM exciter tuned to 97.5 kHz equipped w/Orban baseband interface card, \$800. M Hurst, WICQ, POB 909, Salisbury MD 21801. 301-742-2312.

Harris FMSH 5 kW FM tuned to 89.5 MHz, 9 yrs old w/spares & documentation, excel cond, \$14,000. G Gilbreath, 702-454-2085.

EMCEE HTU-100 UHF-TV LPTV/translator 100 W w/exciter/upconverter, many extras, clean, vgc. Sue Jenkins, WKOG, 1100 W 42nd St, Indianapolis IN 46208. 317-283-5800.

PCB 1000/S power reduction unit, set to 350 W input, 63.7 W output, tuned to 1150 kHz, complete w/coaxial switch. J Sidote, WELC, POB 949, Welch WV 24801. 304-436-2131.

Continental Electronics 315R-1 5000 W AM w/solid state exciter, \$32,000. D Jack, Tamara Comm, 5410 SW Macadam Ste 240, Portland OR 97201. 503-221-5166.

Harris/Gates FM-10H3 10 kW w/TE-3 exciter w/composite STL interface, 20 yrs old, well maintained, in service as aux xmitr. A Chambers, WAWZ, Box 14, Zarephath NJ 08890. 201-469-0991.

RCA BTA 50F 50 kW AM, fully operational, in storage for immed removal. Complete w/all tubes, schematics, floor plans plus many extras. \$18,000 plus shpg; RCA BTA 5F 5 kW AM, excel cond, w/all floor layouts, manuals, tubes, \$10,000 plus shpg; RCA mod transformer for BTA 5F xmitr, new in original crate, \$600 plus shpg. G Heidenfeldt, 2880 W Lake, Wilson NY 14172. 716-751-6187.

RCA BTA 1MS, \$3500; Moseley stereo generator, \$500 & McMartin B-910 exciter, \$850. C King, KIXZ, 1703-B Avondale, Amarillo TX 79106. 806-335-1954.

AM xmitr, 25 kW, 1 yr old. M Pulley, KYOO, 304 E Jackson, Bolivar MO 65613. 417-326-5257.

30 W digital FM exciter, field selectable, 1/2 price. J Phillips, WZOM, 408-112 Clinton, Defiance OH 43512. 419-784-1059.

Trade RCA 20 kW for Harris or Collins 1-10 kW xmitr. J Mauk, KMJ, POB 70002, Fresno CA 93744. 209-266-5800.

Gates BC-10H 10 kW/5 kW AM in excel cond, \$15,000. Jim or Richard, 801-637-0863 or 1752 or 3028.

## 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**

Mobile Broadcast Engineer, A.C.E. wanted for South Florida combo. Must have R.P.U. & telco exper. Maint. & troubleshoot studio/mobile bdct equip. Commun. skills a must. Resume only to: George Corso, WKIS-WOAM, 9681 Sheridan St, Hollywood FL 33024.

Chief/Maint Engineer, extremely organized person sought for 100 kW FM/5kW combo in S.E. Missouri, min 5 yrs exper pref. Resume to: Zimmer Broadcasting, J Zimmer, POB 1610, Cape Girardeau MO 63702.

Shadow Traffic Network's New York network center needs a second engineer. Duties include repair & maintenance of audio, RF, computer & telecommunications equip. Applicant must be familiar w/needs of a broadcast operation. Reply to: Jim Walling, Shadow Traffic network, 201 Route 17, Rutherford NJ 07070.

**POSITIONS WANTED**

FT position, traffic, continuity, airshift or prod, 11 yrs FT & PT, desire Northern AL area. C Calvert, POB 1408, Cullman AL 35056. 205-942-7800, days, 205-739-3866, nights.

Engineer w/17 yrs in radio, 10 yrs Chief, NARTE, FCC, AM/FM, currently employed in California medium market, looking. Write to: Radio World, POB 1214, Falls Church VA 22041. Attn: Box 89-08-04RW.

Tampa Bay engineer, 21 yrs FCC. SBE, Naber, presently employed, looking for contract. Write: Radio World, POB 1214, Falls Church VA 22041. Attn: Box 89-08-02RW.

Innovative young programmer looking to successfully pilot your CHR station into the 1990's & beyond, call Jim, 304-233-8937.

CE w/big prod voice, over 10 yrs hands-on eng exper seeks CE position w/prod in a top 100 market. G Morgan, 704-563-8676.

Young, bright, humorous, eager music director & talent w/5 yrs exper, seeks position anywhere, prefer Top 40 or AC format. J Tirey, 212-1/2 S Third, Richmond KY 40475. 606-464-3151.

Announcer in 13th market seeks PD position in smaller market, South preferred, college degree w/expert to back it up. Matthew, 813-381-4875.

Program Director, assistant engineer, announcer, board Op/AT, 4 yrs exper in mid market station. B.S. in communication, minor in business administration, very creative, willing to relocate. Write: Radio World, POB 1214, Falls Church VA 22041. Attn: Box 89-08-01RW.

Program Director w/16 yrs exper, gd promotional & people skills avail. CHRIA/DIRAC, Paul Wilson, 801-566-2144.

Air personality, 8 yrs exper, seeks PT fill-in on-air work in Los Angeles market. T Greene, 215-224-4651.

Engineering/programming or entry sales position wanted in SF Bay area, also interested in rep position for broadcast equipment. B Berman, 174 Morningsun, Mill Valley CA 94941. 415-388-8368.

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, 304-525-3961.

Small/Medium Mkt GM/Station mgr avail, credible ref, prof, former owner, preferably Southeast but all offers considered. John Bank, Box 2031, Sylvania GA 30467. 912-564-2922 before 11AM or aft 10PM Eastern.

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.

Bdct vet w/15 yrs exper will soon be leaving nationally syndicated company, desires GM/GSM position in North Carolina or eastern area. John, 1-800-527-2514 X520.

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.

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.

Engineer, FT, RF, video, audio, solar, FCC gen'l, SBE cert, ham, educ or com'l, Sunbelt, Chicago, manu, sales, Frank, 312-890-9246.

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.

CE Natl 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.

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.

Sharp, young, aggressive audio sales pro seeks position as marketing mgr for respected, stable pro audio mfr. Bill, 415-726-4786.

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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.



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619-239-8462

Telex 229882 Fax 619-239-8474

RCA 50 kW AM (2), spare tubes & parts. O Borgen, WMIN, POB 25130, St Paul MN 55125. 612-739-4433.

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.

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1 kW RCA-BTF-1  
1 kW Collins 830  
2.5 kW Harris  
2.5 kW Collins 831-D2  
10 kW Harris 10H3  
20 kW Collins 831-G-1  
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NM-PA4A pwr amp w/(2) 4CX250B 32 MHz plug in, mostly tubes, cond unknown, looks fair & complete w/all pwr supplies in same 19" rack mount, you pick-up/ship, 65 lbs, \$160/BO. H Jeschke, 5820 Overbrook, Philadelphia PA 19131. 215-477-5302.

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.

### AM TRANSMITTERS

1kW ITA 1000  
1kW Gates BC-1F  
1kW McMartin BA-1K  
1kW Harris BC-1G  
5kW RCA BTA-5T  
5kW Collins 21-E  
5kW Gates BC-5B  
5kW Gates BC-5E  
50kW Continental 317C  
-Many others-



Harris 3.5K, mint cond, \$23,000. R Wachter, KNSX, 3418 Douglas, Florissant MO 63034. 314-921-2121.

RCA BTE-10C/BTS-1A exciter, stereo gen, metering panel & CBS stereo Volumax in 4' rack w/spares, complete 10 W xmt, will sell separately, \$700 pls shpg. T O'Laughlin, O's Own Labs, Rt 1 Box 41, Barneveld WI 53507. 608-924-2001.

**Dummy Loads  
RF Plumbing  
RF Cable  
FM Antennas**



RCA BTE 15A FM exciter w/stereo generator & SCA generator. M Young, WJON, POB 220, St Cloud MN 56302. 612-251-4422.

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.

Gates BC-1F 1 kW AM, excel cond, \$2000. J Kramden, WBRL, 3342 Perry Rd, Marselus NY 13215. 315-673-9049.

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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.

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Jones-Tepco 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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5kW RCA BTF-5D  
10kW RCA BTF-10B  
10kW RCA BTF-10C  
10kW RCA BTF-10D  
10kW Collins 830F  
20kW RCA BTF-20-E-1  
20kW Harris FM 20-K  
27.5kW McMartin BF-25K  
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FM xmt, 30 kW, 6.7. C Froke, POB 811, Deer Lodge MT 59722. 406-846-1221.

Low band 2-6 VHF TV xmt, 100 W to 11 kW; RCA TTU-1B or TTU-2A UHF TV xmts for parts. J Powley, 1536 Logan, Altoona PA 16602. 814-944-8571.

AM 1 kW in gd to excel cond at inexpensive price. K Hill, WHCB, POB 2061, Bristol TN 37621. 615-878-6279.

Any 3.5-5 kW FM or amp, exciter optional, can repair or retune. J Stromquist, WNCB, 2816 Hasberg St, Duluth MN 55811. 218-722-3017.

Harris/BE/Continental preferred, for non-commercial Christian FM, 25 kW, must be reliable & in gd cond; also seeking high power handling antenna & coax for 100 kW operation at 91.5 MHz. E Welch, WKCL, POB 809, Ladson SC 29456. 803-553-5420.

Any FM xmt needed for high school, willing to pay reasonable price or gladly accept donation. J Mangold, KTBD, 100 Champions, El Paso TX 79912. 915-594-9441.

FM xmt, 5 kW, any age or cond, RCA TTU-2 Series A, C, E or D & TTU-44 exciter, working, any cond or for parts. J Kautz, WJKL, 3342 Perry Rd, Camicus NY 13215. 315-673-9049.

Low band 2-6 VHF TV xmt, 100 W to 11 kW, exper eng can handle removal; RCA TTU-1B or TTU-2A UHF TV xmts for parts. J Powley, 1536 Logan, Altoona PA 16602. 814-944-8571.

UHF & VHF TV translators, 10-100 W, will consider old UHF band 70-83 equip. J Powley, 1536 Logan, Altoona PA 16602. 814-944-8571.

RCA BTE 10-C crystal ovens: Gates BC1F AM xmt; Raytheon RA1000, parts & info; Gates 25-A AM info. C Gill, POB 371, Indianapolis IN 46206. 317-923-2800.

RCA BTE 15A FM exciter w/stereo & SCA generator. WJON, POB 220, St Cloud MN 56302. 612-251-4422.

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.

TTC XL10FM 10 W FM translator. J Mache, KRBB, POB 5180, Roseburg OR 97470. 503-672-6641.

Any 10,000-20,000 W, fixable w/manuals, any age, w/filters & tunable to 101.5 MHz. M McVey, 620 Lake Rd, Ottawia IA 52501. 515-682-0498.

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.

Dummy load for 20,000 W FM xmt, used in gd cond. Kurt, KTRZ, Box 808, Riverton WY 82501. 307-856-2922.

Any 1kW amp, xmt, translator for channel 61. S Kappa, 402-476-6115, Fax: 402-476-6000.

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Partial List: 6623, 23791, TH150, 6425F, 5604, 6696, 6697, 5681, 5682, 5671, 7804, 3CX10, 000H3, 3CX20, 000H3, 4CS5000A, 4CX35, 000C

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RCA 6181, used as final in RCA TTU-1B UHF TV xmt. J Powley, 1536 Logan, Altoona PA 16602. 814-944-8571.

Surplus electron tubes, all kinds, all quantities, sockets, plate caps, etc. C Dripps, Kurluff Ent, POB 2204, Irwindale CA 91706. 818-444-7079.

### TURNTABLES

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Russco Studio Pro B (3), gd cond w/tone arms, \$100 ea. M Black, WEOS, Hobart WS College, Geneva NY 14456. 315-789-8970.

Stanton 210 phono preamp, \$100; Micro-Trak 2604 (2), \$75 ea. G Gilbreath, 702-454-2085.

Technics SP-10 12", 3345 remote start, working cond, BO pls shpg. R Norman, RNP, 11 Glenwood, Toms River NJ 08753. 201-349-8569.

Presto 6N (2) disc cutting lathes w/several lead screws in console, \$1300/both. E O'Brien, Imperial Snd St, RR 31 Box 405, Terre Haute IN 47803. 812-877-2663.

QRK turntables (2), \$50 ea/BO. B Burnham, WHBT, 1293 Floyd, Jackson MI 49203. 517-782-1510.

Technics SL1301 w/arm & Audiotechnica cartridge, excel cond, but dust cover has some minor scratches, \$160/BO. G Pernad, 1510-6 Peachtree, Cocoa FL 32902.

Astatic X26 crystal recording head, w/instructions, new in box, \$50/BO. J Workman, Maritz, 600 W Lafayette, Detroit MI 48226. 313-963-1200.

Technics SL1500 MK II, in gd cond, \$275. E Kain, WNOE, 529 Bienville, New Orleans LA 70130. 504-529-1212.

Micro-Trak 303 (2) tone arms, gd cond, BO; Audio Technica turntable bases (3), BO; Technics SP-15 (2), gd cond, BO; Audio Technica ATP-12T tone arms, gd cond, BO. D Wolfe, KRIX, 901 E Pike Blvd, Weslaco TX 78596. 512-968-1548.

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RCA tonearms (2), BO; (4) Micro-Trak tonearms, BO; (2) Gates MG244B mono preamps, gd cond, BO; (2) RCA BA26B mono preamps, gd cond, BO. J Keller, WKOK, POB 1070, Sunbury PA 17801. 717-286-5838.

Ramko SP8/E (4) stereo TT preamps, \$75/ea; Micro-Trak 303 12" tonearm, vgc, \$75. E Stolz, KWOD, 1425 River Park, Sacramento CA 95815. 916-929-5000.

RCA 328 12" (4), includes tonearms & preamps, \$265/all plus shpg. D Silver, KNKK, Layton Hills Mall, Layton UT 84041. 801-973-7759.

Panasonic SL-1700 MK 2, Technics quartz direct drive TT system, vgc, \$150. D Weston, KCOP, 5922 W 76th, Los Angeles CA 90045. 213-216-7814.

Russco Studio Pro w/Graco wood arm, \$100. W Kremer, 301 SW 16th, Ft Lauderdale FL 33315. 305-524-5652.

### Want to Buy

Rek-O-Kut B-12-H shock mounts, idler wheel, parts; Rek-O-Kut Micro-poise tone arms & parts; ORK 12-C parts, espec idler wheel & shock mounts. M Kuehl, Passage Prod, 1418 N Stevens, Rhineland WI 54501. 715-369-4007.

RCA, Presto record cutters. A Weiner, Britton Rd, Monticello ME 04760. 207-538-9538.

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#### Want to Sell

Numerous pieces of equipment including Gates/Harris TE-201 color film camera, Quanta character gen, RTI film editor & film cleaner, projector, power supply, waveform monitor, videotape recorder & more, to much to list, call for more details and prices. J Fuehrer, NTV Network, POB 220, Kearney NE 68848. 308-743-2494.

B&H JAN 614 EVMS light weight pedestal mount, 16mm optical & magnetic sound telecine projector, complete w/manuals, excel cond, \$795. G Ormod, GFO Prod, 432 E. X St, Tumwater WA 98501. 206-352-8028.

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.

### VIDEO PROD EQUIP

#### Want to Sell

Holtronic AD51-TFS frame sync/TBC, \$4000; Thomson-CSF 7011 chroma insert keyer, \$1250. H.M. Dyer Electronics, 2982 Wixom Rd, Milford MI 48042. 313-685-2560.

color bar & sync generator, make offer. R Rhodes, POB 1550 Radio City Station, Nyny 10101. 212-245-5045.

BTX 4500 time code sync, make offer. R Rhodes, POB 1550 Radio City Station, Nyny 10101. 212-245-5045.



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**VIDEO PROD EQUIP . . . WTS**

Illusion digital EFX, all upgrades thru 1988, bubble, perspec, 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-A30 edit controller, new, \$650. B Bridges, KCAM-TV, 827 Meridian, Nashville TN 37207. 615-226-1122.

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 CVM-1900 profess monitor/cvrs, low hrs, excel cond (2), \$700 ea. 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.

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.

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.

Sony SLO-383 edit recorder, new cond (2), industrial Beta, \$1200 ea. B Bridges, KCAM-TV, 827 Meridian, Nashville TN 37207. 615-226-1122.

Telechrome 3200 video dist amps, rack of eight, gd cond, BO. M Cramer, WGBA, 1391 N Road, Green Bay WI 54307. 414-494-2626.

Hotronic AD51-TFS frame sync/TBC, \$4000; Thomson-CSF 7011 chroma insert keyer, \$1250. H.M. Dyer Electronics, 2982 Wixom Rd, Milford MI 48042. 313-685-2560.

Panasonic editing system, 1/2" VHS, under warranty until 11/89, less than 100 hrs, (2) AG-6500 decks, AG-A750 controller, \$8700; Hitachi 13" color under warranty & (2) CT1386B, \$450/both; Fuji T-30 VHS w/bk hard-cover case (450), \$3.30 per unit, price for entire lot \$7000. D Murray, Murray Video Prod, 1918 Sloan, Latrobe PA 15650. 412-539-0465.

BTX 4500 non-chase synchronizer, \$595. G Freeman, Pranava Prod, 1227 Sierra Alta Way, Los Angeles CA 90069. 213-457-8390.

BTX 4500 time code synchronizer, BO. R Rhodes, POB 1550, NNYN 10101. 212-245-5045.

Cohu 2614-400 video waveform multiplexers (2), parade display, w/manuals, \$50 ea; RCA MI-557301 module extender, \$25; Trompeter LPL-75 video patch plugs, 1" spacing, new, \$3 ea; Vital VI-500 color proc amp w/cable equalization, w/manual, \$75. B Humpherys, UMC 8500, Logan UT 84322. 801-750-3133.

Sony FP-62 video projector, 30" to 200" w/built-in tuner, includes shipping case, \$750. R Nimitz, U of Notre Dame, POB 1088, Notre Dame IN 46556. 219-239-6423.

IVC/Quantel TBC-2000 direct-only, wideband 4-line TBC (2), one working well & one for parts, manual included, \$1200/BO. G Odell, TFG, Box 9, Wethersfield CT 06109. 203-527-2972.

Complete mobile audio/music video system, JVC, Zenith, Numark, EV, Meteor, (2) projectors, (2) screens, (4) speakers, 1600 music videos, lights, \$10,000. J Whitehead, WQBE, POB 871, Charleston WV 25323. 304-744-9691.

**Want to Buy**

Sony 5850/5800/RM-440 wanted in gd cond. Have assorted equip to trade, or cash; also want video sync gen preferably w/rack. R Lawrence, Moonshadow Video Prod, 4280 Reston Rd, Roseburg OR 97470. 503-679-8966.

**VIDEO TAPE RECORDERS**

**Want to Sell**

Sony VO-6800 portable 3/4" U-matic VTR, AC-PS, 8-NP1's w/charger, Kangaroo case/strap incl, \$2950. S Christian, Masterpiece Video Prod, 715 Cornwall, Silver Spring MD 20901. 301-439-5731.

RCA MI-4069B RCP for RCA TR-50 VTR, \$25. B Humpherys, UMC 8500, Logan UT 84322. 801-750-3133.

JVC CR6600U 3/4", low hrs, nice shape, \$1650. J Kreines, 5330 Kennedy, Millbrook AL 36054. 205-285-6179.

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 Std, 208 Cherry, Capitola CA 95010. 408-475-0423.

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.

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TK VIDEO 12300 Coppola Drive  
Potomac, MD 20854 301-762-2786

Panasonic AU-100 broadcast 1/2" M-format portable VTR, dockable to AK-100 camera, excel cond, \$1200. B Bridges, KCAM-TV, 827 Meridian, Nashville TN 37207. 615-226-1122.

Panasonic AU-300 1/2", M-format bdct VTR/edit, excel cond, \$2500. Brenda Bridges, KCAM-TV, 827 Meridian St, Nashville TN 37207. 615-226-1122.

**Want to Buy**

Panasonic NV-9240 or Panasonic NV-9600, 3/4" VTR, must be in gd working cond. A McPeck, POB 444, Rogersville TN 37857. 615-272-4827.

Ampex portable 2" quad VTR; Ampex col- or mdl 1200, low band color VTR; Ampex, IVC old format 1" VTR. A Weiner, Britton Road, Monticello ME 04760. 207-538-9538.

Ampex VR-3000 portable quad VTR. 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.

Please print and include all information:

Contact Name: \_\_\_\_\_  
 Title \_\_\_\_\_  
 Company/Station \_\_\_\_\_  
 Address: \_\_\_\_\_  
 City \_\_\_\_\_ State \_\_\_\_\_ Zip \_\_\_\_\_  
 Phone Number: \_\_\_\_\_

I would like to receive or continue receiving Radio World FREE each month.  YES  NO

Signature \_\_\_\_\_ Date \_\_\_\_\_  
 Please circle only one entry for each category:

**I. Type of Firm**

- |                              |                                 |
|------------------------------|---------------------------------|
| D. Combination AM/FM station | F. Recording studio             |
| A. Commercial AM station     | G. TV station/teleprod facility |
| B. Commercial FM station     | H. Consultant/ind engineer      |
| C. Educational FM station    | I. Mfg, distributor or dealer   |
| E. Network/group owner       | J. Other (specify) _____        |

**II. Job Function**

- |                       |                           |
|-----------------------|---------------------------|
| A. Ownership          | D. Programming/production |
| B. General management | E. News operations        |
| C. Engineering        | F. Other (specify) _____  |

Brokers, dealers, manufacturers and other organizations who are not legitimate end users can participate in the Broadcast Equipment Exchange on a **paid** basis. Listings are available on a \$25/25 word basis. Call 1-800-336-3045 for details and complete display rates.

WTS: <input type="checkbox"/> WTB: <input type="checkbox"/> Category: _____ Make: _____ Model #: _____ Brief Description: _____ _____ Price: _____
WTS: <input type="checkbox"/> WTB: <input type="checkbox"/> Category: _____ Make: _____ Model #: _____ Brief Description: _____ _____ Price: _____
WTS: <input type="checkbox"/> WTB: <input type="checkbox"/> Category: _____ Make: _____ Model #: _____ Brief Description: _____ _____ Price: _____

**Broadcast Equipment Exchange**  
 PO Box 1214, Falls Church VA 22041

**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. Blind box numbers will be provided at an extra charge of \$2. Responses will be forwarded to listee, unopened, upon receipt. Call 800-336-3045 for display rates.

**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). Responses will be forwarded to the listee, unopened.

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| 1980 | Harris FM 20 K           |
| 1976 | RCA BTF 20E1             |
| 1976 | Harris MW5A              |
| 1980 | Harris MW50A             |
| 1976 | CCA AM 50,000D, 50 kW AM |
| 1985 | CSI T-3-F                |

201 Old York Rd.  
 York Plaza Ste 207  
 Jenkintown PA 19046  
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- \* Tuned to your frequency
- \* Guaranteed
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 Open 7 days

# MARKETPLACE

Send us your new product info. Be sure to include a black and white photo. Send all submissions to Radio World Marketplace, P.O. Box 1214, Falls Church, VA 22041



### Studio monitor

Basic features of the A723, Studer Revox's new powered speaker, include: three power amps with negative output impedance, analog delay elements, XLR compatible connectors and coarse and fine trimmer potentiometers.

For information, contact **Charles Conte at Studer: 615-254-5651**, or circle Reader Service 81.



### EBS monitor

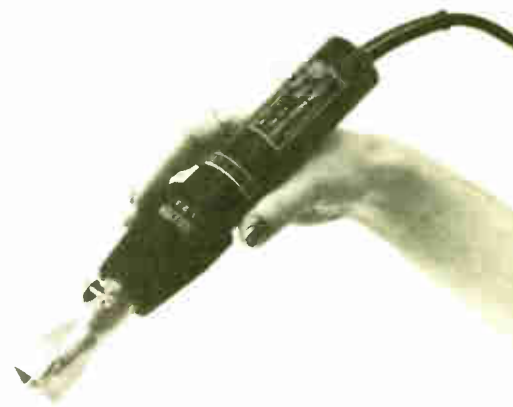
With the System 3000 EBS monitor from Multi-Technical Services, the user can monitor the local EBS operational area, an adjacent operational area and the local NOAA weather services.

System 3000 incorporates three monitor receivers, the EBS encoder and decoder into one unit.

Features include continuous automatic self testing, three channel fast scan, stereo program audio loop through, remote operation, encoder and digital window EBS decoder.

NOAA monitor and NOAA priority alert decode option also are available.

For information, contact **Lyn Williams at MTS: 919-553-2995**, or circle Reader Service 78.

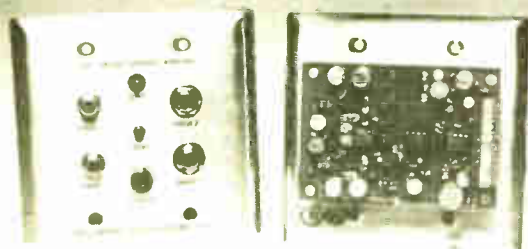


### Rework kit

The Leister Hot-Jet "Flex Circuit" prototype and rework kit consists of the Hot-Jet hot-air soldering and desoldering tool and accessories.

The Hot-Jet is double insulated and available in 100, 120 and 220/240 volts.

For information, contact **Henry Leal at Brian R. White Co.: 707-462-9795**, or circle Reader Service 98.



### Mixing interface

The CID-1 is a two input mixing interface mounted on a two gang stainless steel wall plate.

The CID-1 has a five year warranty on both parts and labor.

For information, contact **David May or Allen Burdick at Benchmark Media Systems: 315-452-0400**, or circle Reader Service 75.



### Professional mixer

The MV1602 audio mixer by Yamaha has two mixing busses and four aux sends from each input.

Inputs one through eight are mic/line selectable with adjustable gain and a peak overload LED.

Inputs nine through 14 are line inputs with a 20 dB pad, switch selectable.

15 and 16 are ganged stereo inputs.

For information, contact **Robert Davis at Yamaha Corp. of America: 714-522-9312**, or circle Reader Service 86.



### Sound absorbers

Azonic Sonics describes its products as advanced forms of standard acoustical convolutes.

Their new AZP (Azonic Pyramid) is available in two, three and four inch patterns.

All patterns are available in four colors.

Azonic also has six and eight inch wedge designs.

For information, Contact **Brent Johnson at Azonic Sonics: 1-800-842-9790**, or circle Reader Service 93.

## Subscription/Reader Service Form

# Radio World

October 11, 1989 Issue Use until January 10, 1990

**FREE Subscription/Renewal Form**

I would like to receive or continue receiving **Radio World** FREE each month.  YES  NO

Signature \_\_\_\_\_ Date \_\_\_\_\_

Please print and include all information:

Name \_\_\_\_\_ Title \_\_\_\_\_

Company/Station \_\_\_\_\_

Address \_\_\_\_\_

City \_\_\_\_\_ State \_\_\_\_\_ ZIP \_\_\_\_\_

Business Telephone ( ) \_\_\_\_\_

Please circle only one entry for each category:

#### I. Type of Firm

- |                              |                                 |
|------------------------------|---------------------------------|
| D. Combination AM/FM station | F. Recording studio             |
| A. Commercial AM station     | G. TV station/teleprod facility |
| B. Commercial FM station     | H. Consultant/ind engineer      |
| C. Educational FM station    | I. Mfg, distributor or dealer   |
| E. Network/group owner       | J. Other _____                  |

#### II. Job Function

- |                       |                           |
|-----------------------|---------------------------|
| A. Ownership          | D. Programming/production |
| B. General management | E. News operations        |
| C. Engineering        | F. Other (specify) _____  |

#### III. Purchasing Authority

- |              |            |            |
|--------------|------------|------------|
| 1. Recommend | 2. Specify | 3. Approve |
|--------------|------------|------------|

### Reader Service

Please first fill out contact information at left. Then check each advertisement for corresponding number and circle below. NOTE: Circle no more than 15 numbers, otherwise card will not be processed.

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007	027	047	067	087
008	028	048	068	088
009	029	049	069	089
010	030	050	070	090
011	031	051	071	091
012	032	052	072	092
013	033	053	073	093
014	034	054	074	094
015	035	055	075	095
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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

# HELLO PAGES



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\*We wrote the book on telephone talk interfaces. To get your free copy—and to see how easy your telephone talk can be with Telemix X™—send us a request on your letterhead to: Telemix, Dept. db, P.O. Box 1487, Richmond, IN 47375.

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Broadcast Equipment

— A HARRIS COMPANY



## 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-500 $\alpha$  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-500 $\alpha$  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-500 $\alpha$  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.

 Wheatstone Corporation

6720 V.I.P. Parkway, Syracuse, N.Y. 13211 (315-455-7740)

Circle 58 On Reader Service Card

World Radio History