Radio World®
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FAA Seeks EMI Authority

by Alan Carter

WASHINGTON Not unexpectedly, broadcasters do not support Federal Aviation Administration (FAA) proposals to gain tighter control over electromagnetic interference (EMI) policies that could restrict radio station changes.

Some of these proposed changes are more stringent than FCC regulations, requiring prior notification that the Commission does not include in its current regulations.

This broadcaster opposition is on record at the FAA, in filings on a Notice of Proposed Rulemaking, for which comments were due Dec. 31. They will continue to be accepted until the text of the document is finalized.

Opposition to the proposals comes not only from broadcasters but also from within the aviation industry. Questions arose over a proposal not to hold public hearings—a point questioned by many others including broadcasters. Commenters also expressed concern over the excessive filings that would be required.

The proposals would require broadcasters to notify the FAA and seek approval for changes or construction of new FM and VHF-TV stations and for any alteration to existing FM or VHF-TV stations, even when there is no change or increase in effective radiated power (ERP).

If the FAA has its way, broadcasters may have to get approval from the agency for new construction or upgrades.

The FCC filed an 11-page document outlining its long-standing concerns with the FAA over interference issues and aircraft safety.

FCC heads list

The Commission maintained that Congress authorized the FCC to implement and enforce technical standards to prevent interference and noted that public law directs the two agencies to "coordinate" work.

"Nothing . . . suggests that Congress intended to alter the traditional roles and balance of authority of our agencies," the FCC stated. "In fact, Congress, recognizing the varying areas of expertise . . . directed both agencies to engage

(continued on page 8)

FCC Calls For Aid

WASHINGTON FCC Chairman Al Sikes has gone straight to the top to keep the FAA from unilaterally imposing new EMI rules.

The FAA's recent proposals to increase its authority over EMI prompted Sikes to pen a Jan. 4 letter to Samuel Skinner, the head of the Department of Transportation. In it, Sikes urged that legal representatives from the DOT and the two agencies meet to work out their concerns.

Chief among Sikes' reasons for the meeting was the "additional costs—without offsetting benefits—on the FCC as well as the communications industry" in conforming to the proposed rules.

A 1985 memorandum of understanding between the FAA and the FCC outlined the way in which the two agencies would interact. "Given current concerns, however," Sikes continued, "I suggest the FCC's General Counsel, the Department's General Counsel, and the FAA's Chief Counsel meet soon to discuss revisions to the 1985 memorandum . . . "

CDRB Chair Named

by Judith Gross

LAS VEGAS About 30 engineers and receiver manufacturers showed up for the most recent meeting of the Committee for Digital Radio Broadcasting at the 1991 Winter Consumer Electronics Show (CES) here.

The January meeting was an attempt to get broadcast and receiver representatives working together to explore the myriad of digital systems which have been proposed for DAB.

In addition to the usual radio engineering attendees, about a half dozen manufacturing companies were represented, along with the Home Recording Rights Coalition and the Car Audio Specialists Association, which had provided the meeting room.

In one surprise development, however, chairman and co-founder of the group, Paul Donahue, DE of Gannett radio, submitted his resignation from the committee in absentia. Donahue cited "time considerations" as his reasons for resigning.

Skip Pizzi, formerly of National Public Radio and now with Broadcast Engineering magazine, was tapped to take Donahue's place, co-chairing the group with Mike Starling, also of NPR.

Not formally announced at the meeting, but confirmed afterwards was the fact that the Society of Broadcast Engineers (SBE) would assume the coordination of future CDRB meetings.

Ben Micznik, acting as consumer electronics liaison for the committee, also announced that Vannin Gale, representing manufacturer Kenwood, had agreed to serve on the committee. Don Palmquist, representing Yamaha, also suggested that a CDRB chairman be present for a meeting the Electronics Industries Association (EIA) was planning, to discuss DAB issues.

While the group had no new information to offer at the CES meeting, members promised that the results of an investigation into FM-compatible DAB systems would be delivered at the next meeting, which is slated for the NAB spring convention.

News Briefs

NAB Names Senior VP

WASHINGTON Kenneth D. Almgren has been hired as the NAB's new senior VP and chief financial officer, according to an announcement by NAB President/CEO Edward O. Fritts.

Almgren, 43, will replace Michael Harwood who is retiring this year after 14 years at NAB's senior financial position.

Almgren previously served as finance VP, treasurer and CFO of the Arinc Companies of Annapolis, Md., from 1981 to 1989.

Station Fined For Illegal Power

WASHINGTON People Wireless, Inc., owner of KDKO-AM of Littleton, Colo., was fined $10,000 in December for various violations of FCC rules, including unauthorized use of daytime power at night.

According to the FCC, KDKO failed to switch from daytime power to nighttime power and nighttime directional pattern. KDKO also failed to cease operations within three hours after a malfunction in the remote system was detected, and was found to be using an unlicensed studio to transmitter link (STL).

Companies Reach Digital Agreement

SAN JOSE, Calif. Digital Microwave Corporation (DMIC on NASDAQ) and AT&T have reached a development and supply agreement for Synchronous Digital Hierarchy (SDH)-based digital microwave radio equipment.

The agreement outlines the development of SDH transmission products by the two companies for global applications. Technology evolving from the venture will be available to both companies.

Memorabilia Sought

LOUISVILLE, Ky. The Association for Recorded Sound Collections (ARSC) is trying to locate individual pieces or collections of radio and technical memorabilia to eventually put into its international directory.

In particular, ARSC is seeking information about private and corporate source collections.

"Our objective is to find the unusual private or specialized source of history, including programs, engineering, equipment, business policy and personalities," said Stephen Cisler, chairman of ARSC's Broadcast Collections Committee. "These will join our listings of large collections from key stations, colleges and museums already known to our committees."

For more information, contact Stephen Cisler at 502-895-5596.

Harris Buys Transmitter Firm

MELBOURNE, Fla. Harris Corp. has signed a letter of intent to acquire the U.K.-based TVT broadcast transmitter division from Varian Associates, Inc.

The purchase is the first overseas manufacturing facility for Harris Communications Sector.

"Establishing a manufacturing facility in Europe demonstrates our commitment to be a world leader in our communication markets," Harris Communications Sector President Guy Numan said.

Terms of the transaction were not disclosed, and a final agreement is yet to be negotiated.

The announcement closely followed Varian's sale of its Continental Electronics division to Houston-based Tech-Sym Corp. for $12 million with a $1.7 million promissory note.

Index

NAB Endorses CEBus Remote

by Frank Beacham

WASHINGTON Convinced that the proposed CEBus system will not cause AM interference, the NAB has given its blessing to the universal specification control system that will permit "smart" household devices to interact through AC power lines.

The NAB announced that it is convinced the proposed Consumer Electronic Bus, or CEBus system, will pose no interference threat to AM broadcasts. The broadcasters organization will support future development of the system, NAB spokesman Doug Wills said.

Proposed by the Consumer Electronics Group of the Electronic Industries Association (EIA/CEG), the CEBus system would create a standard that would launch the long-awaited concept of home automation.

Such home automation promises to allow computer control of the functions of a wide range of devices including sound systems, TVs, kitchen appliances, computers, environmental systems, security systems and lighting.

The home of the future

For example, a homeowner using a single wireless handheld control could remotely operate a television, VCR, stereo, thermostat, security system, lighting, draperies, door locks, dishwasher and dozens of other electric devices. While away from home, those same devices could be checked and manipulated via voice command over a telephone.

In a recent filing with the FCC, the NAB noted initial concern about potential AM reception interference by the home automation system. The broadcaster group, however, said it no longer has such concerns. "Recent modifications to the CEBus system demonstrate that devices can be operated without interference," the NAB said.

Although it is certain that CEBus will not cause interference to AM, the NAB urged the FCC to investigate interference problems caused by similar "carrier current" devices that use the frequencies within or near the AM broadcast band. If necessary, the NAB said, the Commission should modify its rules to prevent interference to AM radio broadcasts.

Still under development

So far, the CEBus standard is still under development and hasn't been enacted into a final specification. The EIA has been a leader in helping develop the standard and companies such as Sony, Philips, Panasonic, AT&T, Mitsubishi, RCA, General Instruments and Johnson Controls are participating in development discussions on a CEBus specifications committee.

Development of the CEBus standard began in 1984 as a way to help reduce the glut of remote controls proliferating in American homes. That work has broadened in recent years to a search for a comprehensive standard that will permit home automation to occur in several interrelated layers.

According to the EIA, developers of CEBus have five primary goals in developing the new standard. The system must be retrofitable and non-product specific. And it must use distributed intelligence without the need for a central computer, must have an open architecture and must be expandable.

Console Firm Bought

by John Gatski

MOORESTOWN, N.J. Fidelipac Corporation, which earlier this month acquired Broadcast Audio Corporation, brings to the current arrangement a larger distribution network for the the latter company's products.

Fidelipac, the prominent cart manufacturing firm, finalized the buy-out plans Jan. 1. All Broadcast Audio manufacturing operations have been moved from Rancho Cordova, Calif. to Moorestown, N.J. The products will be manufactured under the name Broadcast Audio Division of Fidelipac, according to Fidelipac President Roger Thanhauser.

Broadcast Audio is known for its reliable consoles, of which 1,500 have been installed since the company went into business in 1977. Fidelipac will continue to manufacture Broadcast Audio's Series IV and Series VI consoles and other products including turntable preamps and monitor amps, Thanhauser said.

"From the point of view of the user, there will be no difference in manufacture and technical support of Broadcast Audio products," Thanhauser said.

He said the console product line will benefit from Fidelipac's organizational resources, financial strength and distribution network and, in turn, Fidelipac gains an additional product line.


Roger Thanhauser

Former Broadcast Audio President John Fernandez said he will remain as a consultant with Fidelipac until 1993. Fernandez and former partner David Evans, who is now deceased, spun off the Broadcast Audio line from the Sparta/Cetec line.

Fernandez said the consoles have a reliable reputation overseas as well as in the U.S. with units sold as far away as China, Guam and Australia.

For an update on Broadcast Audio products, call 609-235-3900.

Singing Your Way Through the CES

by Judith Gross

FALLS CHURCH, Va. As I write this, I have one ear tuned to an **all news** station. I'm not alone. You'll no doubt know more by the time you read it, but right now everybody's waiting to see if the country is going to go to **war in the Gulf**.

It's gotta be **especially tough** for the TV and radio crews. Imagine waiting for the **call to war** 24 hours a day. I've even heard of some stations that are **postponing** some long-awaited **engineering work** because they don't want to go **off the air**. Maybe after we've been shooting awhile, but not right now when we're all on the **edge of our seats**.

While we wait, we've got **wars** of our own to keep us occupied, though nowhere near as **critical**. The players continue to line up on different sides of the **DAB systems** being proposed.

Ron Strother, who has changed his original plan to test only the **Eureka system** and now wants to test **all** systems, has yet another **amendment** to his petition before the FCC.

This one suggests DAB testing on **multipoint distribution services** (MDS). Shannondale Wireless, in West Virginia, has apparently offered Strother **two channels** to test DAB on MDS.

Meanwhile, it seems we don't already have **enough groups** studying DAB (the CDRB, WARC advisory groups, CCIR, EBU, NAB, etc.). Now the **NRSC** is getting into the picture. The committee named a **DAB study group**, chaired by **Al Resnick** of ABC/Cap Cities and **Bart Locanthi**, a consumer electronics consultant.

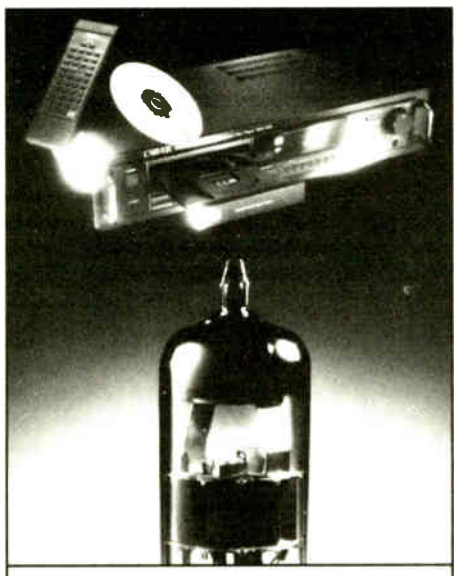
Don't look now, but here comes another **Notice of Inquiry on WARC**, the third one. It isn't out yet, but wait for it. It'll be coming from your friendly **Commission** soon.

So by the time US reps go to **Seville, Spain** for the conference about a year from now, at least they'll know **how everyone feels** about allocating spectrum. No one will **agree** with anyone about anything, but at least we'll all know.

Meanwhile, hot at the **winter CES show** in Las Vegas were a lot of nifty gadgets and games. Japanese **karaoke machines** have finally made their way into the US home entertainment arena.

You know. These are the music-video machines that flash up the words so you can **sing along**, microphone and reverb included. Lots of companies have them and they were hot at the show (along with the **football playoff games** and President Bush's press conference on the imminence of war). One fellow with a British accent was a hit singing *Mrs. Brown You've Got a Luvly Daughter*.

Sanyo was giving away T-shirts that told the world how you **embarrassed yourself** by singing in front of the CES gathering. I won **mine** by belting out *When Will I Be Loved?* Linda Ronstadt, eat your heart out.



Back to the good ole days.

Anyway, the **big news** from the show were two (count 'em) two **recordable write-once CDs**. And neither one was from Denon. **Kenwood** had one and so did **Pioneer**. They aren't ready for primetime yet, but Kenwood, at least, was close. Give you more details in the show wrap up, **next issue**.

Dreaming of hitting the jackpot.

Also at the show, if you're **nostalgic** for that distorted, boomy sound the **old tube amps** used to serenade your ears with, take heart. **Carver** has introduced a (I kid you not) **vacuum tube CD player**.

No, silly, the tube is at the **output**. First you digitize it, then run it **through the tube** for that warm, cozy, good ole rock 'n roll. Or blues or whatever. Geez. And the **audiophiles** complain about compression!

I was surprised to run into another friend from the **broadcast trade shows** at the CES. Audio vendor **Numark** was there and central region sales wiz **Bernie Fryman** was showing another version of the **CD segue machine** the company took to the NAB show last year.

You remember this widget, doncha? This was the one that **synched up the beats** of two cuts on two different CDs and **automatically** segued from one to the other so the DJ could sit back and come off sounding like a pro.

Well, the new Numark gizmo also has a **dual transport CD player** that segues, but this one lets the **jock** do the beat synch instead of having a **computer** do the counting. Guess some air talent wanted to at least **try to feel superior to a machine. Oh well, ya can't please 'em all, Bernie. Oh and by the by, I still dig the 'do.**

Then, if these shows make you a **mite weary**, here's an idea I want to nominate for the **NAB spring show** in Vegas. A company called **Innerquest** let you shut out the rat race with black glasses and headphones playing **soothing music**. You could sit back, relax, and pretend you hadn't **lost that deuce** at the craps table last night.

Vegas was fun. I especially liked the white tigers at **the Mirage**. That place has to be seen to be believed. How about **$500** one-armed bandits?

What about **me**? Hey, I **won**. Naw, not the $500. Try, five cent slots. That's more my speed.

Keep listening for **better news** than war on the radio. And don't forget the men and women serving in the Gulf.

Heard a juicy tidbit? Spill your guts to **Earwaves** *by faxing JG at 703-998-2966, writing to PO Box 1214, Falls Church, Va., 22041, or calling 703-998-7600. Who knows, you could win a coveted* **RW** *mug.*

READERS FORUM

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

Thank you, Lafayette Radio

Dear **RW**,

I also lamented the passing of Lafayette Radio until Radio Shack franchises proliferated. In the void, I managed to find a couple of small neighborhood electronic parts distributors willing to do business with a young lad. They too have passed on.

I guess I pre-date Alan Peterson by a few years, as my first encounter with Lafayette Radio occurred at their "headquarters" on Archer Avenue in Jamaica, Queens. At the time Lafayette had only one other location in Lower Manhattan. The Syosset Long Island warehouse was yet to be.

In those days, most of the house brand equipment, packaged in the Orient, was of pretty poor quality. Electronics from Asia was in its infancy and had lots of maturing to do before the quality products we take for granted today would emerge. Who would have guessed, back in 1959 that the most popular broadcast turntables in the 1980s would be coming from Panasonic (Matsushita) Corporation of Japan?

The Archer Avenue store, which stood out in a rapidly deteriorating neighborhood, had a display window dedicated to distressed merchandise. I was in junior high school when I made the plunge and bought something from that window: a quarter-track stereo tape deck that did not work. After testing it at the store, I was able to persuade a salesman to sell it for $5.00 with a reel of tape to boot!

It took me only two hours to discover that a couple of broken wires were the only things wrong with it. Thus began my career in audio and eventually broadcast engineering. Thank you Lafayette Radio.

Ira. A. Wilner
Wilner Associates
Putney, Vt.

Bring AM receivers up to snuff

Dear **RW**,

Emily Barsh of WBZ (*Readers Forum*, Dec. 12, 1990) is right on target. I would like to follow up with some information and opinions of my own. There *should* be much more attention focused on improving the quality of AM radio as delivered to the listener. This includes the receiver.

During the summer of '89, my wife acquired a used car. I decided to try to find a reasonable facsimile of a good AM stereo receiver for this car. The pickings have gotten pretty slim. Using a list provided by Motorola, I found that the few *quality* units have virtually no distribution. Only a few questionable units are readily available.

Knowing that both Pioneer and Clarion sold good AM stereo receivers in the past, I decided to find out if either of them was still marketing units in the countries that have a standardized system (C-QUAM). I called the Canadian headquarters for both companies and received basically the same response from them.

To paraphrase: "No, we don't have anything on the market at this time." Why not? "The combined consumer market of Canada, Australia, and Brazil is not large enought to justify the cost. We need to have the United States adopt the same standard before the market will be large enough to take the chance again."

Several station owners have told me in the past that they would chance installing stereo if they could be sure that they were buying the right system and would not have to chance the cost of later replacement. I think that makes things pretty clear. It is moot as to which system is superior. C-QUAM works, and it does so quite well.

Yes, Mr. Kahn, I am sorry; you can help the AM industry, or you can continue your crusade and continue the damage. We must have an official standard, and it must be C-QUAM to march these other countries and now Mexico as well.

Ms. Barsh stated that at least three parties (AM stations, manufacturers, and government) share responsibility for making AM stereo a reality. I agree, however, these three do not share this responsibility equally. The lion's share falls on the AM stations. There are quite enough of them to influence the government; and both directly and through the government, influence the manufacturers. The vast majority of AM stations are shirking this responsibility.

Any other industry that faced the prospects that AM broadcasters are now facing would be screaming in mass harmony. Where are the voices of the AM broadcasters? Mostly muttering or saying things like, "It's *only* AM. Why should I waste my money or effort on improving it?"

Because this attitude is a self-fulfilling prophecy, that's why. If AM is dying, it is because of mass attempted suicide. How many of you are transmitting stereo? Not very many. How many of you have state-of-the-art equipment throughout your facility? Not many more. I can understand that some of you are in such bad shape financially that you cannot do these things. The others, however, have no excuse.

But here is the big one: How many of you have taken the time to sit down and write to people such as the NAB, the FCC, the EIA, your congressmen and senators, the receiver manufacturers, etc., and let them know how you feel and what needs to be done? Virtually no one.

If every owner, every manager, every engineer and every program director were to write just one letter, I think that something just might finally happen. The NAB, if they really want to help, could send a letter to all AM stations suggesting points that should be made in a letter as well as suggesting whom to send letters to.

Just a few final points. You must convince the receiver industry that you will transit stereo if the standard is adopted. If you are stereo, you must promote it in every way possible (as media, you should know how). Save yourselves—no one is going to do it for you.

Stephen R. Weber, Jr.
SBE Senior Engineer AM/FM #2811
Fresno, Calif.

Unilateral Action Is Wrong

Relations rarely have been more strained between the Federal Communications Commission and the Federal Aviation Administration. In fact, such interdepartmental struggles within the executive branch of the federal government—played out so openly—are unheard of in recent memory.

The issue is public safety. Or jurisdiction. Regardless, something must be done to smooth the waters between the FAA and the FCC, or broadcasters will find themselves saddled with more expenses and more red tape.

The FAA is attempting to expand its authority over electromagnetic interference (EMI) issues. New rules proposed by the agency would require broadcasters to have FAA approval for changes to FM stations or new construction. Air navigation equipment—avionics—is susceptible to EMI from broadcasters, the FAA alleges, and the proposal would offer protection from such conditions.

But if these rules are instituted, who pays? First, broadcasters. On another level, however, the FCC also pays, because the Commission will be required to see to the rules' enforcement.

This budgetary burden is perhaps what FCC Chairman Al Sikes alluded to in a letter to Secretary of Transportation Samuel Skinner. In it, Sikes notes that the FAA rules would impose costs on the FCC and broadcasters "without offsetting benefits."

Of course, safer air travel benefits nearly everyone, but should the cost of friendlier skies be born solely by broadcasters? Observers already have suggested that perhaps the onus is on avionics manufacturers to build higher quality navigation equipment, less susceptible to EMI.

And is it within the FAA's jurisdiction to attempt such a unilateral action, and to make another independent federal agency work through its bureaucratic processes as the only avenue of objection?

Apparently, Sikes doesn't think so. His letter to Skinner calls for a meeting of the legal representatives of the FAA, FCC and Department of Transportation to arrive at a better understanding of how the two agencies should behave with respect to one another.

Sikes' letter indicates the degree of the FCC's concern with the FAA's proposed rules, and how pressing the need is to resolve the jurisdictional dispute that lies beneath the emotionally larger issue of public safety. To ensure that broadcasters are not unfairly bound by FAA policy, the FCC should institute its own proceeding on EMI and avionics. If a legitimate problem is discovered, the solution must be jointly agreed to, not unilateral.

—RW

RW Shifts Its Staffers

Some readers may have noticed a change in editorial responsibilities at **RW**. Alex Zavistovich, formerly associate editor of the paper, has assumed the position of senior editor. He replaces Judith Gross, who is now devoting more time to an independent journalistic endeavor. Judith will continue to serve as editorial consultant to **RW**.

Charles Taylor, previously a reporter, is now associate editor of the paper, focusing in particular on Buyers Guide. John Gatski, also formerly a reporter, has taken the news editor title.

Alan Carter, who had served as **RW**'s news editor for three years, is now handling editorial duties for the paper's international edition.

All four editors are long-time employees of **RW**.

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Next Issue
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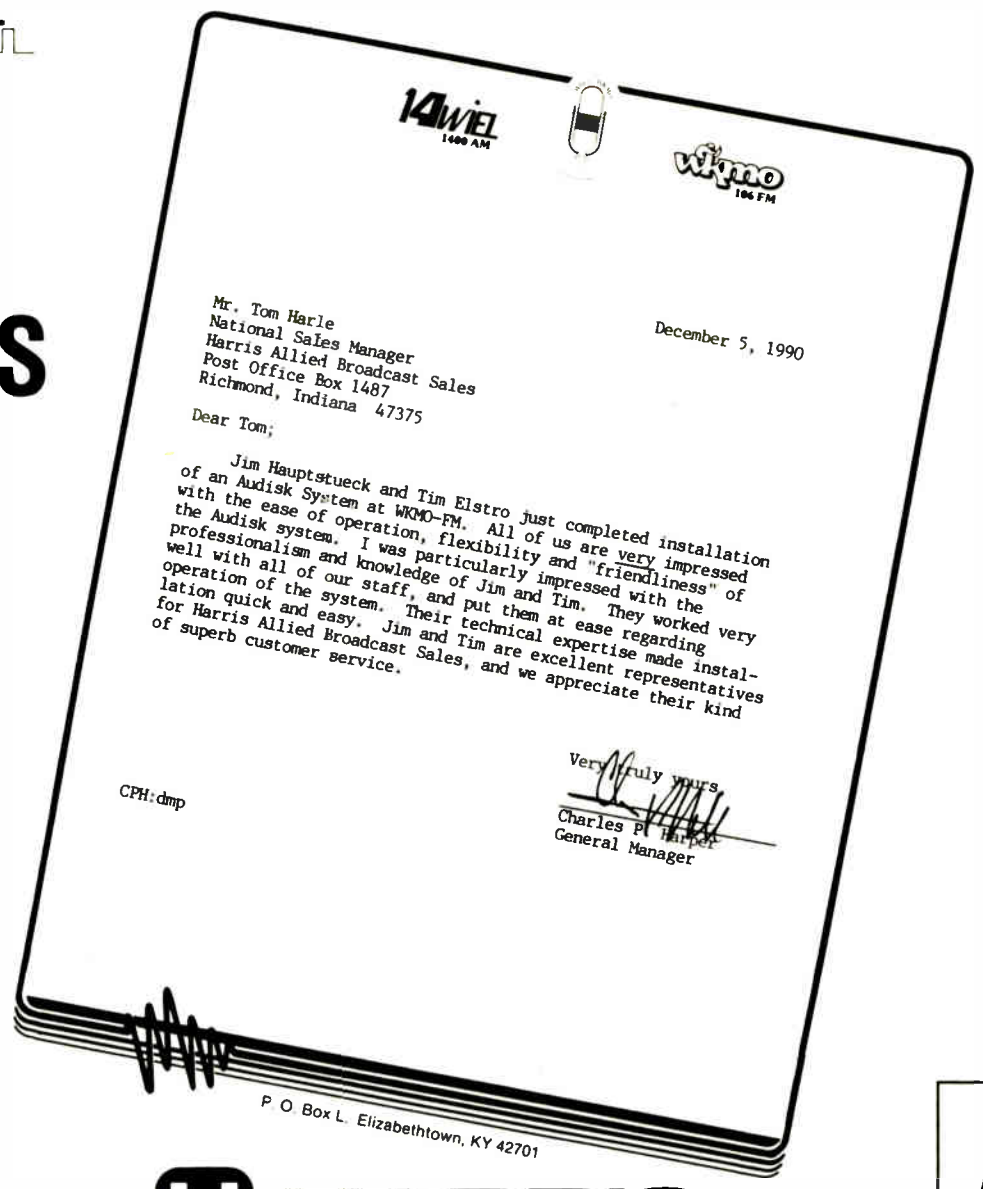

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DAB Royalty Issues Addressed

Copyright Office Receives Numerous Filings, Pro And Con, Concerning Digital Audio Broadcasting

by Charles Taylor

WASHINGTON To tax or not to tax? That was the predominant question wrangled in comments addressing the U.S. Copyright Office's inquiry into digital audio broadcasting.

The notice, posted amid the FCC's own encompassing inquiry on the potential impact of digital services on today's broadcast environment, drew response from a number of broadcast industry powers.

By far, the main issue under discussion was whether or not digital broadcasting's increased audio quality would increase the prevalence of home taping.

Such a scenario could merit royalty taxes to compensate artists and publishers of copyrighted materials, according to copyright fee proponents.

A $1.9 billion loss

The Recording Industry Association of America (RIAA) led the battle cry for copyright fees, citing figures from a Roper Report that claim artists and publishers already lose more than $1.9 billion annually from "illegal" home taping from radio, CDs and television.

"The advent of digital audio broadcast and cable services," RIAA concluded, "means that sound recordings will be exploited more intensively and extensively than ever before, in ways that will often involve charging the consumer directly without enumeration to recording companies musicians or artists."

RIAA urged the Copyright Office to recommend to Congress a performance right in sound recordings and to support legislation requiring broadcasters and cable operators to transmit "accurate and complete digital subcode information embodied in prerecorded digital recordings"; and to endorse restrictions on the broadcast of multiple selections from the same disc.

Other comments included a recommendation that blank tape and recording devices be taxed in an effort to recover lost revenues from home taping.

Blank tape and recorders

The American Society of Composers, Authors and Publishers (ASCAP) said 13 countries already tax blank tapes and tape recorders in an effort to protect copyrights.

The organization also pointed out that home taping DAB cannot be monitored, nor can owners of receiving equipment be pinpointed. As well, attempts to question subscribers about their taping activities would be regarded as an intrusion of privacy, ASCAP said.

As a result, ASCAP reasoned that digital audio services "pose a grave danger to music rights owners." They will likely result in "rampant" home taping, the group said.

Digital system hopefuls Satellite CD Radio and Strother Communications agreed there is no basis or justification for special regulation of digital services from the standpoint of protecting copyrights.

"Such regulation will actually hurt copyright owner interests by discouraging the development of a new radio distribution medium," Satellite CD said. "Digital audio broadcasting services are no more likely to be copied than works now broadcast on AM, FM or TV."

The Copyright Coalition, formed in 1989 to address copyright issues raised by digital audio recording techniques, added that a royalty payment system would neither "unduly encumber consumer taping activity nor interfere with the introduction of new audio recording technologies."

The group said that if not safeguarded, digital radio could thrust the music community into a future in which home recording "may be the principal avenue of commercial exploitation."

Absolutely no new taxes

Although the comments revealed a royalty outcry, there was equally determined unity against additional taxation for copyright protection.

The Home Recording Rights Coalition (HRRC) said that other organizations' insistence on royalties for DAB recordings "seems more about opportunities to tax than about the need to tax."

"Why not tax sales of photocopiers, blank paper and optical scanners to compensate the publishing industry?" the group asked.

There is neither legal nor factual justification for saddling the public and broadcasters with additional financial and technological burdens, the coalition said.

"Royalty taxes are inherently and irremediably unfair to consumers and hardware and blank tape manufacturers," it said. "No further compensation is warranted for the thriving music and recording industries, which year after year post banner sales."

The NAB pointed out that the recording industry's track record in predicting home taping's impact "is not reassuring." As proof, the NAB cited statistics that the total dollar revenue for record shipments actually grew 47 percent between 1985 and 1989.

Although CBS said it had no desire to enter the debate about home taping, it did note that home taping of radio broadcasts "would appear to constitute a relatively small percentage of taping activity. The economic impact of even this limited amount of taping is highly uncertain," the network said.

The network also took issue with a Copyright Office inquiry regarding the potential effects of making DAB a subscriber service. CBS said it strongly opposed any requirements that would prevent local broadcasters from transmitting digital sound free to the general public or that would allow such services to be scrambled.

Satellite CD and the NAB also opposed scrambling or pay per view over digital audio services.

It would be unfair, impractical, counter-productive and unconstitutional, Satellite CD said.

Decentralization in UK Radio

by David G. Burnett

LONDON New transmitter markets are likely to open in the U.K. with the recent implementation of new broadcasting regulations.

The new regulations will increase the number of national and local radio stations, and finally establish community radio service.

The business atmosphere here will be different after years of bulk purchase contracts negotiated by the British Broadcasting Corp. (BBC) and the Independent Broadcasting Authority (IBA), British analysts said.

Transmission questions that to date have been resolved by BBC and IBA engineers now may be faced by the new broadcasters with limited technical expertise.

Expected to be in place by the end of 1990, the new broadcasting bill replaces the IBA, which regulated commercial broadcasting, and owned and operated all transmitters. The IBA will be replaced by two organizations: the Independent Television Commission (ITC) and the Radio Authority (RA), which will regulate commercial TV and radio respectively.

BBC ran the show

For years, U.K. radio broadcasting was regulated and engineered by the BBC and the IBA. But under the new rules, radio will be licensed by the RA, which officially went into operation Jan. 1.

The RA, however, will not own transmitters. The existing IBA network and engineering support functions will become a government-owned company called National Transcommunications Ltd. (NTL), and will be sold into private ownership in 1991.

. . . the license holders will have freedom to make their own transmission arrangements, according to government sources.

The BBC was the dominant force in domestic radio with virtually 100 percent national coverage from the MF and VHF networks. It also operated a chain of MF and VHF local radio stations and the longwave service from Droitwich.

Network developments were technology driven within the BBC mandate of providing a service throughout the U.K. As frequencies were released for new services, the BBC engineered the transmission networks and provided the programs.

The BBC's only competition was the Independent Local Radio (ILR) stations, controlled by the IBA. The IBA granted licenses for the commercial stations and charged an annual fee for transmitter rental.

The license holders built their stations, which were required to conform with the IBA's technical code of practice and were under its program supervision.

The BBC and IBA engineered high quality transmitter systems and, with extensive use of standby equipment, provided a high level of service security.

New structure scheduled

The current proposals call for three new Independent National Radio (INR) licenses to run commercially. Of these, two will be on MF, using frequencies currently occupied by the BBC for Radios 1 and 3, and the third on VHF, using frequencies recently made available to broadcasters, between 99.9 MHz and 101.9 MHz.

While the RA will grant licenses, it will operate with a "lighter touch," and the license holders will have freedom to make their own transmission arrangements, according to government sources.

Licenses mainly will be decided by a sealed bid auction. One MF as well as the VHF will be advertised in early 1991.

The RA invited letters of intent from prospective license applicants. The responses totalled 39, of which 16 were for FM only, four for AM only, and 19 for either or both. The 24 potential applicants who released their names revealed a wide diversity of programing formats and included many substantial organizations.

Both the INR and the RA will oversee the expansion of ILR and the full introduction of the long-frustrated community radio.

The new license holders can contract with the IBA. For INR, however, the existing main transmitter sites are owned by the BBC, which is not permitted to compete for the transmission of new broadcast services. Yes, it will be an interesting time.

■ ■ ■

David G. Burnett is owner of business management and broadcasting consultancy DGB Associates in Cambridge, England.

Rule Sought by FAA

(continued from page 1)

in meaningful dialogue and coordination."

Among the FCC recommendations is that the FAA exempt all radio stations of 1 kW or less, to cover the 2,884,429 operations currently regulated by the Private Radio Bureau.

The Commission also suggested changes for provisions requiring FAA notification and approval including:

- Any construction or alteration of a radio frequency transmitting station with an operation frequency above 54 MHz and below 216 MHz, from an originally proposed 30 MHz, and effective radiated power above 10 kW.
- Any initial or modified operation, including a change in the authorized frequency or effective radiated power, of a transmitting station located within 3,000 feet of an air navigation or communications aid and operating with an effective radiated power greater than 1 kW.
- Any construction of a new broadcast FM or VHF-TV station having ERP greater than 1 kW utilizing an existing tower.
- Changes in authorized frequency, increases in effective radiated power of more than 3 dB, increases in antenna height and changes in antenna types, of existing broadcast FM and VHF-TV stations.

"These changes will include FM and VHF-TV stations, yet will exclude most low power transmitters, since there is no justification provided for the inclusion of these stations in the rule changes," the FCC argued. "The changes will eliminate notice requirements for those trivial changes which would have little or no impact on air navigation or communications facilities."

NAB and MSTV

In a joint filing, the NAB and the Association for Maximum Service Television (MSTV) called for public proceedings coordinated by the FCC and FAA.

The groups also argued that the FAA's technical standards on EMI are flawed and inconsistently applied.

The NAB and MSTV filing further suggested that the proceeding's scope be narrowed to exclude TV because "no evidence that an interference problem exists between the aeronautical and television broadcast services."

National Public Radio (NPR) and United Broadcasting questioned additional EMI regulations without improvements required to aircraft transmitters and receivers.

"An interference model should not perpetuate the use of outdated technology," United Broadcasting said.

"The FAA has not recognized aviation receivers as the source of potential interference," NPR added. "NPR strongly believes that in a maturing RF spectrum environment, those responsible for the equipment should bear the burden of correcting the interference condition."

Consultant concerns

Consulting firm du Treil, Lundin & Rackley also questioned the use of inadequate receivers by the aviation industry.

The group further maintained that the EMI computer program developed by the FAA appears defective. When applied to the airspace around O'Hare International Airport in Chicago, du Treil said it predicted extensive interference to existing FAA facilities.

Another consulting firm, Lahm, Suffa & Cavell, also said it was important that the technical standards the FAA uses to evaluate EMI be published and open to public evaluation.

For more information on the proposals, contact the FAA, Office of the Chief Counsel, Attention: Rules Docket (AGC-10), Docket No. 26305, 800 Independence Ave., S.W., Washington, D.C., 20591.

CUE and REVIEW

Colorization of CDs

by John Gatski

WASHINGTON Hey, engineers, have you heard the latest technique to make your station's CDs sound better? Marinate them in vinegar, bury them in the back yard for two weeks and—*voila*—radically improved sonics for your listeners.

OK, I'm just kidding about subjecting your precious discs to such torture. However, this made-up remedy rivals some of the audiophile fringe element's recent suggestions supposedly to improve CD sound quality.

First, there was the green marker remedy, in which the transparent side of the disc is colored with a green felt pen. Then somebody came along and swore that a black felt pen is the way to go. As I understand it, this will somehow alter the digital decoding process to make your worst CD sound like a million-dollar production.

Another contingent says Armor All™ car treatment is the cure for dull-sounding CDs. Wow! Not only can you protect your car's finish, but also improve the dynamic range of your CDs at the same time.

The latest sound improvement claim is freezing CDs in liquid nitrogen. Brrrr.

The audio community has not heard such a ruckus since the tube versus solid state amplifier conflict several years back. Like that hi-fidelitous controversy, this one appears to be quite heated.

I have read articles in reputable audio magazines, claiming immediate audible benefits from these various CD "treatments." On the other side, there are the lab types, the equipment reviewers, who dismiss these claims as digital quackery.

Although widely respected in the audio field, they have come under fire from those who believe improved sound is just a felt-tip pen away. "Stereo Review" magazine columnist Ken Polhmann, who teaches digital audio theory and has written a book on the subject, was berated recently in a letter by a well-known musician, who swore that Armor All indeed made his music sound terrific.

Based on digital reproduction theory and listening tests, Mr. Polhmann and other audio experts have said there is no basis for these remedies to enhance CD sound quality because of the precise nature of digital reproduction.

Based on their explanations, those little coded numerical bits on a CD contain only the sound that was recorded and mastered onto it. If the player is high quality, the laser reads the information and through the digital/analog process, the bits are reconstructed and the music is reproduced as it was encoded.

From what I am told, no amount of coloring or chemical layering of the CD shell will alter the sound in a way that would enhance it. A bit is a bit.

Such home-spun remedies as Armor-All, however, could affect the sound adversely. They could cause decoding errors similar to a scratch if they obscure the laser's reading of the disc.

Normally, a CD player's error correction systems will compensate for minor scratches, smudges and production flaws and they will not affect the sound. If one of these snake-oil cures is beyond the error correction mechanism's ability, however, it could result in skipping or those bursts of continuous repeats that characterize an ailing CD.

And something else to consider—especially with Armor All. The laser, though low in energy output, may cause the chemical to melt onto the vulnerable CD player circuitry. Some sound improvement, huh?

Now it is true that the quality of digital-to-analog converters, other internal components and filtering techniques can affect CD sound, but that is not the fault of the CD surface. A few years ago, some of the cheap players that used low-grade parts sounded harsh. But today, just about any CD player sounds good, no matter what its price.

Despite evidence that greening, blackening, Armor All-ing or freezing CDs does not make them audibly superior, these people continue to emphatically believe in their cures.

In light of this, I think it is time for the reputable audio press to put this controversy to rest, perhaps by conducting a comprehensive blind listening test similar to the one that was conducted with amplifiers a few years ago.

An audio magazine conducted such tests with golden-ear audiophiles who, overall, were hard pressed to discern major audible differences between amplifers costing hundreds of dollars and thousands of dollars. It is a controversy that continues to simmer, but was satisfactorily addressed for a lot of hi-fi buffs who previously were not sure what to believe.

The same type of test could be done with these CD improvement techniques. Treat a CD with one of those remedies and compare it to an untreated one, using the latest in double-blind testing techniques and quality equipment.

I am willing to bet that the tests will show CD sound quality is not affected by surface treatments, but only by how it was recorded.

It is likely that most of the audio-buying public would be satisfied by the test results. It might even convince a few of the felt pen proponents who are spraying car wax on their CDs how ridiculous their ideas are. On second thought, it probably won't.

WORKBENCH

Solving Telco Woes

by John Bisset

FAIRFAX, Va. It's becoming popular in many markets for radio stations to tap the services of the local TV weatherman or sportscaster to join the station lineup.

Typically, these feeds are done either at the talent's house or from the television station. In some markets, a mic and mixer are set up at both locations, with equalized lines running back to the radio station. A novel way to deal with these two feeds can be seen in Figure 1.

The outputs from each telco equalizer coil are fed in series, since neither are used at the same time. The front panel switch is usually left in the "both" position. In this case, the forecaster can call in reports from either location, without confusing the jock as to where the feed will originate.

The circuit has a couple of other added benefits as well. First, the tip-ring-sleeve monitor jacks provide a convenient way of monitoring either signal. Second, should one line fail, the operator simply switches to the other line. While the phone company sends down its tones (or who knows what else), the output from that equalizer is shorted — and won't go out over the air.

★★★

Speaking of quiet telco circuits, sometimes this can be a problem. At a recent SBE meeting, several engineers complained that telco installers were pulling their circuits for special or occasional broadcast. One station did a monthly live remote from a restaurant, and more times than not, there was no continuity when the circuit was checked the night before the broadcast.

Several engineers offered a solution that appears to be working—leave the tone on-line all the time. Installers, searching for a spare pair, may select yours if they bridge across it and hear nothing.

I know they're not *supposed* to do that; nonetheless, the practice does occur. The engineers who offered the suggestion said their continuity problems dropped to zero since they started hanging a buzzer or tone generator on their line.

For more permanent installations, the Shure mixer has a built-in tone oscillator. Fostex builds an inexpensive, yet reliable battery-powered oscillator.

This multi-frequency device is distributed by a number of dealers. Bradley Broadcast Sales is one such dealer, and they sell the Fostex TT-15 for $41.95. For information on the Fostex TT-15 or for a Bradley catalog, circle **Reader Service 4.**

If you're searching for something a little less elaborate, you can buy the telco-type "buzzers" or "tweedle-tone" oscillators from Specialized Products Company.

The 77A Tracer sells for $25. If you are into telco-type accessories—butt sets, signal tracers, etc., then the specialized products catalog is for you. For information, circle **Reader Service 123.**

★★★

You say you're tired of playing games with old Ma Bell? Then circle **Reader Service 88.** You'll receive a copy of "Answers to Common RPU Questions," written by Marti Electronics. This two-page bulletin takes you by the hand through RPU selection, licensing and antenna selection.

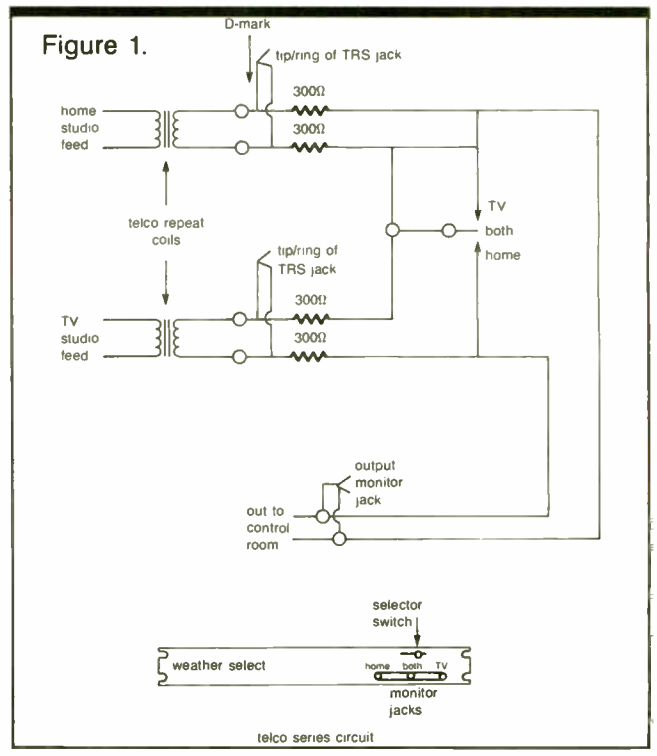
They even answer some tough questions, like, "Just how much RG-58 can I use?" (which might make a great SBE Certification question).

This publication is a good refresher for those of us experienced with RPUs as well. Oh, and as to the answer to the RG-58 question—the RF loss in RG-58 is too great to use more than 20 feet in any of the RPU bands.

■ ■ ■

John Bisset recently left Delta Electronics to concentrate on Multiphase Consulting, a contract engineering company. He can be reached at 703-379-1665.

Figure 1.



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Circle 117 On Reader Service Card

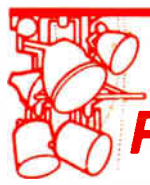
Learning the Ropes by Video

by Frank Beacham

LOS ANGELES How does the novice broadcaster learn to produce a radio spot? Or learn to read a VU meter? Or learn the basics of signal processing?

The answer used to be at school or from more experienced station employees. But now there is a new way: videotape training.

In what may be the first collection of videotapes on radio production ever assembled in a specialty catalog, First Light Video Publishing of Los Angeles is offering what it terms "master classes in media arts" on video cassette.



Focus on Production

Among the tape titles are "Radio Production: Making a Radio Commercial," "The Art of Radio Advertising," "Writing for Radio," and "Radio Drama with Shaun McLaughlin" (of the BBC). These programs, which were produced by the Australian Film, Television and Radio School (AFTRS), are being offered for the first time in the United States.

A series of tapes featuring producer/engineer Tom Lubin provides training on microphones, mixers, equalizers, compressors, gates, reverb, delay and multitrack recording. Workbooks are offered with practice exercises keyed to the video programs.

"We anticipate our largest sales will be in the middle of the country, outside the Los Angeles and New York areas where classes in these subjects are not readily available," First Light co-owner David Lebrun said.

Numerous topics

"Some of the programs are introductory, others are advanced and specialized," First Light's newly released catalog advises. "Some programs provide an audiovisual 'how-to' manual for a particular technical task or role; others provide an experimental immersion in a creative process."

The tapes teach a wide range of skills needed by radio station personnel. For those who do location remotes, veteran recorder Bill Linton offers his expertise in "Location Sound Recording." He delves into dozens of location situations—from press conferences to strolling interviews, from parties to phone booths, from noisy streets to pastoral natural settings.

For news reporters, there are tapes on interviewing and current affairs reporting. For those who produce commercials, Dr. Phillip Bell, Senior Lecturer in Australia's Macquarie University Mass Communications program, offers a specialized tape on "Advertising: The Hidden Language."

In addition to the radio tapes, the catalog offers many programs on television, film production and related creative topics. Many of those programs cross over into the radio production category. First Light's Lebrun said he was skeptical at first of video's value as a teaching tool.

"I came to video education kicking and screaming," he said. "I'm a lover of books myself. I had to be persuaded that video was an appropriate medium for teaching. But now I'm convinced that video's ability to let you see things change is unique in teaching. The medium is the best way to teach some skills."

Quality productions

In reviewing sample tapes, RW confirmed Lebrun's statement. For example, in the series of tapes on sound production techniques, the high quality VHS HiFi soundtrack allowed the viewer to hear the effect that processing equipment has on the audio signal. Other topics such as microphone characteristics and phase cancellation were clearly demonstrated on the tapes.

So far, First Light's primary marketing effort has been aimed at schools. Marketing to radio stations and other businesses producing audio will begin early in 1991.

The school/business price for radio-related tapes average about $100.00 each. However, there are substantial discounts for individuals who wish to purchase tapes for private study.

"These tapes may not appeal to people with that coastal attitude that 'we already know it all,'" said Lebrun. "The tapes are more for people who say 'God, I wish I could have access to that kind of information. We could be a lifesaver to that kind of person.'"

First Light Video Publishing is located at 374 N. Ridgewood Place, Los Angeles, CA 90004. Telephone: 800-777-1576.

PRODUCT TRENDS

Condenser microphone

Sennheiser Electronic's MKE4032 condenser microphone includes a presence peak from 2 kHz-12 kHz and a supercardioid pickup pattern that maximizes feedback rejection with full frequency response.

Maximum cancellation is −20 dB at 135 degrees and minimum terminating impedance is 600 ohms. The microphone has a battery life of 100 hours.

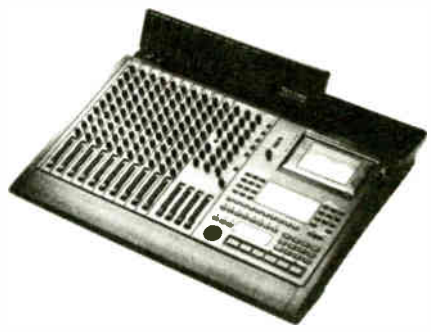
For more information, contact John Kenyon at Sennheiser: 619-538-6104, or circle **Reader Service 53.**

Eight-track portable studio

The 688 "Midistudio" portable eight-track mixer/recorder from Tascam integrates a 20-input, multifunction eight-group mixer with a sophisticated eight-track recorder.

The mixer section has 20 mix positions with separate gain, pan and effects controls. The 8×2 tape cue monitor can handle 18 signal sources with 10 main channels open for recording a mix of 10 other inputs to the multitrack recorder.

Up to 99 scenes can be stored in the Midistudio. An LED meter bridge



can monitor recording levels and channel assignments.

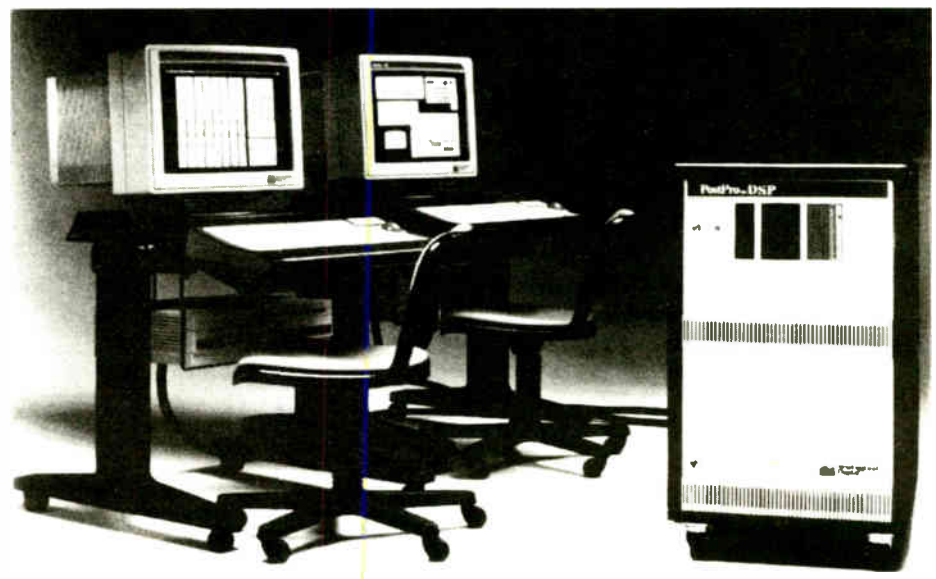
For more information, contact Bill Stevens at Tascam/Teac: 213-726-0303, or circle **Reader Service 118.**

IBM digital mastering system

The 1.1 version of SoundStage, the two-track editing software for the 56K digital recording system from Turtle Beach Systems, includes sample rate conversion, time compression/expansion, a scrubbing window, and separate mono left/right control.

The 56K digital recording system connected to a DAT machine and any IBM 286 12 MHz or faster will enable the system to record, playback and edit compact disc-quality sound.

For more information, contact Jeff Klinedinst at Turtle Beach: 717-843-6916, or circle **Reader Service 40.**



DSP Option

The DSP Option from New England Digital offers on-board mixing and 32-bit data path with 24-bit audio resolution.

The DSP is designed to work with MultiArc technology for multiple-user applications when used with the PostPro™ and PostPro SD digital audio workstations.

For more information, contact New England Digital at 603-448-3684, or circle **Reader Service 125.**

Racking Up Production Gear

by Ty Ford

BALTIMORE If you've been thinking about increasing your production studio's "ear candy quotient," a meander through this special installment of *Producer's File* may prove helpful.

First, consider improving quality and safety of the power that runs your rack. Although there are a few filters and power line conditioners on the market, I found the ISOBAR from TrippLite a likely choice because it offers protection from voltage spikes, as well as RFI and EMI AC line noise.

Make sure the suppression is quick enough to do the job and make sure the upper clamping voltages are low enough to keep from frying your gear.

If you're doing phone-in, FAX or modem stuff, don't forget surge protection for your phone lines. Some years back, lightning hit a phone pole a few miles down the road from my house and made a nice black hole in the middle of the master board of my security system. It can happen. If you're running computers in the studio, consider battery backup systems and voltage regulator/stabilizers to prevent momentary power drops and brownouts from ruining your day.

The rack

To the true Production Rat, an empty slot in the effects rack is like a promise waiting to be fulfilled. In an attempt to reduce the tantalizing effect of seeing a space that constantly whispers "fill me," I installed a rack-mount shelf in my last open rack space.

Such a shelf is more expensive than a blank filler panel, but it makes a handy repository for the by-products of the production I'm working on. To be honest, it also provides a great spot for gear that doesn't have rack-mount ears.

If your production studio console was originally designed with dedicated console returns and you've used them all up, consider expanding your capability with an additional patch bay or audio switcher. This works especially well if the input strips you're using as returns are switchable and available.

If you use a lot of the same patch configurations during your work and you hate patch cables, consider electronic switchers from Gentner and 360 Systems. If you're running an advanced MIDI system, the MM-8 from 360 Systems is an 8×8 MIDI-capable switching matrix.

The MIDI music makers are coming out faster than the market can absorb them. If you haven't had much music training, but still want to get into using synths, there are several "entry level" models under $1,000.

Some even have built-in zaps and whooshes. If you'd like to make some sustainer beds with drums, but feel shaky about creating your own drum arrangements, check out the Alesis SR-16 drum machine. Although it's not rack-mountable, it has great sounds and comes with 50 preset drum patterns that you can link together by number to create your own arrangements.

And if you need a sequencer or MIDI recorder, consider the Alesis MMT-8 sequencer or Mac-based Mark of the Unicorn's Performer software with a Mac-MIDI interface box.

Eating up channels

If your MIDI rig is eating up too many channels of your console, there are many rack-mountable mixers. The Alesis 1622, with 16 channels, six sends, eight returns and high/low shelving EQ is a good value, but it requires a fairly large hole in your rack. This kind of setup allows you to pre-mix the audio from all of your MIDI boxes before bringing them into your main console.

If your present MIDI-capable effects box suffers from lack of dedicated controls, try the Lexicon MRC-1 or Yamaha MPC-1 MIDI table-top controllers.

If you don't have the counter space for remote controls and you have an affinity for dedicated controls, check out the Yamaha REV 5 digital reverb. It's cleaner, quieter and more versatile than its predecessor, the REV 7.

At the top of my list of major effects devices are Eventide's Ultra-Harmonizer with sampler board; the Eventide SP-2016, the TC 2290 sampler/multi-effects box from TC; the Lexicon 300 and the Quadraverb from Alesis. When the 4 Mbyte RAM chips recently released make it to these devices, expect a quantum leap in sampling time and new special effects.

If you're in it for the long haul, it pays

(continued on page 15)

Who's Setting The Pace For FM Transmitter Technology?

When it comes to making claims about technological developments in FM transmitters, the record is very clear.

Broadcast Electronics:

First to introduce a Proportional VSWR Foldback System.

First to introduce "PWM Automatic Power Control" with "Soft Start".

First to offer a built-in synchronous AM test port.

First to design a single tube high power 30kW FM Transmitter.

First to introduce a single tube 10kW FM Transmitter with a 4CX7500A tube.

First to introduce a single tube 3.5kW FM Transmitter with a 4CX3500A tube.

First to introduce a Microprocessor Video Diagnostic System.

First to offer built-in, PC based, transmitter remote control.

First to offer a standard synchronous FM booster option.

And, Broadcast Electronics again sets the world standard for FM Exciters with the new FX 50 which stands alone in audio performance with 93 dB S/N and .003% THD and IMD.

Patented Innovations

Broadcast Electronics has the largest and most skilled engineering staff dedicated to the radio broadcast equipment industry. Significant FM transmitter design patents awarded to B.E.:

- Folded Half-wave Output Cavity, patented 1982.
- Internal Second Harmonic Suppressor, patented 1982.
- Broadband Input Impedance Matching Circuit, patented 1985.

State of the Art Leadership

Stereo technology, only B.E. designs it all - AM, FM and TV stereo generators.

Broadcast Electronics is the only major FM transmitter manufacturer who designs and manufactures its own solid state intermediate power amplifier (IPA).

All products are backed by B.E.'s 24 hour parts and service and a strict quality assurance program.

The result of this commitment to state-of-the-art innovation is a complete line of RF products, designed to provide you with years of reliable service. Certainly it's clear who **is** setting the standards for FM transmitter technology!

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Circle 140 On Reader Service Card

E-Mu Proteus Adds to the Mix

by Al Peterson

DANBURY, Conn. Stations now equipped for MIDI production enjoy the advantage of creating in-house music for spots and promos. Contemporary synth sounds and aggressive drum samples spice up any major station's presentation.

Focus on Production

Now, E-Mu Systems of Scotts Valley, Calif., turns it all around by putting a real symphony orchestra right into the mix with the Proteus 2 sound module, a one rack unit high multitimbral MIDI module weighing less than a violin case.

While Proteus itself is a recent addition to the E-Mu lineup, the company has made waves for years with its Emulator line of sampling keyboards (remember the synth that coughed in "Ferris Bueller's Day Off"?).

In fact, E-Mu used its ultra-quiet Emulator III to record and edit samples for Proteus, so there is no grit or fizzle to the sounds, and no noise anywhere. Sample playback rate is 39 kHz for a respectable 20 Hz to 18 kHz frequency response — more than ample for FM.

Nothing's missing, is it?

My first impression of the front panel was that they left out a lot of controls; up front are five buttons (one's for power), two dials and a display. But the editing power behind these innocent controls is awesome.

The Master key calls up the menu controlling overall operation of Proteus, including tuning, MIDI mode, real-time controller assigns and even what angle you want to see the display from. Tweaking any operation is done by the Cursor key and the Data dial.

Move the cursor under a line on the fluorescent display and enter a new value with the dial (Proteus seems to have been designed for musicians who prefer "giving the dial a ride" over laboriously inputting individual values—a very speedy method to rough-out a desired sound). The other dial is volume, which I left up all the way; for me, volume was handled by key velocity and Controller 7 commands.

The Edit key digs deep into each preset (or Patch, a complete set of parameters for any given sound) and can alter and reroute nearly everything Proteus has. You even can reverse a sound (plucked strings and percussion sound unearthly) or splice it onto another (how about a tubular bell turning into a trumpet?).

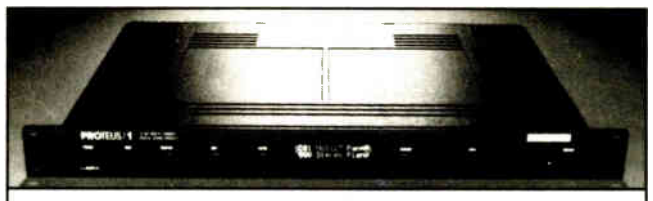
Back panel features include the now-standard MIDI In/Out/Thru jacks and six assignable quarter-inch line level (+4 dB into 600 ohms) jacks. Four of the six handle double duty as submix in/outs for patching outboard effects—very handy if your console is short on effect send busses.

MIDI implementation is excellent. Fact is, MIDI is the only way Proteus will make a peep (unless you play back the demo sequence ad infinitum). Even a studio equipped with a lower-priced "consumer" keyboard with MIDI Out can achieve dramatic results. Proteus shines with a sequencing computer, since its multitimbral capabilities put the majesty of a full real-sounding orchestra right there.

Outboard processing

Someone's bound to grouse about the absence of on-board processing (reverb) and the lack of some voices. E-Mu designed Proteus to be used with outboard processing, just as there is no single way to add ambience around an orchestra. With the assignable outputs, strings can get a large hall program, horns can be left alone or percussion can be given a gated slap sound.

Admittedly, the Proteus 2 is not for everybody. It isn't an "everything box" like the Eventide Ultra Harmonizer and it doesn't speed you through editing like the AKG DSE-7000 will. The Proteus is a sound module targeted toward musicians and composers. But it is a cost-effective addition to every well-equipped MIDI production room.



E-Mu's Proteus digital sound module.

Priced between $1,000 and $1,200 (well below any 16-bit sampler), in-house music production for station use breaks away from the "bloop-bleep-rat-a-tat-tat" the rest of the market is filled with. Give the Proteus 2 a listen.

For information, write E-Mu Systems, 1600 Green Hills Road, Scotts Valley, Calif. 95066.

■ ■ ■

Al Peterson is a synthesist and award-winning production director now with WLAD/WDAQ in Danbury, Conn. He acknowledges the assistance of composer Dr. David Chase in preparing this article.

Producer's Wish List

(continued from page 13)

to invest in effects boxes that are software-controlled. That way, as the technology advances you won't end up with a "dead-end" box. Aphex's Compellor and New Studio Dominator and Orban's 424A Studio Optimod and 464A Cooperator top my list for high-quality gain reduction devices for both production and air studios.

For flexible control of mic processing, try the Symetrix 528 mic processor. This de-esser, compressor/expander, parametric EQ setup is especially a good choice for consoles with no effect sends—the 528's back-panel patching connections can be used to feed a signal to an effects box, and the stacking input can be used as a return. Make sure the effects box you use in this configuration can mix the dry and effected signals.

Slightly more refined

If you're a tweaker with bucks, go for Orban's 787A processor. Besides doing everything the 528 does in a slightly more refined way, it also can store up to 32 presets and can be remote operated by basic optional remote control, MIDI, or RS-232 interfaces.

Studios with lots of open mics, like morning shows and interviews, can benefit from the four-channel expander gating of Valley's Gatex, Gold Line's 400, Symetrix 564 (due in April), or the ShureSmart Mic System.

If your production studio doesn't have a good parametric equalizer for remedial EQ, you need one. High-budget buyers should check out the Orban 764A digital parametric. Smaller budget buyers, head for the Orban 642B, Klark-Teknik DN410, Rane PE15 or a pair of the Symetrix SX201s.

Single-ended noise reduction systems such as the Symetrix 511A or the CRL DX-2 do a great job of cutting tape hiss and console noise, or you can get some relief from a pair of dbx 563X Silencers. If you need aural enhancement and single-ended noise reduction, check out the Orban 290RX adaptive enhancement processor.

And that's the way it is.

■ ■ ■

Ty Ford's studio continues to be a beta test site for production gear. Reach him by phone at 301-889-6201, via MCI mail (#347-6635) or via America Online (Tford).

A History of Chain Broadcasting

by George Riggins

LONG BEACH, Calif. John Landry of WBZ in Boston, suggested a look at the "Blue Book" of 1946. Perhaps we should go further back and start with one of the first reports issued by FCC, the "Report on Chain Broadcasting."

One fact we must remember is that the FCC as we know it today came into being after the Communications Act of 1934. Prior to that time, radio was governed by FRC—the Federal Radio Commission—and the Department of Commerce.

The Report on Chain Broadcasting became public in May 1941. The report was a study of the two major networks, CBS and NBC. NBC was controlled by RCA and consisted of the Blue and Red networks. CBS was the younger of the two, and not as dominant at that time.

NBC owned by RCA

One of the major points of the report was the fact that NBC was controlled by RCA. The report went on to cite the many ways RCA controlled radio through patents, receiver sales, control of artists, recording contracts, record labels, motion pictures and phonographs. The report writers contended that the two networks, Blue and Red, were not truly competitive.

Comments by John S. Wilson on the record jacket of a Larry Clinton album (LPM 1342) illustrate a few of the controls RCA held over recording artists: Larry Clinton was not allowed to record "Dipsy Doodle" and "Study in Brown" with his own orchestra before WWII because "Dipsy Doodle" had been recorded by Tommy Dorsey, and "Study in Brown" had been done by Bunny Berigan.

Old Timer

It was not until after the close of the war that Larry Clinton was allowed to record his own compositions on the RCA Label.

Other aspects of the report cited the contracts that were written for the benefit of the network to the exclusion of the best interests of the listening audience. Further evidence was cited of the control over local stations by the networks.

28 days notice

The networks could pre-empt local programming on 28 days notice, but the local station had to give considerably more notice if there was a desire not to "air" the national program. Contracts were written to give the network a one-year cancellation provision for breaking the affiliation, but the station had to give five years notice.

RCA, under pressure, sold the Blue Network, which then became ABC. One of the problems associated with the sale and renaming was the fact that most of the ABC stations were not located in major markets. This still left many potential listeners without any way of getting competing programs.

Programming took into account the influence over program content that was maintained by the advertisers themselves. Figures cited indicate that Proctor and Gamble purchased enough national time (19,812 station hours) to fill the annual program schedule of more than three stations. Of one network's revenue, 35.7 percent came from just six sponsors. Of the total advertising revenue on all networks, 10 advertisers accounted for more than 18 percent of the billings.

As we can imagine, some of the intrigue that went into wooing potential affiliates would probably make a good "whodunit" book.

One of the other developments of the era that was brought about by the strength of the networks (CBS in particular) was the elimination of a stranglehold on radio news reporting held by the newsgathering industry (wire services).

CBS threatened to establish a worldwide news gathering service of its own if changes were not made. The established news media relented and allowed radio stations to have five-minute news summaries, timed to follow newspaper editions at 9:30 a.m. and 9 p.m.

Stations were to stay 12 hours behind the news. Not until 1939 was Associated Press available to networks.

New stars

Some reported benefits that came from network radio included the development of new stars of the entertainment world and the birth of worldwide instantaneous current event availability.

As for news gathering, we were able to know very quickly after an event happened, rather than waiting for the next "Extra" newspaper edition. I remember the San Francisco Chronicle being sold late in the evening after the Lindbergh kidnapping—hours before there was any mention of the event on either the Red or Blue Network.

The Chronicle had to be printed and trucked 150 miles to the little town where I lived. KMJ, Fresno, was the nearest network station for NBC and carried a mix of Red and Blue programming.

If anyone doubts the changes in values over the past 56 years that FCC has been in existence, look only to the original salary set forth for a commissioner: $10,000 per year.

■ ■ ■

George Riggins has experience in radio and electronics dating back to the 1930s. He also is a licensed ham radio operator and has had his own broadcast sales and service company, Riggins Electronic Sales, for more than 20 years. He can be reached at 213-598-7007.

Straightening Out the Radio Learning Curve

by Barry Mishkind

TUCSON, Ariz. According to many engineers, deregulation was the worst possible thing to happen to the broadcasting industry since disc jockeys were permitted combo operation.

Some owners and managers would take the opposite view: Deregulation was the best possible thing for broadcasting; it freed stations from onerous regulations and expenses.

As with many matters, the truth really lies in between. Many engineers, as well as owners and managers, have found benefits as well as problems in deregulation.

Forest-killing paperwork

For example, the forest-killing paperwork and outdated regulations are well left in the past. On the other hand, today we find DJs "controlling" transmitters and logging parameters they don't understand (and usually don't *want* to understand), as many stations use deregulation to reduce their technical commitment.

"Chief operators" are often simply DJs with restricted permits.

Yes, the days when every station needed a full-time CE are long gone. Now, "chief operators" are often simply DJs with restricted permits.

Has this had a detrimental effect on station operations? Many observers listening up and down the dial agree that the average station's audio quality has certainly degraded. "Marketplace forces" have rarely led to better operations—merely louder audio.

What we'd like to focus on is a problem faced by many working engineers in small and medium markets: modern technology is passing them by.

Trying to keep current

That's not to say these engineers are unconcerned. Rather, they find themselves trapped by the working conditions and budgetary constraints of the deregulated world.

The difficulties that engineers face include both the ancient transmitters that some stations refuse to replace, as well as the brand new technology they don't fully understand yet. In other words, they can find themselves lost on the learning curve.

Of course, there's nothing wrong with repairing and maintaining transmitters. Indeed, if nothing ever went wrong with the RF side, stations could be maintained by the kid from the stereo store down the street. (*Gasp*—just thinking about that causes my spine to shiver).

ECLECTIC ENGINEER

Classes at the local community college or university rarely address the day-to-day technical needs of a broadcast facility. Beyond the basic electronics classes, there usually is little available for the person interested in broadcasting.

Thus, the engineer with a problem transmitter finds the need to develop a network of friends experienced with the unit and willing to share their knowledge. Sometimes they're local, other times they're reached via telephone calls or electronic BBSs.

If the station has a newer transmitter and the budget for it, the engineer may visit the manufacturer for a seminar to learn the tricks and traps of operation. Otherwise, he has to go back to networking in order to get help. There really are few other options. Furthermore, the tremendous flood of digital and microprocessor-controlled products in the audio chain requires a wide range of knowledge on the part of the technical staff to keep it all in top form.

This could lead us into a long discussion of the proper compensation level for those with this knowledge; at the least it should be more than that earned by the gardener, shouldn't it?

Many engineers wonder how they can keep up with advances in technology, especially if they work at a station that resists replacing older equipment.

Not being able to get hands-on experience with newer gear can mean missing those advances in technology. After 10 years in a smaller market, many engineers worry that they're not qualified to handle the gear they'll find as they move up to larger market stations.

Moving up the learning curve

How can one jump from servicing a 25-year-old transmitter, a 15-year-old console, 10-year-old cart machines, etc.

(continued on page 19)

Pirate Evades FCC's Clutches

by Dee McVicker

EAST COAST, USA "Joe" is a card-carrying radio pirate—the sort that FCC pirate buster Judah Mansbach warned us about in **RW**'s Dec. 12, 1990 "FCC's Mansbach Scuttles Pirates."

But Mansbach's warnings do not seem to bother this radio pirate, whose real name is being withheld for obvious reasons. Feeling secure behind his broadcasting fortress located somewhere on the East Coast, Joe called to talk candidly about radio piracy.

"I'm not a frustrated broadcaster," he was quick to say, referring to Mansbach's comment that many pirates are simply frustrated DJs who can't get a job at a licensed station. "(I'm) a broadcast consulting engineer." Joe said he maintains several licensed stations on a regular basis.

He also claims to operate an unlicensed pirate station, a sideline that cost him $25,000 in initial investment and, at least for now, a scowl from the FCC. If caught, Joe's radio piracy could cost him up to $100,000 in fines and a year in jail.

For the sake of shortwave

To Joe, it's a small price to pay. "It's not to get into the freedom of speech thing or to aggravate the FCC. It's primarily done just for the shortwave listener, the young kids that want to hear something different and new."

Joe's fascination with the airwaves began as a youngster. Self-described as a lonely child with radio his only connection to the outside world, 13-year-old Joe was an avid AM listener who eventually turned to DXing. Reaching out one evening to the wide world of radio, he logged what would become his first introduction to pirate radio.

Years later, after engineering some six or seven radio stations and making a career in broadcasting, Joe would draw on this childhood experience to cross over into radio piracy. In the late 1980s, Joe fired up his home-brew transmitter and signed on his pirate station with 5 kW of power on 1620 kHz. He's been broadcasting without FCC licensing ever since, and has yet to regret the decision.

"The first year I was on from about December all the way into March or April, continuously every night for four or five hours," Joe said. Today, the radio pirate keeps a more relaxed schedule, airing the station's middle-of-the-road rock music and spoof commercials as time permits.

Most of the station's loyal listeners, according to Joe, "are professional people. They're engineers, they're legal people, they're doctors, they're people who would love to do what I'm doing, but they don't want to risk it."

OFFBEAT RADIO

By far, he maintained, the biggest task is replying to all the listener mail. "Everyone gets a personal answer," he said. "It's a lot of writing, so I learned how to type"

Keeping a watchful eye

Joe also has learned how to stay clear of the wrath of the FCC. While his pirate station is under the vigilant eye of ace pirate busters like the notorious Judah Mansbach, and has been for several years, Joe also keeps a watch out for the FCC.

Located on a mountaintop in Somewhere, USA, the pirate station's 85-foot tower is surrounded by a fortress of pine trees. From this vantage point, Joe can see approaching vehicles—including FCC direction-finding cars—for miles down the road. Since the FCC pirate busters "have to catch you operating on the air," Joe believes it is unlikely that the pirate station will be yanked off the air anytime soon.

Although he readily admits that radio piracy gets its bad name from a few careless pirates who abuse the sport, he maintains that he is a courteous pirate and is careful not to interfere with licensed U.S. stations. "There's nobody anywhere in my area on this channel, (or even) near me. The closest station to me is 120 or 130 miles away."

Joe added he is careful not to abuse the airwaves, and does not air anti-religious or anti-government broadcasts. "You know," he mused, "there's a lot of nuts that have ruined this."

Does he plan to ever join the ranks of licensed broadcasters? "I have been looking into buying an AM broadcast station," he said, but quickly added, "These little AM stations, most of them are going for $100,000. It doesn't warrant (the cost).

Out of FCC reach

For the immediate future, Joe plans to keep his bootleg station on the air and out of reach from the FCC. Risking hefty fines and possible incarceration, Joe maintains that piracy does have several advantages over licensed broadcasting, not the least of which is coverage.

On a good night, Joe said he can expect the station to cover a large region ranging from Nova Scotia to Cuba. Some listeners have reported the station's reception as far away laterally as Topeka, Kan. The only pirate to cover this expanse of territory, to Joe's knowledge, was the mastermind behind radio pirate ship, "Sarah."

"On 1620, to cover 2,000 miles is a feat," Joe said. This challenge, now accomplished and making Joe a distinguished pirate in some circles, is what lured him to the AM band in the first place. "It's too easy to cover many thousands of miles on 7415 or 6240 (shortwave)."

Joe speculates that his station is the longest running AM pirate station at 5 kW power. "There was WKND Weekend Radio in Pittsburgh—a young guy, who, as a matter of fact, talked to me on 1620. I had done a show and I had my receiver on and I listened back to see what was there. And he called me on 1620, which was probably the first and only time that has ever been done."

WKND Weekend Radio, like the radio ship Sarah, has since joined the pirate graveyard, a fate that Joe hopes is not in the cards for his station.

■ ■ ■

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

The Learning Curve

(continued from page 17)

to a plant with new equipment?

Personally, I've found that developing a relationship with the manufacturers, attending the NAB and SBE conventions and making the effort to develop ties with fellow engineers has been a great help. The person who stays isolated either because of no station support or an unwillingness to network is at a severe disadvantage.

Still, not everything can be learned at a broadcast convention or in a conversation with the manufacturer's technical support staff. The convention papers can't cover the whole spectrum of educational needs. Some sort of continuing education seems to be necessary, even essential.

Some sort of continuing education seems to be necessary, even essential.

There are some programs at community colleges around the country. The only trouble is, they're not always close, so they're a bit difficult for most working engineers to attend.

Another source of education is **RW**. Sure, I'm biased a bit, but seriously: In these pages you'll find everything from regulatory news to Ed Montgomery's tutorial series leading to continuing education units at Northern Virginia Community College. And, amazingly enough, some of you find this column to be useful, too.

There are SBE chapters that have long been a valuable resource in providing training tips and help in the field. Sharing the benefits of experience is basic to their mission. At least one chapter has developed a training program for members in coordination with a local community college.

By putting real effort into training, more direct benefits accrue to the average engineer in the field than that provided by lobbying efforts in D.C. or even the SBE's certification program.

This opens the door for opportunities on two fronts. First, there are great resources out there for those wanting to increase their knowledge of the technology of the 1990s. Secondly, there is the opportunity for those with knowledge and experience to put something back into the industry by helping others to benefit.

Whether through the SBE chapter or just among your local group of working engineers, you can move up the learning curve. But, more importantly, you can contribute to making radio better for all of us. The question is: Will you take the challenge to get involved?

■ ■ ■

Barry Mishkind, aka **RW***'s "Eclectic Engineer," is a consultant and contract engineer in Tucson. He can be reached at 602-296-3797, or on FidoNet 1:300/11.*

ANSI and Transmission Lines

by Harold Hallikainen

SAN LUIS OBISPO, Calif. Last month, our discussion of complying with the ANSI specifications for electromagnetic radiation safety looked at shielding the electric field and shielding the magnetic field in a perfect conductor.

While researching this, I noticed some similarities between electromagnetic radiation and transmission lines.

My college text on electromagnetics discusses both radiation in a medium or free space and propagation down a transmission line, but did not develop many analogies between them. Perhaps I'm seeing similarities that are not there. I found Smith charts to be an excellent way to visualize how a transmission line acts, so I've tried to apply them to radiation.

Although I'm putting forward this approach for your comments, keep in mind that it may not necessarily be valid.

Lossy transmission line

With a non-perfect conductor such as aluminum, we might model the shield as a transmission line and use a Smith chart to analyze it. The "block" of aluminum is a lossy transmission line with a characteristic impedance of sqr(u/e) where u is the absolute magnetic permeability, and e is the electric permittivity (dielectric constant is the relative permittivity or the ratio of the absolute permittivity of the material and that of a vacuum).

Due to the conductivity of the aluminum, the characteristic impedance (intrinsic impedance) is very low. However, the input impedance of a short no-loss transmission line with a low characteristic impedance is about the same as the load impedance. If you plot a point anywhere on a Smith chart, then move down the line less than 0.1 wavelengths, the impedance at the second point is about the same as the first.

Assuming the world outside this shielded box can be represented by an infinitely long transmission line with a characteristic impedance of 377 ohms (intrinsic impedance of a vacuum), then our shield transmission line—the sheet of aluminum around the phasor—has a load of 377 ohms. The input impedance of an infinitely long transmission line is its characteristic impedance, independent of the "load" at the end of the infinitely long line.

This 377 ohms then could be "rotated" around the Smith chart an appropriate distance to determine the impedance at the input of the shield transmission line. Two factors affect how we rotate this about the Smith chart.

Velocity in aluminum

The first is the velocity of the electromagnetic wave in the aluminum. The speed of an electromagnetic wave is 1/sqr(ue) meter per second. This changes to C/sqr(ue) if we use relative permeability and permittivity (C is velocity of light in a vacuum).

I do not have the numbers for aluminum, but the velocity of an electromagnetic wave through copper is about 3.22 meters per second. Assuming aluminum is similar, the wave travels very slowly through the material, causing a 6mm "long" transmission line to be several wavelengths long (1863.354 wavelengths at 1 MHz, using the velocity factor for copper), causing us to "rotate" about the Smith chart several times.

If this line were lossless, the "input impedance" still could be relatively high, since the input impedance of a lossless line "reappears" every half wavelength down the line.

With a 377 ohm load on a lossless line that is some integer multiple of a half wavelength, the input impedance of the line would be 377 ohms, matching the impedance of the free space inside the phasor cabinet. This would allow the wave to propagate through the "shield" with no reflection.

Like a circle in a spiral

The aluminum (or copper) is lossy, however—not a desirable trait for a shield. On a Smith chart, loss in the transmission line is handled by reducing the radius of the (constant SWR) circle an amount corresponding to the loss.

INSIGHT ON RULES

This turns the circle into a spiral, closing in on the characteristic impedance of the line (the center of the spiral) as we move farther from the load. For aluminum, the signal is attenuated to 1/e for each .0814/sqr(f) meters we go into the aluminum (the "skin depth").

At 1 MHz, the skin depth is 18.4 micrometers. The 1/e corresponds to a loss of about 8.7 dB. Our 6mm-thick aluminum has a loss of about 2,832 dB. By the time the "constant VSWR circle" has spiraled around 3,727 times (each rotation is 0.5 wavelengths) and in 2,832 dB, the input impedance of our line (the chunk of aluminum) is about the same as the characteristic impedance of the line (or the intrinsic impedance of the medium), which is around 2 milliohms at an angle of 45 degrees.

The angle is introduced by the loss in the medium (a lossless medium or line has an angle of zero degrees). This phase angle represents the phase between the electric and magnetic fields, where a positive angle indicates the electric field leads the magnetic by this amount at some point in space. The phase angle really is not important in this analogy, however.

At this point, the aluminum side of a phasor cabinet might be modeled as a transmission line that has a characteristic impedance of 2 milliohms, is 1863.354 wavelengths long and has a loss of 2,832 dB.

The "load" on one end of the line is 377 ohms (the free space on the outside of the phasor cabinet).

The impedance seen on the generator side of the line (the inside of the phasor cabinet) is about the same as the characteristic impedance of the line, since the line has so much loss. Inside the phasor cabinet, we have more free space (with its intrinsic impedance of 377 ohms).

We can model the space inside the phasor cabinet as another transmission line with a characteristic impedance of 377 ohms. It is terminated by the impedance at the input of the transmission line that models the aluminum side of the cabinet (2 milliohms).

The termination of the 377 ohm line by

(continued on page 31)

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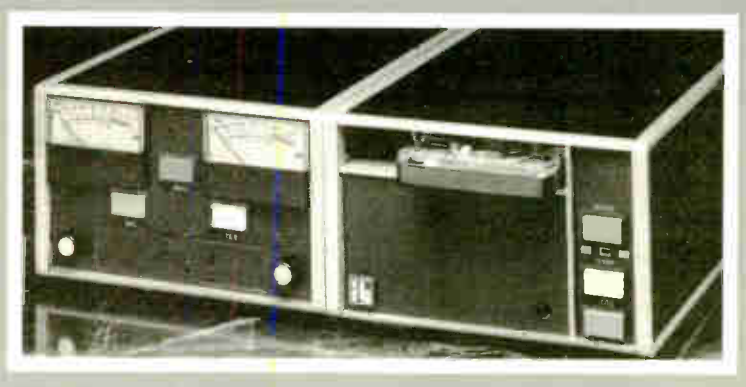

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Circle 141 On Reader Service Card

A Closer Look at AM Antennas

by Tom Osenkowsky

Part III of III

BROOKFIELD, Conn. I have previously indicated that the phasor designer has several options when trying to attain optimum sideband impedance symmetry and pattern bandwidth.

Figure 1.

Tower	Height	Field	Phase	Spacing	Orientation
1	126.2	.437	-139.5	72.2	340
2	115.0	1.000	0	17.5	250
3	126.2	.553	+145.5	72.2	160

Daytime Moment Method Predictions

Tower	Operating Z	Base I / Phase	Power
1	-2016 +j1221	.675 +157.5	-919.9
2	133.1 +j355.7	6.44 +0	5515.2
3	44.3 +j381.5	3.02 +138.5	404.7

Daytime 1969 Predictions

Tower	Operating Z	Base I / Phase	Power
1	-50.1 +j235.5	4.45 -142.5	-991.7
2	50.9 +j134	10.2 -3.0	5274.9
3	22.7 +j35	5.63 +142.5	719.5

Let's examine an actual three-tower array. The operating parameters are shown in Figure 1. The base operating impedances were determined by first measuring the self impedance of each radiator with the remaining two towers floating.

The open towers are not detuned and we must include their effect on the tower being measured. After measuring the self impedances, the transmission lines were "megged" to test for insulation breakdown, water contamination, etc. The electrical lengths were measured using an RF generator and oscilloscope. Tower 1's line measured 83.7 degrees while Tower 3 measured 101.8 degrees.

In the year 1969

The lines were depicted as being 55 electrical degrees long in the 1969 design. This would be quite difficult, since the phasor is located at Tower 2 and the end tower spacings are 74.4 degrees apart. With the self impedances known, a moment method model is constructed, using slightly taller heights so that the Z11, Z22 and Z33 self impedances best match the measured values:

Z11=Z33=450+j355 and
Z22=126+j262

The computer is further used to determine the drive point impedances, power distribution and base phase angles. It is very important to assume nothing.

You must account for every variable so that the most accurate model can be constructed and the desired results achieved in the field. The process of designing the feeder system now can begin. This is a DA-2 with all towers used for both day and night operation. Towers 1 and 3 originally were used as a DA-1 on 860 kHz, with tower 2 added to complete the "dog-leg" design.

This design goes back to the mid 1960s when computers were not readily available. Using two existing towers; not changing height, spacing or orientation; and adding a third tower to produce drastically different day/night patterns, was quite a task to be done manually. Figure 2 shows the day and night horizontal patterns, while Figure 3 shows the original and new daytime phasor designs.

In 1969, the complex field ratio phase angles were assumed to be the same as the base phase angles. The phase shift of the power divider was assumed to be zero. The phasor was severely field modified in 1969 due to the fact that the impedance predictions were so far off.

Figure 2 day.

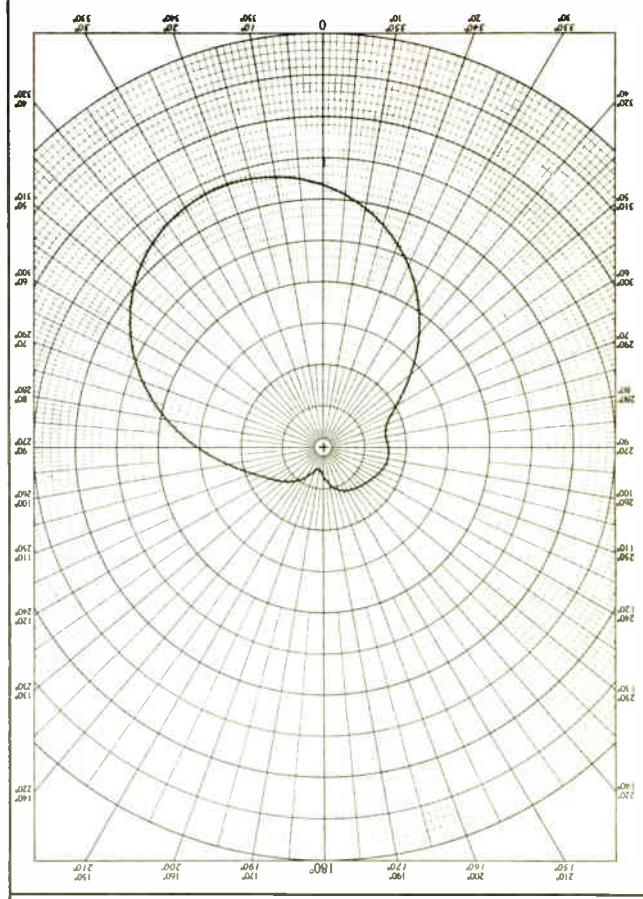
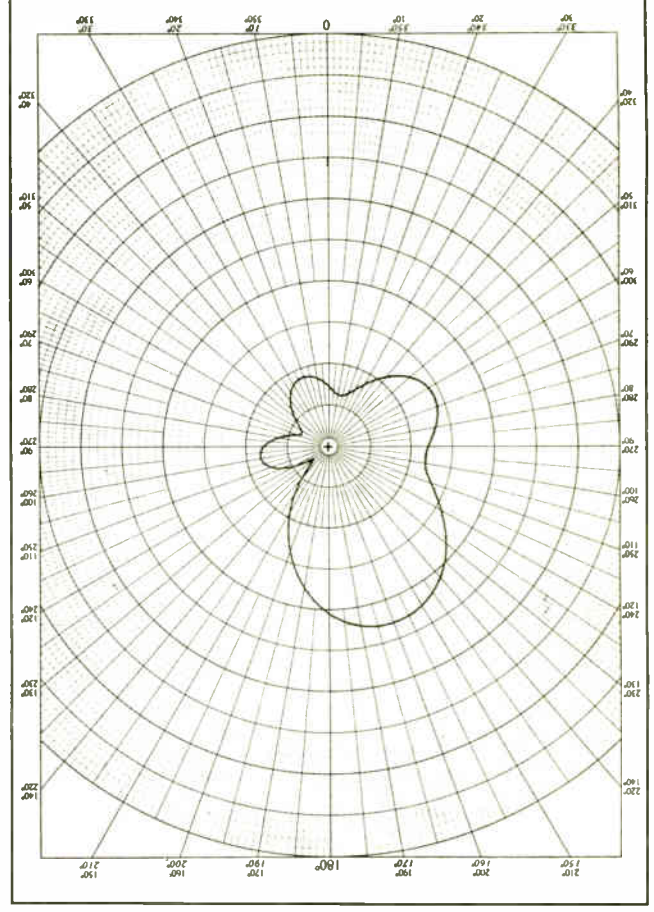


Figure 2 night.



Best for a bargain

When new ownership recently took over this station, it had been dark for some time and a new transmitter was purchased. Array efficiency was very poor, line mismatches were present, several deteriorated capacitors were found and pattern bandwidth left much to be desired.

I began the phasor redesign by choosing to quadrature phase Tower 2 for both patterns, since it carried the majority of power. I then iterated about the 90 degree phase value, trying to reuse existing phasor coils and capacitors, while maintaining good pattern and impedance bandwidth.

Tower 1 day has a very high drive point impedance. A single Tee network cannot be used to transform this impedance down to 50 ohms. A parallel resonant tank circuit can be used here. A 40 to 50 uh coil usually is employed and the tank is resonated to about 80 percent of Fo.

A less expensive method uses a coil shunting the tower to ground. A 40 uh coil was on hand and transforms the 2016+j1221 drive impedance down to 37.2+j317.9. Since this is a negative tower, we subtract the −31.2 degrees of load phase shift (−atn x/r) from the transformed load phase shift of +83.3 degrees.

This leaves us with a conventional +75 degree Tee network and a total network

(continued on page 29)

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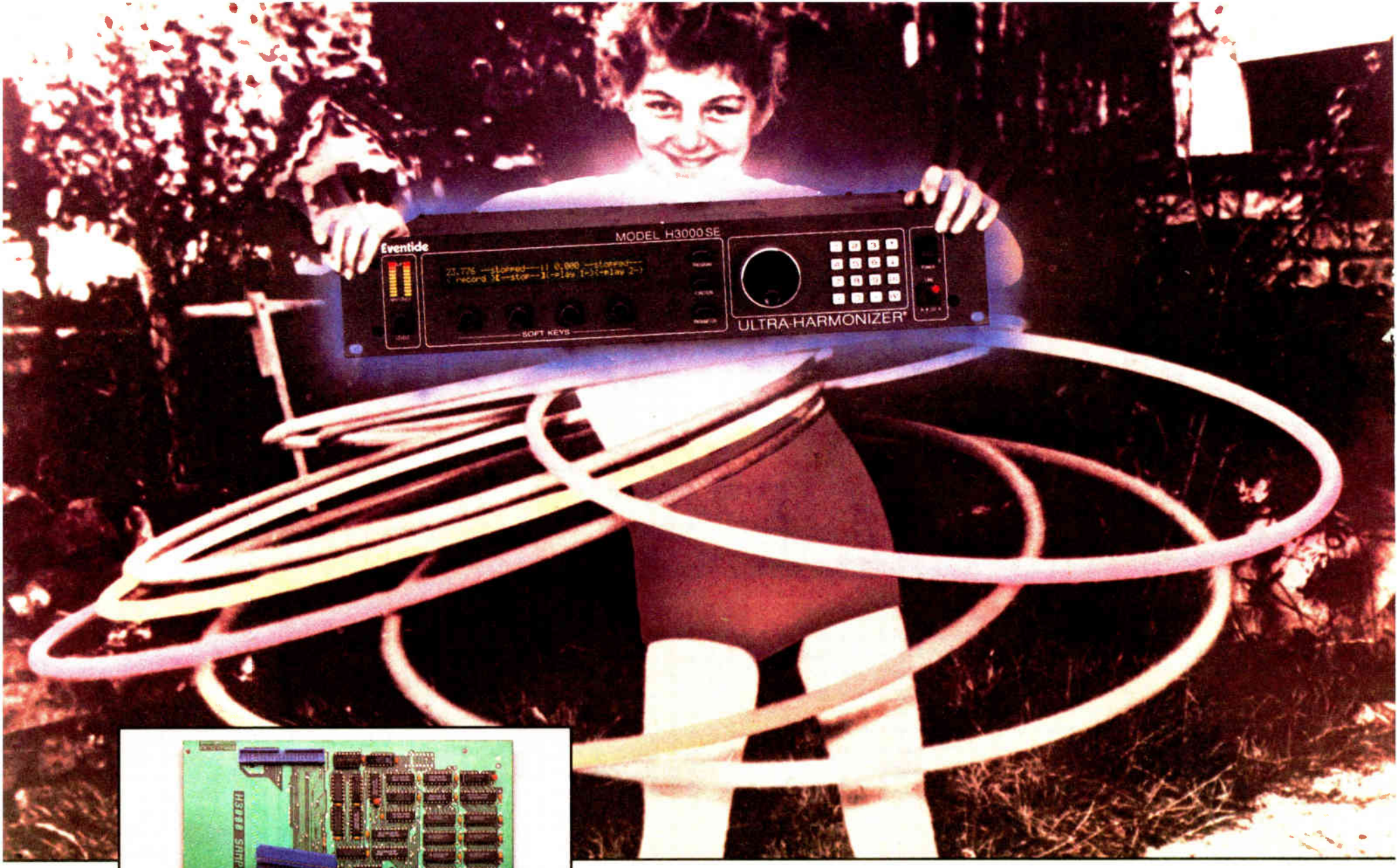

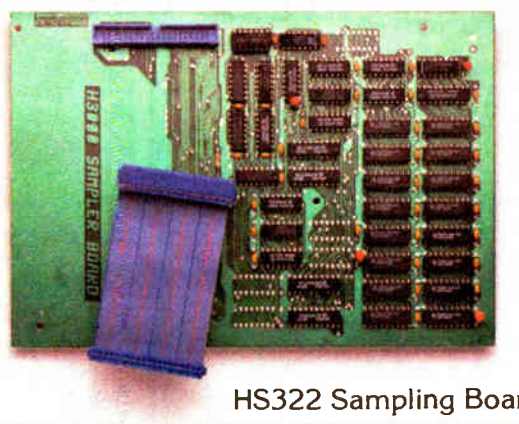

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WEBE-FM Takes to the Rails

by Neil Lewbel

BRIDGEPORT, Conn. One morning this past fall, WEBE-FM did its morning drive time show from a remote location—a moving train. While remotes are nothing new, doing a remote from a train filled with morning commuters presents some interesting challenges.

On Sept. 26, 1990, WEBE's morning program, "The Breakfast Show," began from the New Haven, Conn. station of the Metro-North railroad. The morning team—Peter Bush, host; Ken Main, news; Anne Rondepierre, traffic—along with Kevin Plumb, the station's assistant CE, boarded a train with commuters and did the show from the aboard the vehicle until it reached Stamford station.

On and off

While the train stopped at Stamford to allow passengers on and off, the morning team disembarked, carrying all their equipment. They continued the show from the platform at the Stamford station. The train, filled with commuters, continued its trip through Connecticut and then to New York's Grand Central station.

Ken Main, WEBE morning news anchor and morning man Peter Bush on board the train.

According to David Widmer, WEBE's national sales manager, the idea occurred as a result of a visit to an agency promoting a program to alleviate the severe congestion problems on Connecticut highways.

Widmer indicated that although everyone at the railroad cooperated, the size and bureaucracy of the Metro North organization made planning more difficult than for most remotes. Many people and departments had to be involved and approve the plan before the station could receive permission to do the remote.

The equipment involved in the remote had to be able to be quickly and easily lifted and moved on or off the train. To accomplish this, most of the equipment was mounted in two plastic mail boxes. These are the plastic boxes typically used to carry mail between offices or from a business to the post office.

The audio feed from the remote team was sent back to the studio using a cellular phone.

For an antenna, Plumb went to a radio service shop, where he tried mixing and matching various antennas to find one with the highest possible gain. He came up with an arrangement providing about 5 or 6 dB gain. This antenna was mounted, using gaffers' tape, on the side of the plastic mailbox with the cellular phone.

The second mailbox was fitted with a Comrex unit and mixer.

A test run was tried on the train about a week before the remote. This test used a cellular phone with the selected antenna. The test found a cell site drop-out in one spot. It was determined the station would make sure to run a commercial or record—to be played back at the studio—when the train went through the area of the drop-out.

WEBE morning man Peter Bush, GM Vince Cremona and Stamford Mayor Tom Serrani took to the tracks for a novel remote.

On the rails

The remote was done from the train's bar car. The mailbox holding the cellular phone was placed on the countertop next to a window, with the antenna adjacent to the window.

A trickleptype battery charger was used on the train. However, the equipment could not be reliably powered from the locomotive's 110 V power because of power loss experienced by the train in certain areas.

Back in the studio, where all music and spots originated, the audio chain included a Comrex unit, a CBS Audimax and an Orban parametric equalizer.

Each air personality was issued a Uniden cellular phone and several spare batteries. This way they could contact the studio or other locations as needed.

For off-air program monitors, Sony AM-FM headset monitors were used. A Bose boom box radio also was used.

Ed Butler, WEBE CE, waited at the Stamford station. While the train made its normal stop in Stamford, the team walked off the train carrying all the equipment. In addition to the CE, they also were met by Stamford Mayor Thomas Serrani. The rest of the show was done from the Stamford train station.

■ ■ ■

Neil Lewbel, an **RW** *contributor specializing in the marketing of communications equipment, often writes about radio. He can be reached at 203-377-8517.*

The Ins and Outs of Digital I/Os

by Mel Lambert

STUDIO CITY, Calif. After my lengthy sojourn into the mysteries of data compression techniques, this time around I would like to return to (possibly) more down-to-earth matters.

This month's column will consider problems we might encounter while interfacing digital equipment, including a certain degree of confusion that some users are experiencing with the newer generation of SCMS-equipped consumer DAT players.

In my various consulting activities for manufacturers of workstations, editing systems, DAT machines and other digital components, time and time again the one topic that appears to cause the most potential confusion—and frustration—is that of interfacing.

Variety of digital I/Os

As I have mentioned before in these columns, it is unfortunate that our industry still needs to accommodate a variety of digital I/Os, the most prevalent these days being SDIF-2, AES/EBU and IEC 958 Type II formats (the latter sometimes referred to CP-340 or "S/P DIF").

While the SDIF-2 I/O is relatively easy to handle—two BNCs carry left and right channels, with a third carrying a dedicated word-clock/sync signal—AES/EBU and IEC 958 interfaces can pose more of a challenge.

The AES/EBU I/O (which specifies balanced connectors operating at TTL-compatible levels) was intended to provide a reliable, standardized format for passing two-channel digital information over respectable distances. This, however, is not always the case.

Occasionally, you might come across interfaces which, through an oversight on the behalf of some manufacturers (and, it must be conceded, a shortage of suitable interface chips and support parts), do not behave as advertised. Often the problems are as simple as insufficient drive level to handle high capacity cable, and/or the less than optimum connections encountered during a signal's passage through a complex patchbay, for example.

Work currently is being completed by appropriate AES Digital Committees to revise the original AES3-1985 standard, and add—among other things—an important section that will more closely define three "implementations" for the interface.

Not only will these long-awaited refinements allow users and manufacturers alike to more accurately predict the way in which professional-format interfaces should behave in real-world situations, they also will pave the way for additional capabilities.

Operational funnies

But minor operational "funnies" exhibited by AES/EBU I/Os are nothing compared to the problems many of us are experiencing with variants of the unbalanced/low-level digital interfaces bearing the designations "S/P DIF," CP-340 and IEC 958 Type II.

Although the original format was developed and implemented by several Japanese and European consumer manufacturers, it soon began to appear on professional equipment—or more realistically, on hardware that was designed primarily for use by consumers, but which soon found its way into broadcast facilities.

With care, attention and the use of short, high-quality-cables, these consumer-based interfaces *can* be used to transfer data between units from the same manufacturer. Still, they do not enjoy the same degree of universal application currently enjoyed by SDIF-2 and AES/EBU I/Os.

And the recent introduction of the Serial Copy Management System (SCMS) within all consumer DAT machines destined for sale within the U.S. has only added to the confusion. SCMS is designed to control the number of digital-to-digital DAT copies a consumer can make from CDs, pre-recorded DAT tapes and other material via IEC 958-format "consumer use" I/Os.

DIGITAL DOMAIN

In essence, only one serial (or generational) digital-to-digital copy can be made from a copyright protected source, such as a commercial CD or pre-recorded DAT. SCMS does not affect the ability to make copies using a DAT machine's analog inputs and outputs, nor does it apply to digital-to-digital copies made via the AES/EBU digital I/O.

The SCMS scheme involves four complementary stages, including encoding the appropriate SCMS IDs onto a commercial audio recording, signifying the copyright protection and its generational status; detecting SCMS IDs by a consumer CD player, DAT deck and other playback systems and setting appropriate bits in the output via an IEC "consumer use" digital port.

Reception and detection of the SCMS information codes is accomplished by a consumer DAT recorder from the bitstream input, via an IEC 958 port. Finally, the consumer DAT machine acts upon the SCMS information and either prevents or enables digital copying, and simultaneously records the correct SCMS codes onto the DAT copy.

Several data bits

The SCMS Status is carried across the IEC "consumer use" interface as a combination of several data bits within the Channel Status.

SCMS circuits in a consumer DAT machine analyze the various combinations of data bits, and determine whether the digital data being input via the IEC "consumer use" interface is a pre-recorded copyright protected source, or a digital-to-digital copy of that material. In the former case, SCMS allows one more copy to be made, while in the latter it disables record mode.

So far so good, because most of the latest-generation professional DAT machines equipped with IEC-format I/Os differ in one important respect. Even though these decks currently are equipped with SCMS circuitry, they do not mute when a copyright-protected digital bitstream is encountered.

So, we can still use IEC-format I/Os featured on CD players, workstations and other DAT machines to perform multiple-generational digital-to-digital transfers without problems (which

(continued on next page)

Analyzing AM Antenna Arrays

(continued from page 22)
phasing of +127.3 degrees. Figure 4 shows the new versus old feed line VSWRs and predicted sideband parameters.

Tower 1 is now properly returning 919 W back to the power divider, the station's signal no longer tears up in the null areas and the measured fields are significantly increased.

Even power distribution

Let's examine an actual two-tower array, again illustrating the effect of changing the reference tower phasing. Figure 5 compares the results. The base parameters for Tower 2 are .874/+134.5 degrees as calculated by the moment method.

Even though these are 90 degree towers, the complex field ratios are not equivalent to the complex base ratios. This is due, in part, to the 60 degree spacing between the towers. Notice that design number 1 produces an incredible VSWR of 31.5:1 on Tower 2's transmission line at the lower sideband.

I chose this particular reference tower phasing to illustrate the point that careful choice of design parameters can yield superior results, many times without the need to purchase a single new component.

For those who might have believed quadrature phasing the low power tower to achieve stability by virtue of the properties of a quarter wave line, you need to consider the entire picture. This design would not produce good audio quality at all, let alone AM stereo.

Design number 2 produces much better pattern bandwidth and line VSWRs. Treatment of the transformed common point impedance using line stretchers has been previously covered.

Remember, when dealing with sideband symmetry, a flat or symmetrical load must be placed at the final amplifier inside the transmitter and not necessarily at the transmitter antenna terminals.

■ ■ ■

Tom Osenkowsky is a consulting engineer based in Brookfield, Conn. He can be reached at 203-775-3060.

Figure 4.

Sideband Complex Field Ratios and Feeder VSWR

Tower	1370 kHz	1380 kHz	1390 kHz
1	.395/–138.8	.437/–139.5	.483/–140.8
2	1.00/0.0	1.00/0.0	1.00/0.0
3	.583/+147.4	.553/+145.5	.524/+144.3

Freq	Line 1	ATU 2	Line 3
1370	1.39:1	1.12:1	1.02:1
1390	1.44:1	1.12:1	1.02:1

Figure 5.

Design #1

Tower	Branch Phasing	Operating Z	Power
1	–232	38.7 +j88.9	871
2	–97.5	7.46+j31.9	129

Freq	Field Ratio	Line VSWR
1560	.665/+137	1.26:1/31.5:1
1570	.776/+137.6	1.00:1/1.00:1
1580	.782/+127.8	1.33:1/1.87:1

Design #2

Tower	Branch Phasing	Operating Z	Power
1	–180	38.7 +j88.9	871
2	–45.5	7.46+j31.9	129

Freq	Field Ratio	Line VSWR
1560	.754/+136.1	1.23:1/1.02:1
1570	.776/+137.6	1.00:1/1.00:1
1580	.799/+139.5	1.26:1/1.05:1

Figure 3 old design.

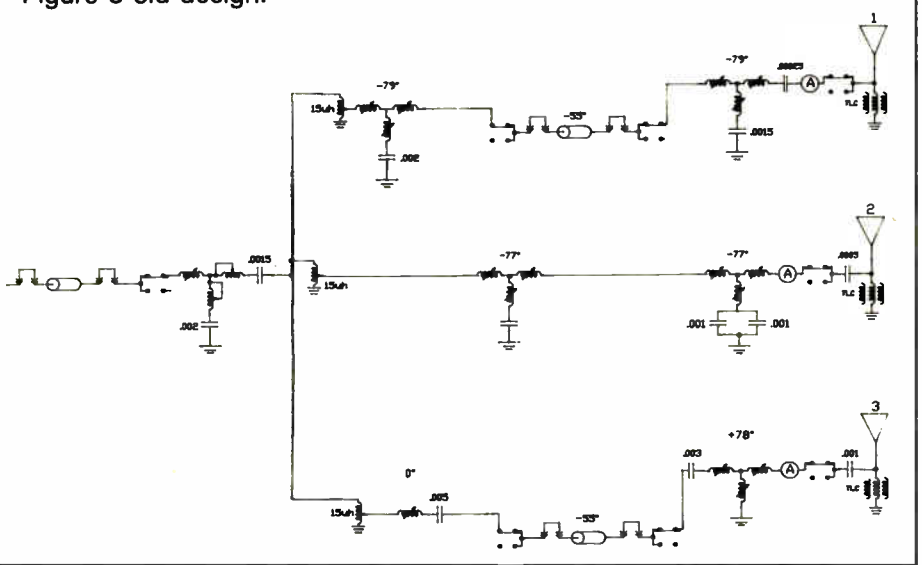
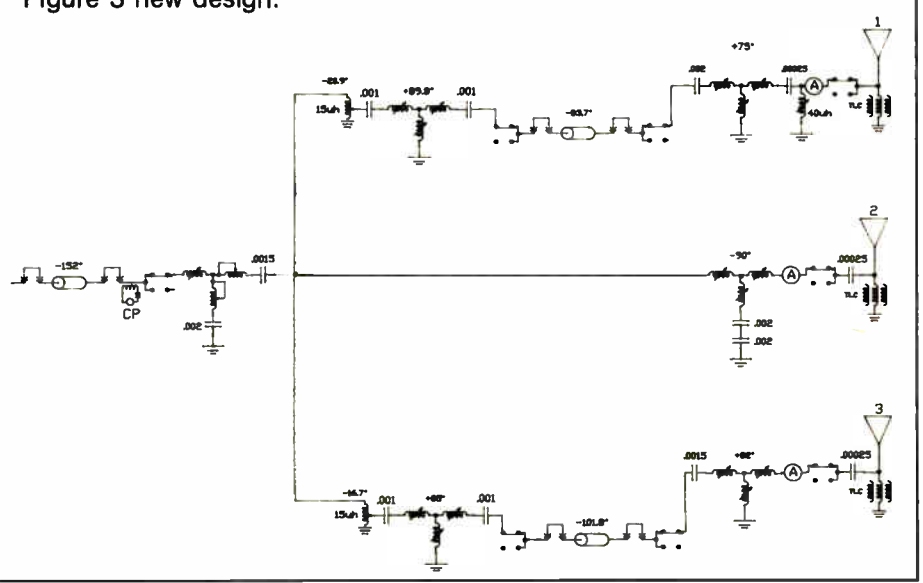


Figure 3 new design.



The Perils of Interfacing

(continued from previous page)
would not be the case with consumer hardware).

Where we can still run into minor difficulties, however, is while attempting to transfer digital material from a newer-generation pro-DAT machine to one of the older digital processors that feature S/P DIF I/O connections.

I know of at least one instance where a producer wanted to transfer a master recording from DAT to a Sony PCM-601 processor ("F1" videotape-based format), but soon discovered that the SCMS data within the bitstream was identical to an anti-copying flag recognized by the 601—with inevitable results.

It is a fact of life that we will need to live with such anomalies and format inconsistencies until all recording, editing and processing hardware is provided with fully-implemented AES/EBU ports, and/or manufacturers can agree on other standard techniques for transferring data reliably between various components in an all-digital broadcast and production facility.

■ ■ ■

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

More on MS Miking Methods

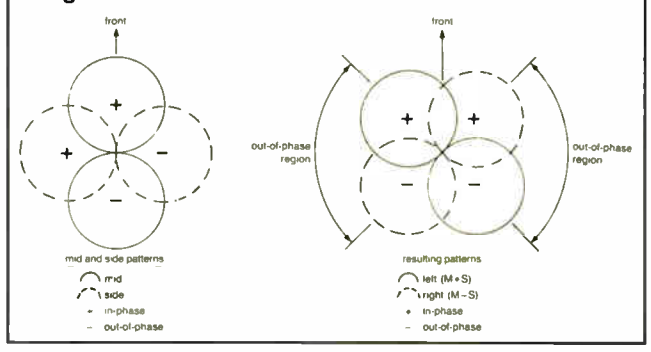
by Bruce Bartlett

ELKHART, Ind. Mid-side (MS) stereo miking is a popular method used by radio station engineers to record concerts for later broadcast. We've covered MS in previous issues of **RW**.

Here are some new ideas on MS miking, based on a recent conversation with Ed Kelly, who has enhanced past columns with his stereo miking experiences.

Suppose you plan to record an orchestra concert with an MS stereo microphone. To determine good mic placement, you first record a rehearsal.

Figure 1.



Choose any pattern

How should the mid polar pattern be set? Some MS microphones let you choose any pattern for the mid element. You might prefer a bidirectional pattern because it provides warm, spacious reproduction of the hall acoustics. So you set the mid pattern to bidirectional, and are pleased with the stereo effect.

But then the audience shows up for the concert. Their applause, coughs and chair squeaks are picked up in opposite polarity (out-of-phase) between channels. And if you sum the stereo channels to mono, the applause drops in level and sounds hollow.

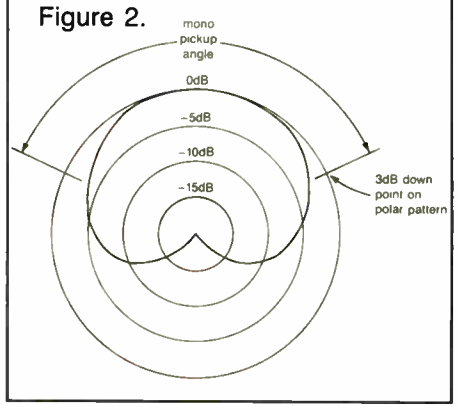
Why does this happen? Large segments of the stereo pickup pattern are of opposite polarity. To see why, take a look at Figure 1. It shows a bidirectional mid element aiming forward, and a bidirectional side element aiming to the sides.

When you run these through an MS matrix, you get a bidirectional pattern aiming 45 degrees left, and another bidirectional pattern aiming 45 degrees right.

Note that each pattern has a front lobe and a rear lobe, and these lobes are opposite polarity. The left-rear pickup is out-of-phase with the front-right pickup, and vice versa. So there are two 90 degrees arcs, one on each side, where the sound pickup is out-of-phase. Much of the audience exists in these arcs, so the audience sounds are reproduced out-of-phase.

This out-of-phase audience pickup sounds diffuse and directionless. If you sum both channels to mono, the audience noise partially cancels out.

Figure 2.



For these reasons, using a bidirectional mid capsule is not recommended when recording a live concert. Also, many radio stations check the quality of in-house recordings made for broadcast, and may reject a recording if it contains excessive out-of-phase components.

Mid capsule without audience

Ed Kelly often prefers to use a bidirectional mid capsule at sessions without an audience. The recorded hall reverberation is out-of-phase and pleasantly spacious, while the direct sound of the orchestra is in-phase and sharply localized. The reverberation forms a "halo" wider than the speaker spacing, so it is spatially separate from the coherent images of the musical instruments.

LINE OUT

Let's consider another aspect of MS miking: its relation to XY miking. A mid-side pair is equivalent to an XY pair, which is a coincident pair of directional microphones angled apart. However, the MS microphone cannot simulate *any* desired XY polar pattern at *any* desired angle.

For example, you can't use MS to simulate two cardioids crossed at 90 degrees. When the mid-side signals are matrixed, the resulting polar patterns and the angle between their axes are inextricably linked in a fixed relationship.

In an earlier column, I suggested that using a stereo microphone to pick up a single person speaking made little sense. Since most speech pickups are dry (free of reverb) and a person talking is a point source, stereo speech recording isn't too effective.

But here's an instance of where it worked. Ed Kelly recorded an on-stage speech by John Cage presented in front of an audience. Cage did not walk around; he sat in a chair next to an antique table and lamp. Kelly mounted a Neumann RSM-190 stereo shotgun mic out of camera view on a shock-mounted stand two feet away.

Even with the mic at two feet, the resulting recording had excellent articulation. The stereo effect made it easier to understand what Cage was saying by spatially separating his voice from the hall reverberation. Turning up the side signal in the stereo mic was like turning on an exciter; it added a lifelike quality absent in mono.

Kelly turned up the side signal only a little, in order to keep Cage's voice from jumping from speaker to speaker when he moved.

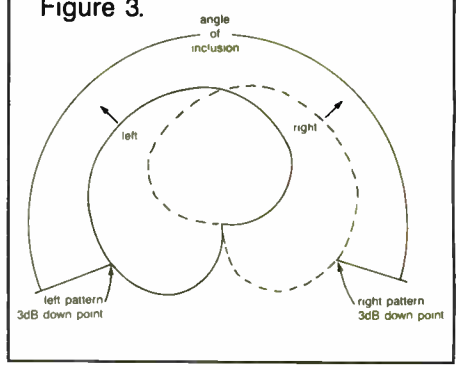
Three other factors

Let's consider three other factors in MS stereo miking that are important to your work: mono angle of acceptance, stereo angle of acceptance and stereo angle of in-phase pickup.

The *mono angle of acceptance* of a microphone is the angle between the 3-dB-down points of the polar pattern (Figure 2). It is an arc that provides efficient pickup of frontal sound. For example, in a cardioid pattern, the output is 3 dB down at 65 degrees either side off axis. So the mono pickup angle is 130 degrees.

Suppose you take two directional mics and angle them apart to record in XY stereo. The *stereo angle of acceptance* is the angle between the far-left and far right 3 dB down points of both mics (Figure 3). For two cardioids crossed at 90 degrees, the stereo angle of acceptance is 130 degrees plus 90 degrees, or 210 degrees.

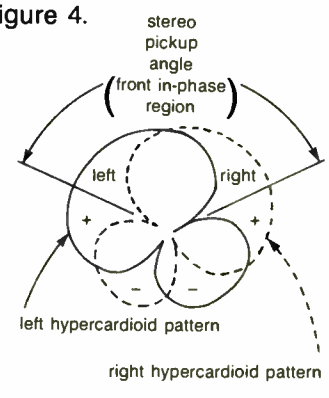
Figure 3.



Kelly says that two crossed cardioids accept reverberation from a wide angle of acceptance, but "cram" the reverb into a small angle during reproduction over two speakers. Although the mic pair is picking up most of the hall reverb over a broad 210 degrees angle, this reverb is reproduced inside a 60 degrees speaker angle. The result is a confined sense of ambience.

Another important concept in stereo miking is the *in-phase pickup angle*. This is the angle in which sound sources are picked up with the same polarity in both channels.

Figure 4.



Why are there any out-of-phase areas? Some supercardioid, hypercardioid and bidirectional polar patterns have a rear lobe that is out-of-phase with the front lobe. The left-channel rear lobe is out-of-phase with the right-channel front lobe. A sound source in some positions

(continued on next page)

Transmission Lines And EM Radiation

(continued from page 20)
the 2 milliohm load results in almost all of the signal being reflected and very little being transmitted. About .001 percent of the signal (voltage or current) is transmitted across the air to aluminum boundary while the remainder (about 100 percent) is reflected back into the cabinet.

Finally, that portion of the signal that is transmitted is attenuated 2,832 dB before getting to the outside of the sheet of aluminum.

At that point, the signal finds the free space outside the phasor cabinet, which again has an intrinsic impedance of 377 ohms. This 377 ohms is a severe mismatch for the 2 milliohm line, resulting in transmission of about .001 percent of the signal into the space surrounding the phasor, with the remainder reflected back into the aluminum, where it is eventually dissipated (it loses 2,832 dB each time it goes from one side to the other).

Possible problem areas

I have not seen Smith charts applied to transmission of electromagnetic radiation through a medium before (having only used them for analysis of transmission lines). The similarities between radiation and transmission lines seemed to be too much to pass up.

I don't know if the analogy is really any good, so I look forward to your comments. Problem areas in the analogy include the modeling of just an E field or an H field generator. I'd be tempted to model an E field generator (a conductor with a high RF voltage on it) as an ideal voltage source. An H field generator (typically a coil carrying RF current) could be modeled as an ideal current source.

However, if we have a very long 377 ohm transmission line and drive it with either a voltage source or a current source, the voltage will be 377 times the current everywhere on the line.

In EM radiation, however, the E/H ratio changes as we go down the line (getting farther from the radiator), eventually reaching 377 in the far field. My analogy seems to fall apart here.

I noticed similarities between radiation and transmission lines.

As I was discussing the ANSI limits on radiation with various people, it became unclear to me exactly how a conductive shield encloses a varying magnetic field. I did see similarities between radiation and transmission lines.

There also is a similarity between optical index, intrinsic impedance and characteristic impedance. Optical density is similar to a transmission line velocity factor. Further reading through my old textbooks (from about 20 years ago) reinforced these similarities.

I've always thought Smith charts provided a very good way of visualizing how a transmission line works, so I transferred these ideas (perhaps without validity) to radiation.

Next month we'll finish off this discussion with suggested actions you can take to insure your station meets the ANSI specifications.

■ ■ ■

Harold Hallikainen is president of Hallikainen and Friends, a manufacturer of transmitter control and telemetry systems. He also teaches electronics at Cuesta College, San Luis Obispo. He can be reached at 805-541-0200, or on Internet at HHallikainen@vax.seng.CalPoly.edu.

More on MS Miking

(continued from previous page)
might be picked up by the front lobe of one channel and the rear lobe of the other channel.

During reproduction, the sound source is out of-phase and hard to localize.

Minimum pickup

The polar patterns mentioned above have "nulls" of minimum pickup at a certain angle. The in-phase pickup angle is the angle between the front-aiming nulls of each polar pattern (Figure 4). Within this angle, images are sharp and in-phase. Outside this angle, images are diffuse and out-of-phase.

Be sure to keep your sound sources within the in-phase pickup angle to prevent phase-related localization problems.

You don't have to work this out on graph paper when you record. Just set up your MS mic with the desired mid pattern and M/S ratio. Record yourself speaking in various positions: at the left side of the orchestra, half left, center, half right and far right.

Play back the recording. If the MS mic is set up properly, you should hear your voice coming from the left speaker when you're at the left side of the orchestra. Other positions should correspond as well.

If your voice sounds phasey at extreme left or right positions, you went past the in-phase pickup angle. Make the mid element more omnidirectional and try again. Or move the mic farther away.

The stereo spread is the reproduced stage width, the distance between left-side and right-side images. If the stereo spread is narrow—not reaching from one speaker to the other—turn up the side signal.

If you hear a hole in the middle, or if half-left speech sounds full left and half-right speech sounds full right, you have too much stereo separation. Turn down the side signal a little and try again.

As we've seen, mid-side requires some knowledge to use properly. But the mid-side method is very flexible and mono-compatible, making it a highly effective tool for stereo miking.

■ ■ ■

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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Radio Frequency Amp Design Considerations

This is the 11th in a 12-part series called Amplifier Fundamentals. *Northern Virginia Community College will offer 1.2 CEUs (continuing education units) to registered students who successfully complete the course and an examination mailed at its conclusion.*

by Ed Montgomery

Part XI of XII

Annandale, Va. Amplifier design requires that the components operate in such a manner that the amplifier faithfully reproduces the input signal at a greater output level.

Audio amplifiers must be designed to introduce the least amount of distortion into the amplification chain. This is not an easy task, especially when operating within the linear area of the vacuum tube or transistor.

Converting analog information to a digital code initially introduces distortion, but further introduction of distortion is limited. It is much easier to design an amplifier that operates at cut-off and saturation rather than within the linear region.

Radio frequency amplifiers also suffer from added distortion in their design. Harmonic and spurious radiation can be produced. Harmonic radiation is a radio frequency signal produced at odd and even multiples and divisions of the amplifier's operating frequency.

Spurious radiation is energy amplified at any frequency not related to any harmonic. Amplifier designs can eliminate these problems, but after manufacture they can occur when passive components within the amplifier fail.

Radio frequency power amplifiers usually operate in a non-linear region. Figure 1 illustrates a sine wave. A class "A" amplifier will have current flowing through it for the entire 360 degree cycle of the wave.

The number of cycles per second is the frequency of the wave measured in Hertz. Class "B" amplifiers will conduct current for only 180 degrees of the cycle; class "C" amplifiers conduct current for less than 180 degrees and class "D" amplifiers conduct current for only a few degrees around the 90 degree location of the illustrated sine wave. When not passing any signal, the amplifier is considered to be in the "off" mode, not using any power.

The output of this amplifier is extremely distorted, but when its load is a resonant circuit, the entire sine wave is reproduced. This is known as the "flywheel effect."

Figure 2 is a parallel resonant circuit. It exhibits a high impedance and high voltage output. It often is referred to as a "tank circuit" because it appears to absorb energy and keep it within the coil and capacitor.

When a pulse of energy enters this circuit, as it would from a class "B," "C," or "D" amplifier, the coil will have a surge of current through it creating a magnetic field around it. When the pulse of energy begins to decay, the magnetic field begins to collapse, inducing a reverse voltage in the coil and sending energy to the capacitor. This, in turn, charges up, creating an electrostatic field.

Once the charging of the capacitor is complete, it begins to discharge, sending its energy back to the coil.

This would go on forever if it were not for resistance, which will ultimately use up the energy in the circuit. If the amplifier receives a continuous chain of pulses, it will produce a continuous sine wave at its output.

It is economically efficient for a radio frequency amplifier to operate at several thousand volts and several amperes for only a portion of the sine wave cycle, permitting the resonant circuit to restore the entire signal.

Interelectrode capacitance within the vacuum tube or transistor can cause a portion of the amplifier output to be injected back into the input circuitry. This is known as regeneration, and can result in the radiation of unwanted frequencies.

Regeneration can be countered through neutralization or coupling a small portion of the output signal back to the input. Figures 3 and 4 illustrate neutralization in amplifiers containing a vacuum tube and a transistor.

Neutralization is accomplished by energizing the input tank circuits—in this instance T_1—and shutting off the plate or collector voltage to the RF amplifier. The output tank circuit is then tuned for maximum radiation.

This will indicate that the vacuum tube or transistor is indeed passing on a signal even though it is not amplifying anything. The neutralization capacitor C_N, then is adjusted until the output of the non-operating amplifier is nulled (minimized).

Figure 5 is an illustration of a transmitter's output. Resonant circuit L_1, C_1 is an adjustment to establish maximum amplifier efficiency. C_3 tunes the amplifier for maximum output and C_4 adjusts for maximum transfer of power to the antenna (load).

Resonant circuits C_5, L_3 and L_4, C_6 are circuits designed to eliminate harmonic radiation by prohibiting them from reaching the antenna.

■ ■ ■

Ed Montgomery can be reached at 703-971-6881.

Figure 1.

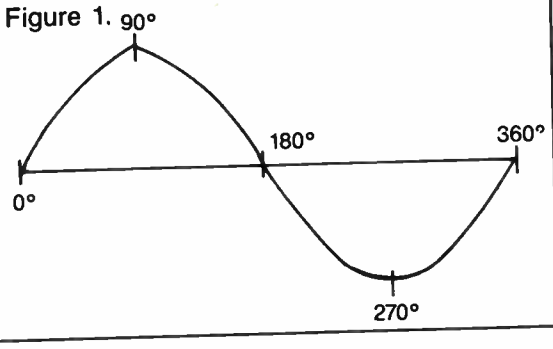


Figure 2.

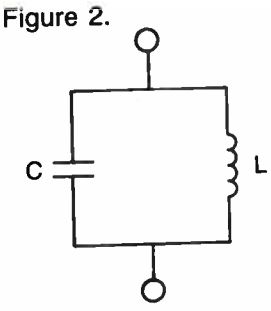


Figure 3.

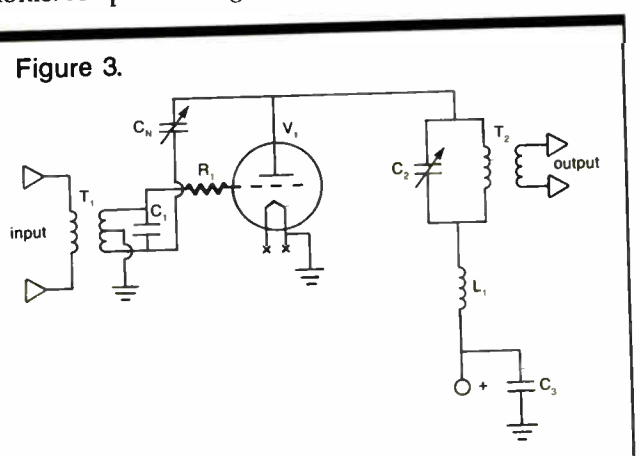


Figure 4.

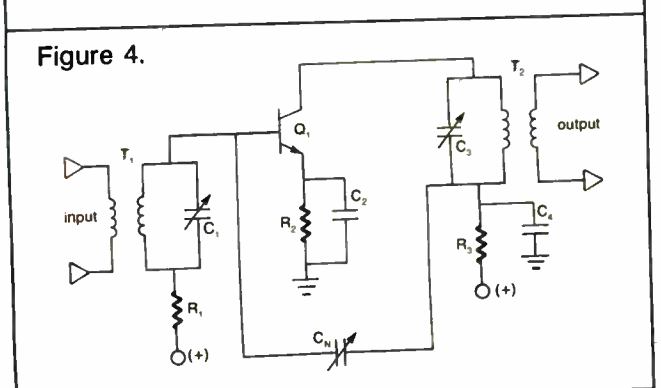
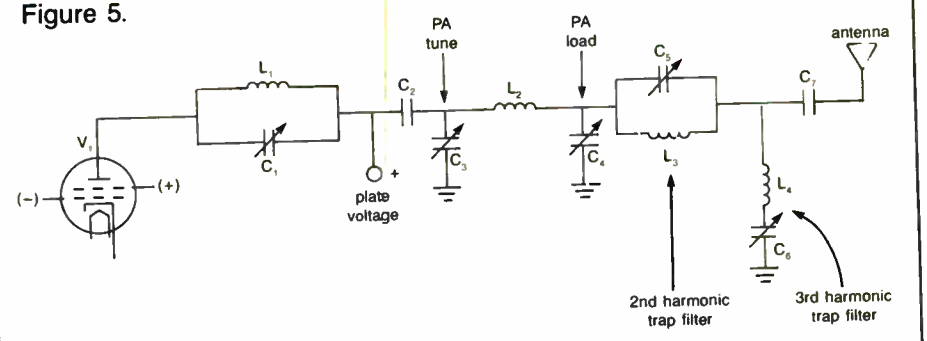


Figure 5.



The Right Amount of Clipping

by John "Q" Shepler

ROCKFORD, Ill. Audio clipping is a power tool for enhancing your air sound.

Used properly, it can deliver the punch you desire, without the loss of depth and spaciousness caused by heavy limiting. The trick, of course, is to use just the right balance of clipping combined with other processing techniques.

Clipping has acquired a certain stigma from clippers that don't work very well and from heavy-handed clipping levels. Often, it is difficult to distinguish the artifacts of improper clipping from other problems in your audio chain.

This column will discuss what you can expect from properly and improperly adjusted clippers. First, though, we have to create a signal capable of being clipped without disintegrating.

How to prepare your signal

Distortion is cumulative. Two percent distortion in a tape dub plus another couple percent through the processor plus two percent clipping is the same as clipping a clean CD at six percent. Strictly speaking, distortions in various pieces of equipment can counterbalance each other. Most of the time, though, it seems like they conspire to give the worst possible effect.

This means that the best sound you can create will come from having a scrupulously clean audio chain right up to the transmitter processing. The only distortion will then be the result of adding power to the audio.

Forget trying to see distortion on a scope. Buy at least a THD (total harmonic distortion) meter and preferably an audio analyzer that will measure THD and IM (intermodulation) types of distortion. Strive to get your chain under 0.1 percent from microphone input to processor input.

By the way, you don't have to spend a fortune on test equipment. It is still possible to buy used Heathkit and B&K test sets, consisting of low distortion sine wave generators and THD distortion meters, for a couple of hundred bucks or less. Check the used equipment ads.

Comparing limiters and clippers

Common wisdom says that you want to use as little clipping as possible. The manuals state that clippers, especially simple diodes, are for "overshoot protection only." Following this advice may produce a sonic effect exactly opposite of what you are trying to achieve.

Surprising as it may seem, a clipped signal may sound less distorted than a limited signal. This is exactly the opposite from what your instruments will say when measuring the distortion of an audio processor. That's because a clipper is a static device. It clips any waveform with any frequency at exactly the same level every time.

A limiter circuit is an active device and works differently. Most limiters, by today's definition, are servo circuits that operate by feeding back part of the output signal to adjust the gain of the amplifier.

Feed a large sine wave into a limiter and the circuit will generate a large DC control signal that will reduce the stage gain until the output is reduced to a preset level. After this is done, the output will look exactly like the input. The waveform wasn't affected. Only the amplitude is adjusted to control the signal. A steady tone will even be measured as having fairly low distortion.

This makes it seem like the limiter is the more desirable device. It certainly seems to be less brutal to the audio signal. What is not so well understood is that limiters create a different type of distortion.

To limit a signal, a limiter has to be adjusting peak amplitudes very fast. You could say that the limiter is riding gain on the waveform so that the peaks never exceed the limiting threshold. Now if you are riding gain very fast, in microseconds or milliseconds, isn't that the same as amplitude modulating the signal at the speed of the limiter?

In fact, any high speed compressor or limiter will distort the audio by constantly adjusting the amplitude. The program audio that comes out of a processor certainly is not what went in. If you doubt this, use a two-channel scope to monitor the input and output of your favorite processor.

What you really want to do is substitute clipping for part of your present processing scheme. Substitute, don't just add more processing. If you try to just add clipping on top of everything else, you probably will wind up with a slightly louder but worse-sounding signal.

How to adjust your clipper

Comparing the effects of clipping and limiting is easiest on processors that have both methods available as front panel adjustments. Turn down the limiting and turn up the clipping at the same time. You should hear the signal begin to open up. It should sound more spacious and less like a solid wall of sound.

Q-TIPS

How does too much clipping sound? The first tell-tale effect is that voices will start to sound raspy. Music will start to sound harsh or biting on the loudest passages. The announcers will develop a lisp they didn't have yesterday. These effects will fade away as you turn down the input to the clipper.

There are some even more drastic effects of overclipping that can get you in trouble with the law.

Generally, clipping is used as the last processing stage to catch any remaining peaks before the transmitter sees them. Consequently, if you clip hard into an AM transmitter or on your FM composite, the distortion products will modulate the transmitter and cause your signal to splatter. Be very careful if your clipping processor does not have preset limits or warning lights to help you avoid creating splatter.

You also should realize that older AM transmitters don't have the transient response to handle sharply clipped waveforms. They ring and distort, causing overmodulation. Some modulation transformers can even overheat due to higher average power. If your transmitter can't handle a sharp edge, back off the clipping.

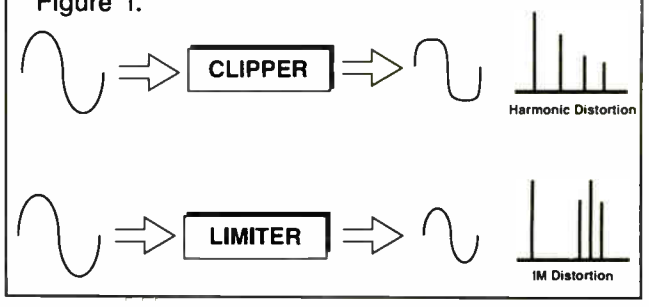
Having passed along those warnings, I'd like to encourage you to experiment with the ratio of compression/limiting to clipping and see if there is some adjustment that gives you a loud signal that retains the audio qualities you expect from high fidelity sources like CDs and DAT tapes.

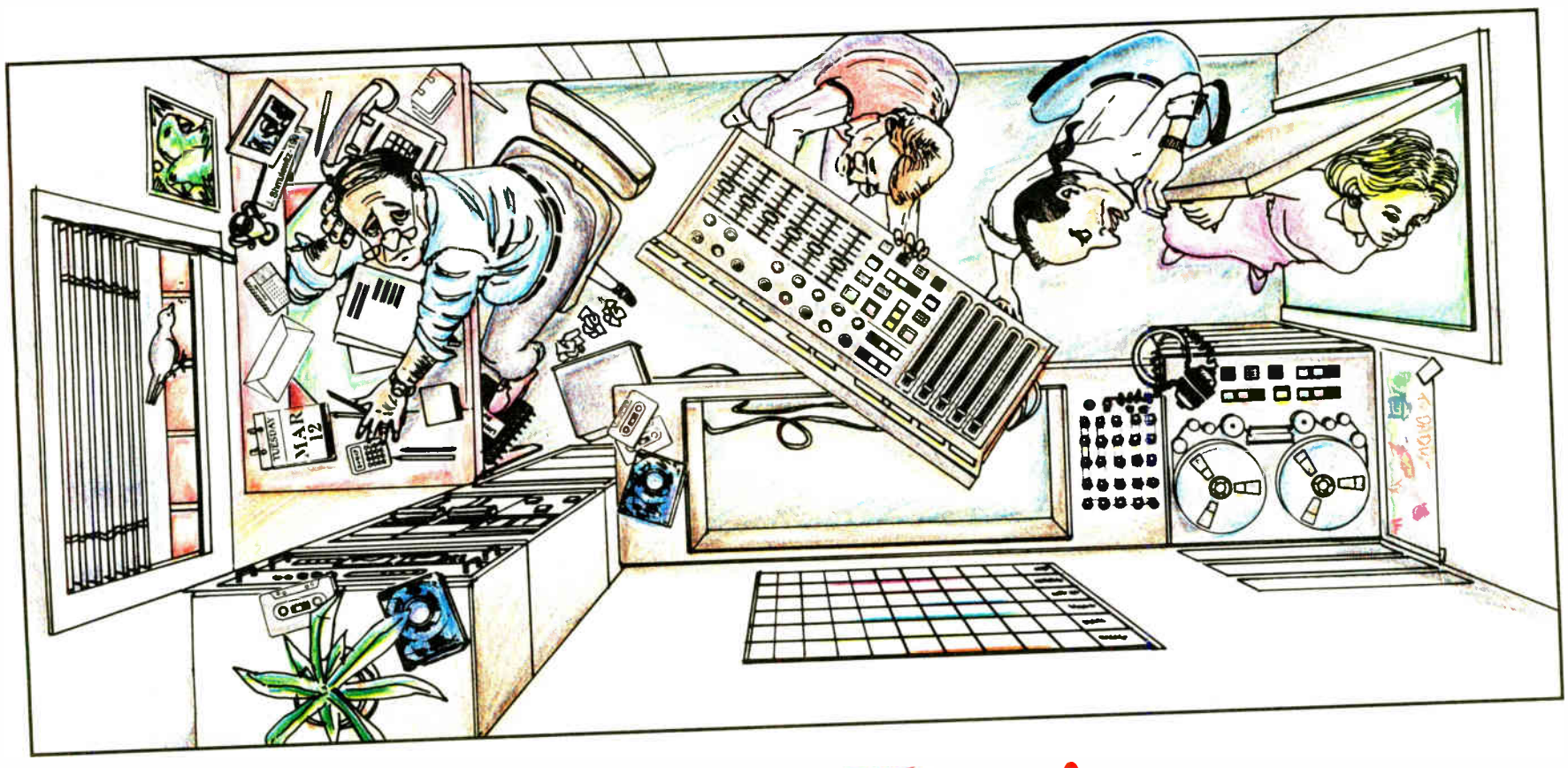
Use just a nibble of clipping to control those modulation peaks. Then turn down the heavy level control imposed by fast compression and limiting. You may be surprised at how good a clipper can sound.

■ ■ ■

John Shepler is an engineering manager, broadcast consultant, writer and regular **RW** *columnist. He can be reached at 815-654-0145.*

Figure 1.





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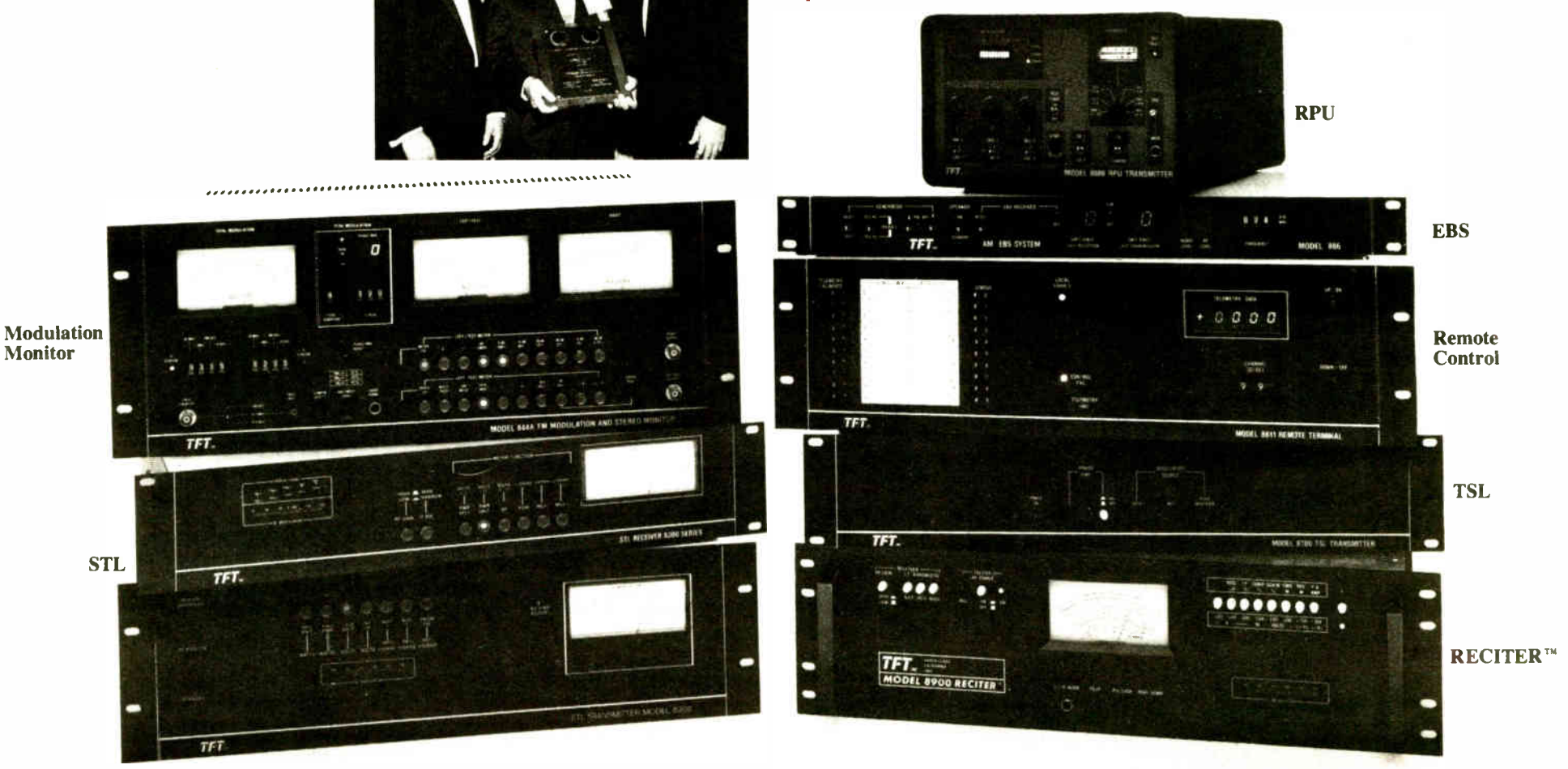

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Licensing by Live Auction

FELKER'S FORUM

by Lex Felker

WASHINGTON Many observers have described the comparative licensing process as a "private auction." The typical case, though, has involved a rather conventional transaction in which the surviving (or winning) applicant has paid the others to dismiss their applications.

In one especially intriguing case, however, the licensing process really *was* an auction. The case was actually resolved among the parties some time ago, but has become final only recently. Involving a dozen and a half competing applicants, the situation was, in fact, resolved through a live auction.

Historical profit prohibition

Although the FCC's rules governing the selection of new broadcast permittees have changed over the years, one doctrine that had remained in place for more than three decades was a prohibition on settling parties profiting from withdrawing their applications.

A 1982 Communications Act amendment (and subsequent Commission policy change), however, made it lawful for settling parties to receive compensation greater than their out-of-pocket expenses.

Through two separate decisions, the Commission now has decided to reapply the restriction on for-profit payoffs. In 1989, the agency acted to stop the common (and highly lucrative) practice of filing, and then dismissing (for a payment), a competing application that challenged the license renewal of an existing broadcaster.

In a move that, in many respects, paralleled the earlier decision, the Commission in December imposed similar restrictions on parties competing for a new broadcast construction permit. The goal in this instance was to eliminate the financial incentive in filing "speculative" applications, thereby reducing the FCC's workload and speeding the licensing process.

The Commission's new rules will not become operative immediately, however. The agency delayed the effective date until late March, partly because approval must be obtained from the Office of Management and Budget.

But this more than 90-day delay also gives existing applicants a "grace period" in which to settle their cases under the old, more financially favorable rules. The agency hopes that bringing down the curtain in this fashion will encourage many comparative applicants to come to terms with one another.

From what I hear, settlement activity has picked up substantially in recent weeks.

To return to the topic of the licensing auction, it is important to note that there have been some variations on this theme, including cases involving parties that had not applied for the permit originally. Sometimes, auctions are used to sell an operating broadcast facility.

But this particular case is the first I know of in which a live auction was employed in a *new* licensing case.

Committee was formed

As I understand it, after the concept had been raised at an applicant negotiating session, a committee was formed to work out the details, including the important matter of minimum levels of compensation.

The committee's plan was approved, an auctioneer (a well-known member of the communications bar) was retained and the auction was held. With the grant of the permit now final, station construction is expected to be completed; the station is to be on the air before the end of this year.

The special circumstances surrounding this case—especially the large number of applicants who were seriously interested in constructing and operating a broadcast station—suggest to me that a settlement may not have been achieved in any other fashion, and conditions may never warrant using this approach again.

It is expected that, under the FCC's new policies, far fewer applicants will compete for particular construction permits and that the duration of the licensing process will be measured in months, not years. Therefore, as the ledger is closed on a wild and wooly period in the history of broadcast licensing, this incident will be recorded as nothing more than a colorful footnote.

■ ■ ■

Lex Felker is a technology/engineering consultant with the law firm of Wiley, Rein & Fielding in Washington, D.C.

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Dynaco PAT-4 stereo preamps (3), gd cond, $30 ea. B Weiss, KLSI, Kansas City MO 64111. 816-753-0933.

McIntosh MC-240 in excel cond, $500. Z Masoomian, WQXR, 141 Park Ave, Arlington MA 02174. 617-646-2037.

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Bozak CMA-150 rack mount pwr amps (4), no fans they are silent, 150 W/8 ohms/ch, new pwr caps, very fine sound, $800/all. P Appleson, Appleson Stds, 1000 NW 159 Dr, Miami FL 33169. 305-625-4435.

UREI 6260 amp, Carver PM-200 amp, both in gd cond, BO. N Kuvshioff, Compact DJs, POB 2913, Salisbury MD 21802. 301-548-5352.

McIntosh MC-2500, silver, $2875/BO; MC-2500, black, fact sealed, $3475/BO; MC-240 (2), $975 ea/BO; MC-40 (3), MC-225 (2), $475 ea/BO. R Katz, Allegro Snd, 15015 Ventura, Sherman Oaks CA 91403. 213-859-5543.

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Rane MA6 multi chnl amp, 100 W chnls, $550. M Norman, KCCU, 2800 W Gore, Lawton OK 73505. 405-581-2425.

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McIntosh MC-60 (2), 60 W tube amps, consecutive serial number, gd cond, $750. P Patton, WAPO, 29 W Main, Jasper TN 37347. 615-942-5611.

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Pirod towers (5) 160', ATU's, loops, lots of phasing components, other surplus like sat rec dishes, STL dishes, monitors, etc. write or call for list. G Whitaker, KSSA, 3500 Maple Ste 1310, Dallas TX 75219. 214-528-1600.

Decibel Products Db 413 11 dB gain, offset pattern 450 MHz colinear array, $300. E Swanson, WZTR, 520 W Capitol, Milwaukee WI 53212. 414-964-8300.

Potomac Instruments AM-19D (210) antenna monitor, 5 tower, digital readout, never used in perfect cond, BO. E Bie, KWAM, 64 Flicker, Memphis TN. 901-320-1755.

Heliax, 350', 1-5/8", never used, w/connectors, $2000/BO. K Kushnir, Empire Comm, 2120 Bluebell, Santa Rosa CA 95403. 707-545-8300.

Phelps-Dodge 3-bay, 107.1 ready to ship. D Sports, WCLA, POB 427, Claxton GA 30417. 912-739-3035.

Jampro JCP FM elements (3) w/heaters tuned to 107.3 MHz, connection cables w/out pwr divider, $1500/BO. A Wasilewski, KMWX, POB 1460, Yakima WA 98902.

Side lights for towers w/globes (11), $40 ea; side light for tower w/out globe, $40; (20) tower control boxes for lights, $100 ea; (2) Huey Philips side lights, $40 ea; photo electric lighting control Fiser Pierce/Sigma Instrument 63305/DA 120 V load 300 W; Rohn tower beacon, $600; (2) RF tower lighting chokes CSC M-600-160-2, $100 ea. Delta Bdctg, POB 430, Helena AR 72342. 501-338-8361.

Phelps-Dodge CFM-HP-7 7 bay, hor & vert polarized. S Cichorsky, KPRL/KDDB, POB 7, Paso Robles CA 93447. 805-238-1230.

Potomac Instrument AM-19, 204, antenna phase monitor, used 6 mos & in new cond, 2 tower set-up, $2000/BO. G Fields, KDXI, Drawer 1306, Mansfield LA 71052.

Jampro FM antenna elements (4) tuned to 99.9 mHz, hor polarized, pwr divider, no cables or connectors, $500/BO. A Wasilewski, KMWX, POB 1460, Yakima WA 98902.

50 kW phasor & 4-tower ATU's w/(4) 200' G-17 towers, contain Delta metering & sampling toroids, vacuum caps, high current coils, avail early 1991, BO. J Bisset, Multiphase Consulting, 703-379-1665.

Rohn 25 140' guyed AM on ground w/insulator, guys, painted, excel cond, $900. D Barton, KMTI, POB K, Manti UT 84642. 801-835-7301.

280' 24" face tower in gd cond, w/lights, you remove, BO. S Newberry, WHHT, Box 457, Glasgow KY 42142. 502-651-6050.

Scala HDCA-10 (2) 10 element yagis w/stacking harness, cut to 185.9 MHz; Scala HDCA-5 (2) 5 element yagis w/stacking harness, cut to 99.3 MHz. P Lierman, KCSP, 601 W Collins Dr, Casper WY 82601. 307-265-5414.

Potomac Instruments AM-19 2-tower antenna monitor, avail in late January, $3500. J Bisset, Multiphase Consulting, 703-379-1665.

Tower, 330', 24" face. J Stevens, WLAU, 56 Wansley, Laurel MS 39440. 601-649-1840.

Shively 6810-4D 4-bay high pwr 40 kW tuned to 100.7 MHz, has de-icers, $5000/BO; Cablewave 3-1/8" heliax 300' w/EIA flanges, $3000/BO. B Hansen, WMXP, 224 North Ave, Pittsburgh PA 15209. 412-821-6140.

Kintronics 5 kW weatherproof tuning unit, new capacitors & coils, excel cond, $800. D Barton, KMTI, POB K, Manti UT 84642. 801-835-7301.

Utility Tower 300'+ AM tower, 24" face w/all appendages guys, lights w/beacon, jonny balls, flasher unit, etc plus transformer; ATU in metal housing, BO. H McDonald, Broadcast Associates, POB 807, Veradale WA 99037. 509-924-8298.

RF switch, Andrew 4 port motorized, (2) 3-1/8", (1) 6", excel cond. Goodrich Ent, 11435 Manderson, Omaha NE 68164. 402-493-1886.

Micro Communications 90063 6 bay FM panel antenna tuned to 92.3 MHz, just removed from operation, BO. J Bennett, Great Trails, 717 E David, Dayton OH 45429. 513-294-3333.

Harris/ERI FML 1E 1 bay, CP FM, tuned to 92.1 w/transformer, 1/4 wave stub & brackets, pre 1981 mdl, $1000; Harris/ERI FML 3E 3 bay, CP FM, tuned to 92.1 w/transformer & (2) interbay lines, post 1981 mdl, $3000; Cablewave 200' & 7/8" foam heliax cable w/type N female connectors w/split kit, $250. J Fellows, KCMA, 2021 S Lewis Ste 760, Tulsa OK 74104. 918-747-9999.

Gates 1 kW 2 tower phasor complete w/new coils & capacitors, excel cond, BO. D Barton, KMTI, POB K, Manti UT 84642. 801-835-7301.

Phelps-Dodge CFM-2P CP 2-bay at 107.1 MHz, $475. P Wells, KJQY, San Diego CA, 619-238-1037.

Want to Buy

Tax credit avail or cash for tuned 89.7 FM antenna, cable & de-icer for community charity. Rev Sylvester Williams Jr, ICU Ministries, POB 3931, South Bend IN 46619. 219-287-4700.

UHF TV bdct/translator antennas; Scala parapanels, any channel; Scala SL-8 chnls 19-23, 32-46, 60-64; Bogner B Series chnls 20-30, 31-42, 55-69 or Bogner LPS 1, 2 & 4; Thomas UHF panels any chnl. J Powley, 1536 Logan, Altoona PA 16602. 814-944-8571.

UHF TV translator antennas on old chnl 70-83 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.

Antenna, line, xmtr, need 10 bay FM on or near 98.3 MHz; 440' of 1-5/8" heliax; 10 kW FM xmtr. R Paskvan, KBSB, 3516 Mill, Bemidji MN 56601. 218-751-3077.

Rigid coax, Andrew or Celwave accepted, 50 pieces 20' 3-1/8", can fax info. E Anderson, WEAS Inc, 2515 Abercorn, Savannah GA 31401. 912-234-7264.

FM CP 3 bay or 6 bay on 100.9 MHz. J Crawley, WLSK, Box 680, Lebanon KY 40033. 502-465-5762.

10 bay FM on or near 98.3 MHz; 440' of 1-5/8" heliax; 10 kW FM xmtr. R Paskvan, KBSB, 3516 Mill, Bemidji MN 56601. 218-751-3077.

AUDIO PRODUCTION

Want to Sell

Rane SM6 splitter/mixer, $200. M Norman, KCCU, 2800 W Gore, Lawton OK 73505. 405-581-2425.

CRL Dynafex DX-2 stereo NR unit, single ended, high freq noise gate, downward expander, like new cond, never rack mounted, $550/BO. T Alexander, WDOK, 1250 Superior Ave, Cleveland OH 44114. 216-696-0123.

White Instruments 4003 1/3 octave, active EQ's w/manual & security covers, BO. E Domeseck, Audio Tape Srvs, 160 E Chester, Valley Stream NY 11580. 516-825-3969.

dbx 222 type 2 NR module, $80. D Miller, Airborne Audio, 11647 W 83 Terr, Lenexa KS 66214. 913-492-8822.

Shure SE30 gated compressor mixer, excel cond, $100; CBS Audimax 3, fair cosmetics, works, $50. W Kremer, Kremer Kraft, 301 SW 16th, Ft Lauderdale FL 33315. 305-524-5652.

Fender tube-type reverb, 3 tubes, dwell, mixer, tone controls, pwr switch, input & output; RCA MI-12238-B 6 W 4 tube, mic & crystal type phono inputs, speaker output; RCA BA-4C line amp; Bogen 2120 PA amp; Realistic MPA-90; Int'l Telemeter Mdl III UHF input/output; GE BA 5A limiting amp w/pwr supply; Ware Electronics RCM-G-L RF amp; Gates limiter amp, tube-type. K Hart, WIEZ, RD 3 Box 1414, Mifflintown PA 17059. 717-436-9089.

MEI Digisound, (2) hard drives, remote keyboard configured for 10 kHz, 175 minutes mono, 86 minutes stereo, $7000/BO. D Greer, WDZZ, Ste 1830 Genesee Twrs, Flint MI 48502. 313-767-0130.

UREI 527A 27 band 1/3 octave graphic EQ's (2), $600/both; UREI Cooper time code 14 & 16 MS stereo delay unit, $300; Maestro rack mount flange doubler delay unit, $200. J Krepol, RNDL, 6147 Walker St, Philadelphia PA 19135. 215-624-1050.

Art Smart curve graphic EQ w/monitor & manuals, $650. D Greer, WDZZ, Ste 1830 Genesee Twrs, Flint MI 48502. 313-767-0130.

AUDIO . . . WTS

Digital Audio TC-4 bdct digital audio processor delay unit w/catch-up card, 4 mos old, excel cond, $1100. R Sherman, WKBM, 32401 S Rte 53, Wilmington IL 60481. 815-476-5855.

Want to Buy

Pultec, Altec, Fairchild, WE, etc, tube compressors & EQ's. W Kremer, Kremer Kraft, 301 SW 16th, Ft Lauderdale FL 33315. 305-524-5652.

AUTOMATION EQUIP

Want to Sell

Cetec/Schafer 903 automation brain w/pwr supply & control head in equip rack; IGM 48 tray stereo Instacart; SMC/Schafer mono 250 Carousel in rack, $4000 plus shipping. M Persons, WJJY, Box 706, Brainerd MN 56401. 218-828-1244.

Microprobe automation controller, 6 source w/manual, BO. R Coleman, WGEN, 1003 S Oakwood, Geneseo IL 61254. 309-944-4633.

SMC 350RSB Carousel, recently overhauled, will consider trade for cart machines, $1500/BO. D Brintnall, KBUF, 1309 E Fulton, Garden City KS 67845. 316-276-2366.

Format Sentry 12B automation systems (2), w/updated software, ready to ship, $2500 ea. B Schloss, KRRO, 1704 S Cleveland, Sioux Falls SD 57103. 605-335-6500.

Cetec 7000 w/(3) Audiofiles & Level II memory. S Cichorsky, KPRL/KDDB, POB 7, Paso Robles CA 93447. 805-238-1230.

IGM Basic III in excel cond, clean complete w/manuals, $4000; 48 tray Instacart system, $5000; (3) Otari R-R PB tape machines, $500 ea. Delta Bdctg, POB 430, Helena AR 72342. 501-338-8361.

BE SAT-16 complete w/SAT 16 microprocessor, (4) stereo Go-Cart 24, printer, racks. J Bennett, Great Trails, 717 E David, Dayton OH 45429. 513-294-3333.

Schafer 903E stereo automation system w/(4) Ampex AG440 stereo PB's, (3) stereo IGM 42 Go-Carts, (6) cabinets, Extel printer, full memory & 901 control unit w/keyboard, manuals, excel stock of spare parts, gd cond, must sell as complete unit. S Thomas, KJOY, 110 N El Dorado, Stockton CA 95202. 209-948-5569.

IGM Basic A, complete, 12 yrs old, just removed from service, working well, w/(2) 42 tray Go-Carts, ITC 3-deck, ITC single, R-R, will demo at Hutchinson MN, $6500. D Gander, KKJR, Box 10, Hutchinson MN 55350. 612-587-2140.

Schafer 900 stereo, junked out operating system, all decks & pwr supply avail at $100/deck. V Clayton, CEC Inc, 1380 Oakcrest, Provo UT 84604. 801-375-1357.

Complete SMC DPI-C automation system w/(4) 350 RSB Carousels, (4) SMC/Otari R-R PB's, SMC dual cart, single play deck, (4) matching equip racks, logging w/X-tel printer, digital programmer w/brain & remote encoder w/monitor & all manuals. D Kulbel, KCIM, 1119 E Plaza, Carroll IA 51401. 712-792-4321.

Brain for a SMC automation system w/ESP-1 Brain & programmer, DS-20A switcher, PDC-4a superclock, pwr supply w/battery support, AL-1 memory loader, Extal printer, Rac-31 remote control, Green SMC rack, (2) TS-25 dual tone sensor units, BO. J Hartmeyer, WCLT, POB 880, Newark OH 43055. 614-345-4004.

Otari ARS-1000 (2) like new, less than 2 yrs use, $1800 ea. D Canipe, WSVM, POB 99, Valdese NC 28690. 704-874-0000.

Harris 9000 Series w/(5) ITC 770 R-R's, (3) 48 tray IGM Instacarts, mono, $25,000/BO. B Chesson, WSTV, 320 Market, Steubenville OH 43952. 614-283-4747.

SMC Minipro w/Otari interface; Harris System 90 automation Brain & switcher. R Lankton, WDUV/WBRD, 813-749-1420.

Harris 9000 w/CRT keyboard, $1500; (2) new style Instacarts, $8000 ea; (2) older style Instacarts, $4000 ea; (2) 42 slot Go-Carts, $2000 ea; (2) Criterion play only cart machines, $75 ea; Extel AH 11-R printer w/9 cases or paper, $50; Sony remote B&W video monitor included w/Harris 9000, (3) racks, $100 ea, all cables, interfaces & manuals included, BO. D Greer, WDZZ, Ste 1830 Genesee Twrs, Flint MI 48502. 313-787-0130.

Sono-Mag 250 Carousels (3), two work, one for parts; w/72" Schafer rack, $600/BO. C Edwards, WWJM, 210 S Jackson, New Lexington OH 43764. 614-342-1988.

SMC DAS 6/12 digital audio switcher, (2) SMC CH4 programmers, (2) Magnavox computer monitor 80, SMC MSP-12, (3) SMC mono Carousels, racks, cables, etc. $15,000. P Berger, WNAM, POB 707, Neenah WI 54957. 414-727-2040.

New 452 stereo bi-directional Carousel, w/MSP-12/system programmer, desk mount control head & CRT display w/SA-1 silence alarm package & racks, (3) Carousels, assume lease payment of $476.05/mo, complete automation package. J Jernigan, WWAV, 1234 Airport Rd, Destin FL 32541. 904-654-5102.

Satellite service automation system, full day walk-a-way time, 5 yrs old, SMC MSP-1 w/2 liner carts & RTR ad playback. $5600. D Doelitzsch, WDDD, Marion IL. 618-997-8123.

Format Sentry FS12C plus 7 SMC Carousels, fully integrated w/IBM computer, 4 racks & working perfectly, on air now, $14,500. P Anderson, KZBQ, 208-234-1290.

Satcue 400 switcher by Colorado Magnetics, $400. H Widsten, KGNB, 1540 Loop 337 North, New Braunfels TX 78130. 512-625-7311.

Want to Buy

Automation system, must be ready to go on air, very reasonable price for educ station. D Parsons, KLUH, POB 1313, Poplar Bluff MO 63901. 314-686-1663.

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CAMERAS (VIDEO)

Want to Sell

RCA TK76B w/PS, case, manual, working, $500/FOB; JVC KY-1900CH w/PS, case, manual, working, $450/FOB. K Kuespert, A-V Prod, 1794 Russell, Baroda MI 49101. 616-422-2235.

Sony DXC 1200 studio color cameras (2) w/tripod, head, dollies, $1200; Ampex 3-tube color w/CCU, cables, $800; Hitachi 3-tube color w/CCU, cables, $800; (2) Norelco PC 70 systems, complete, $500. J Krepol, RNDL, 6147 Walker, Philadelphia PA 19135. 215-624-1050.

Sharp XC-800 3 tube, color, 2L image enhancer, 54 dB S/N, 600 line hor, resolution w/AC adapter, new Pro-Pac battery, extender card, case, $2850/BO. R Jensen, Telecable Prod, 5812 21st St, Racine WI 53406. 414-632-3131.

Panasonic 300 CLE ENG package w/Porta-Brace case, $5900. V Michael, WHOT, 575 Montgomery Pk, S Williamsport PA 17701. 717-326-8200.

Sony BetaCam RVP 3A, Fujinon lens, Nalpak case, Gitzo sticks, O'Connor fluid head, mech excel, cosmetic fair, $10,000 pkg. TJ Worrell, Multimedia, 7620 W 78th, Minneapolis MN 55439. 612-942-9681.

RCA TK-76 3-plumbicon bdct camera, just overhauled, excel cond, Canon 20:1 zoom, case, AC, batts, etc, w/BVU-110 cable, $1600; JVC KY-2000 3-saticon camera, gd cond, 10:1 zoom, AC adapter, case, etc, $1600. Ugly George Satellite TV, 314 West 52 St, NYNY 10019. 212-877-2200.

Ikegami ITC-730A, Canon J13 x 9B lens, batteries, charger, AC, case for all mannuals, mech excel, cosmetic fair, $5000 pkg. TJ Worrell, Multimedia, 7620 W 78th, Minneapolis MN 55439. 612-942-9681.

CART MACHINES

Want to Sell

BE 3200RP R/P, 3 tones, direct drive capstan, mono, manual, like new, $750. R Rocks, KEMC, 1500 N 30th, Billings MT 59101. 406-657-2941.

ITC PD-II mono cart recorder, works, $350. T Ray, WTIC, Hartford CT. 203-522-1080.

Otari CTM-10SR stereo R/P, FF, splice find, 3-tone, cue erase, Dolby HX-Pro, brushless PLL servomotor, $2700/firm. G Stivers, KECH, POB 2158, Ketchum ID 83340. 208-726-5324.

ITC SP w/rack mount, $800; ITC PD-II w/record, $1000; UMC Beaucart II, $500 ea. Clark, WFAS, Secor Rd, Hartsdale NY 10530. 914-693-2400.

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ITC 3D stereo w/WRA record amp & spare motor, $2500. B Weiss, KLSI, Kansas City MO 64111. 816-753-0933.

Stereo 48 tray Instacarts (2) w/interface for Format Sentry automation, ready to ship, $3000 ea/BO. B Schloss, KRRO, 1704 S Cleveland, Sioux Falls SD 57103. 605-335-6500.

ITC Premium & PD-II, both PB & RPB, mono, (7). D Doelitzsch, WDDD, Marion IL. 618-997-8123.

Gates mono, (5), one fits w/spare module w/(3) Gates mono, CPD, CDP, cart record amps. Richard Lynn, 615-459-6616.

SpartaMatic 200RP; Sony TC-102 portable; RCA portable; Magnacord S-36 type rack mt in portable case w/schematic; Magnacord S-36 (2) complete (1) missing, reel motors for parts w/schematics; Magnacord PT-6 type. K Hart, WIEZ, RD 3 Box 1414, Mifflintown PA 17059. 717-436-9089.

Otari CTM-10 R/P, 5050BII in a smaller box, stereo, FF, splice find, all tones, selective erase, test oscillator, PB deck w/separate record elect box, $2700/firm. G Stivers, KECH, POB 2158, Ketchum ID 83340. 208-726-5324.

Gates Criterion mono R/P, gd cond, $300; ATC/Gates Criterion, mono/play, gd cond, $200. B Clark, Bullitt Bdctg, Rt 1 Bardstown Rd, Mt Washington KY 40047. 502-538-4784.

ITC stereo 3D triple deck w/all tones, $1395. B Mountjoy, WIDD, POB 1240, Elizabethton TN 37644. 615-543-5849.

McCarta stereo PB cart decks w/tones (4); Tapecaster 700P; Tapecaster 700RP. R Lankton, WDUV/WBRD, 813-749-1420.

ITC 99B mono recorder, $1650; ITC RP mono recorder, 3 tones, $775; ITC ESL-IV splice finder/eraser, $400; UMC 11-113 mono repro, 3 tones, $375. P Wells, KJQY, San Diego CA, 619-238-1037.

Want to Buy

ITC 3D capstan motor. R Yaw, KOJM, POB 7000, Havre MT 59501. 406-265-7841.

Gates Criterion (2) 150 Hz detector cans. J David, KMPL, POB 907, Sikeston MO 63801. 314-471-1520.

ITC stereo PB's, must be willing to sell cheap. P Lotsof, KAVV, Box 42977, Tucson AZ 85733. 602-889-9797.

CASSETTE & REEL-TO-REEL RECORDERS

Want to Sell

MCI/Sony JH-110A (6) 1/4" 1/2 trk 1980, may need heads, just removed from service, working, well maintained, also many new repair parts & motors & books, $1500 ea. T Nelson, WCAL, St Olaf College, Northfield MN 55057, 507-663-3328.

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Nashville, TN. 37203 (615) 244-6892

Revox PR 99 R-R's (2) w/rack mounts, ready to go, $500 ea. B Schloss, KRRO, 1704 S Cleveland, Sioux Falls SD 57103. 605-335-6500.

Ampex 351 deck, no heads, $150; Ampex 400 deck, no heads, $200; Ampex 400 deck plus original tube electr, FT, $400; Ampex AG440 1/2 trk stereo w/electr, excel cond, $1500; brush sound mirror, BK403, prof mdl w/(3) reels paper tape & original BA 106 mic, excel cond, $500. W Kremer, Kremer Kraft, 301 SW 16th, Ft Lauderdale FL 33315. 305-524-5652.

Magnecord w/record amps, (2), one newly recond & one cond unknown, BO. R Coleman, WGEN, 1003 S Oakwood, Geneseo IL 61254. 309-944-4633.

Ampex AG-350 FT in console, gd cond, $400; Crown 801 FT portable w/matching speaker/amp, vgc, $250. B Weiss, KLSI, Kansas City MO 64111. 816-753-0933.

Studer port case for A77 w/mon spkrs & pwr amps, excel cond, $275. R Katz, Allegro Snd, 15015 Ventura, Sherman Oaks CA 91403. 213-859-5543.

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Teac V417C stereo w/Dolby B, C memory & soft touch controls, $130. W Dougherty, WLD Recdg Std, Rt 1, Mill Spring MO 63952. 314-998-2377 aft 5:30 PM.

Ampex 351 w/Inovonics amps, $800 ea; Ampex AG-600 portable w/case, $100; Scully 280B w/amp in rack, $500; MCI JH-110B w/Ruslang cabinet, $2600 ea. Clark, WFAS, Secor Rd, Hartsdale NY 10530. 914-693-2400.

MCI JH 110 2 trk in roll-around (2); MCI JH 110 4 trk 1/2" in roll-around; (2) Metrotech 500 mono w/electr. D Johnson, WFYR, 130 E Randolph Ste 2303, Chicago IL 60601. 312-861-8132.

Ampex AG-440C 4 trk, 1/2", in roll around stand, gd cond, $1200/BO. J Bible, KEZO, 11128 John Galt, Omaha NE 68137. 402-592-5300.

Technics SV-100 records digital audio on any NTSC VCR, VTR w/AC pwr supply & manual, $500. P Patton, WAPO, 29 W Main, Jasper TN 37347. 615-942-5611.

Telex Series 235 stereo tape duplicator system, 1 master w/complete spare & 4 slaves, in new cond, $600. J Krepol, RNDL, 6147 Walker St, Philadelphia PA 19135. 215-624-1050.

Scully 270 PB's (5), fair cond, $300/all or $75 ea. B Elliott, WRFX, 915 E Fourth, Charlotte NC 20204. 704-338-9970.

Otari MK-5050BII, w/all factory mods, no wear on heads w/service man & rack mounts, low mileage, $1850. P Appleson, Appleson Stds, 1000 NW 159 Dr, Miami FL 33169. 305-625-4435.

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Nakamichi 1000-ZXL computer-controlled w/NR-100 Dolby C, rack mount w/rosewood case, low hrs, excel cond, $1475/BO. R Katz, Allegro Snd, 15015 Ventura, Sherman Oaks CA 91403. 213-859-5543.

Sony/MCI JH110B, (2) to trade for ICOM R9000 rcvr. D Solinske, WSUN, 877 Executive Ctr Dr, St Pete FL 33702. 813-576-1073.

Magnecord DPB-60 R/P, Viking R/P, Roberts R/P, $75/all plus shpg. B Elliott, WRFX, 915 E Fourth, Charlotte NC 20204. 704-338-9970.

Dictaphone 5612 logger tape system. D Johnson, WFYR, 130 E Randolph Ste 2303, Chicago IL 60601. 312-861-8132.

Teac A4300SX 7" 2 speed in gd cond, $300/BO. C Springer, KLMR, POB 890, Lamar CO 81052. 719-336-2206.

Studer HS-77 MK IV special fact order FT mono, 15-7.5 ips, only 10 hrs use, wood case, excel cond, $475/BO/trade. R Katz, Allegro Snd, 15015 Ventura, Sherman Oaks CA 91403. 213-859-5543.

Ruslang R-R push carts, (3) adjustable decks, castered base, woodgrain finish w/black facing, $450 ea/BO. A Wasilewski, KMWX, POB 1460, Yakima WA 98902.

3M M56 8 chnl 1" tape pro-studio recorder w/full remote, sel-sync, Dolby A interface cables & new tape stock, $2900; Audix MXT1000 8 chnl master mix down console, $1500, or both for $4000. J Krepol, RNDL, 6147 Walker St, Philadelphia PA 19135. 215-624-1050.

Sony PCM-2500 A & B, DAT's (2), 1990, new, BO. I Seredni, KNVR, 407 W 9th, Chico CA 95928. 916-895-1197.

Otari MX 5050 BII2 tape player/recorder (2), one w/new tape heads, $1200 & one without new heads, $1000, both in use. L Armer, KBOM, 500 Montezum, Santa Fe NM 87501. 505-982-0088.

Technics RS 1500 US 3 speed isoloop, 1/2 trk stereo R/P, 1/4 trk play 10.5" reels, never used w/full factory warranty, $899. G Chapkis, Digital Prod, POB 22122, Denver CO 80222. 303-689-9114.

Nagra 4.2 w/single preamp, new xtal sync, leather case, manual, refurbed & set to specs. R Sumner, CAVU Corp, 3322 Applegate Ct, Annandale VA 22003. 703-560-0233.

Revox A77 1/2 trk stereo, 3-3/4-7.5 ips, low hrs since factory overhaul w/service manual, $650. F Ostrander, Ostrander Prod, 5 Grandview, Cornwall/Hud NY 12520. 914-534-4025.

Magnecord 1021R mono relay control, gd cond, $300; Revox A77 (2), one in gd cond the other in poor cond, $400/both. B Clark, Bullitt Bdctg, Rt 1 Bardstown Rd, Mt Washington KY 40047. 502-538-4784.

Sony TC854-4 R-R 4 trk, $100. P Russell, Bowdoin College, Sills Hall, Brunswick ME 04011. 207-725-3066.

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Ampex AG-350 mono 1/4" in console, $500; Ampex AG-440 mono 1/4" in console, $500; Sony TC854-S 4 chnl 4 trk w/sync & dbx-154 type I, $950; Crown SX-701, $250; Crown 800TX w/4 chnl 4 trk heads & HRI electronics, $300. J Krepol, RNDL, 6147 Walker, Philadelphia PA 19135. 215-624-1050.
Technics RSB-85, $199. G Chapkis, Digital Prod, POB 22122, Denver CO 80222. 303-689-9114.

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CASSETTE . . . WTS

Roberts 977 stereo tape deck, stand-up tube type, cond unknown, $50; Pioneer RT-101L 10" R-R 4 trk stereo in excel cond, $300; Pioneer RT-707 7" R-R 4 trk stereo w/auto-reverse in excel cond, $300, plus shipping charges on all items. J Emmel, WWAX, 509 Third St, Peckville PA 16452. 717-383-1118.

Ampex 601 in custom woodgrain cabinet; Ampex AG440B in roll around cabinet; Comex Bleepmate 675 program delay 3 or 6 sec delay w/remote switch; (2) Ampex R-R's, mdl unknown. Richard Lynn, 615-459-6616.

Ampex 440 Series stereo PB's w/reproduce electr (5); Scully 280B stereo R/P w/all electr in roll around cabinets (2); Crown 700 Series R-R transports (2); ITC 750 Series reproducers (3); Magnecord 1021 w/electr (2); Telex 230 Series 7" R/P w/electr (2). R Lankton, WDUV/WBRD, 813-749-1420.

Revox B-77 4 trk stereo, 3-3/4 & 7.5 ips, no visible head wear, excel cond, $600 plus shpg. C Kocsis, PGE Recordings, 2826 Raymond, Falls Church VA 22042. 703-237-2590.

Ampex 350 stereo rcdr, $375; (4) Scully 285 repro decks, $225 ea or $775/all; (2) Inovonics 370 R/P electr, $375/pr; MCI JH-110B FT stereo for 14" reels, $2375. P Wells, KJQY, San Diego CA, 619-238-1037.

Ampex AG 440-2, Altec 21-B mics, Ampex amps. EV mics, lots of misc, call for list, must sell. Bob Lindahl, 10680 S W Wedgewoood, Portland OR 97225. 503-644-9643.

Want to Buy

Ampex MR-70 2 trk in gd original cond; Ampex NAB test tape, 15 ips; pair of RCA ribbon mics. D deForrest, 7441 Wayne, Ste 10-D, Miami Beach FL 33141. 305-866-5401.

Ampex MR-70 2 trk in gd, original cond. D deForrest, Insight Prod, 7441 Wayne Ave, Ste 10-D, Miami Bch FL 33141. 305-866-5401.

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.

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

COMPUTERS

Want to Sell

Tandy Mdl 4 TRS-80 computer w/2 floppy drives, 5 meg hard drive, daisy wheel 410 printer & software, $650. R Allen, WRBS, 3600 Georgetown Rd, Baltimore MD 21227. 301-247-4100.

TRS-80 mdl 4 microcomputer w/(4) 360K dbl sided drives, 3 internatl, 64K RAM, RS-232 port, software packages; Radio Shack DMP-1000 dot matrix printer; Radio Shack mdl 100 laptop computer with 36K RAM, internal 300 baud modem, RS-232 port, printer port, built-in software for text, telecom, Basic; Teletype w/keyboard, paper tape reader/punch, stand. K Hart, WIEZ, RD 3 Box 1414, Mifflintown PA 17059. 717-436-9089.

Macintosh SE 20 meg hard drive w/monitor, keyboard & $5000 worth of software, 3 mos old. G Chapekis, Digital Prod, POB 22122, Denver CO 80222. 303-689-9114.

CONSOLES

Want to Sell

LPB Signature II S-15A 8 chnl mono, excel cond, $1200/BO. K Kushnir, Empire Comm, 2120 Bluebell, Santa Rosa CA 95403. 707-545-8300.

Quantum QM-8, 8 inputs, 4 busses, quad & stereo mon, +4 dBm nom, +30 dBm max, lrg Triad input xfmrs, Duncan linear faders, audiophile quality, excel cond, $475/BO/trade. R Katz, Allegro Snd, 15015 Ventura, Sherman Oaks CA 91403. 213-859-5543.

Shure M67/M675 mixer/prod master combination, excel cond, $400/set. T Ray, WTIC, Hartford CT. 203-522-1080.

NorthEast Ohio combo looking for specialists who can rebuild an RCA BC-8A stereo/dual chnl consolette mdl MI-11667A. B Wolf, WFUN/WREO, 3226 Jefferson Rd, Ashtabula OH 44004. 216-993-2126.

Auditronics 110A Grandson, 18 inputs, 4 outputs, 3 band EQ, 2 echo sends, 8 VU's, $3900/BO. Mr. Freeman, Pranava Prod, 1227 Sierra Alta Way, Los Angeles CA 90069. 213-457-8390 aft 1PM.

Altec 250T3 12 chnl stereo,, gd working order, $1750/BO. K Kushnir, Empire Comm, 2120 Bluebell, Santa Rosa CA 95403. 707-545-8300.

Gates MI-5136 remote mixer, old but appears to be complete, $50 plus shpg. B Elliott, WRFX, 915 E Fourth, Charlotte NC 20204. 704-338-9970.

Sparta A-10B monaural, mint cond, $400; Gates Studioette monaural, gd for parts, $100. B Weiss, KLSI, Kansas City MO 64111. 816-753-0933.

Ampro AC-6-SB 6 mixer dual chnl, gd for small prod or on air use, $700 plus shpg. B Elliott, WRFX, 915 E Fourth, Charlotte NC 20204. 704-338-9970.

Snake, 16 phantom-pwrd inputs w/ext ps, 250' Belden 19-pair cable w/mil connectors & stainless steel strain reliefs, 10' Neumann XLR snake mates w/box or Belden snake, excel cond, $575/BO/trade. R Katz, Allegro Snd, 15015 Ventura, Sherman Oaks CA 91403. 213-859-5543.

Yamaha PM 700 12x2x2 mixer & PM 400 8x2 mixer, both $900; UREI 527A 27 band graphic EQ's (2), both $700. J Krepol, RNDL, 6147 Walker St, Phildelphia PA 19135. 215-624-1050.

UREI Mod One 10 chnl stereo, OK cond, $850 plus shpg. B Elliott, WRFX, 915 E Fourth, Charlotte NC 20204. 704-338-9970.

GE BC1A in gd cond, needs minor work, $50 plus shpg. G Heidenfeldt, 2880 W Lake, Wilson NY 14172. 716-751-6187.

RCA BC7 in gd cond, works but needs wiring work, BO. J Ballentine, WSBF, POB 2156, Clemson SC 29632. 803-653-5222.

Arrakis 2000 SC's, (2) stereo, both in use, on-air board, $1250, production board, $1750. L Armer, KBOM, 500 Montezuma, Santa Fe NM 87501. 505-982-0068.

Gates Produce mono, modified w/switches & cue pots, manual & modifications, $300. B Clark, Bullitt Bdctg, Rt 1 Bardstown Rd, Mt Washington KY 40047. 502-538-4784.

Ramsa WR-8816, 16x4x2x1 prod console w/EQ floor stand, outboard pwr supply, new; Harris stereo 5, Solid State 5 chnl; McMartin 500 Solid State 5 chnl stereo; UREI mod one 10 chnl Solid State stereo; RCA 100 Solid State 4 chnl stereo. R Lankton, WDUV/WBRD, 813-749-1420.

Sonex, 1/2 rolls. Richard Lynn, 615-459-6616.

Collins 212T-1 audio control system, mint cond w/manual, $595; Shure SR101 Series 2 portable audio mixer, rack mt in portable case, excel cond w/manual, $395. R Sumner, CAVU Corp, 3322 Applegate Ct, Annandale VA 22003. 703-560-0233.

Yamaha PM-700 2x2x2 PA mixing board, $400; Yamaha PM-400 8x2 PA mixing board, $200; Shure 8x1 pro-rack mount mixer w/reverb, $200. J Krepol, RNDL, 6147 Walker St, Philadelphia PA 19135. 215-624-1050.

Ramko DC 8M5 8 chnl, stereo 18 inputs, excel cond, $3800. R Trumbo, KNLF, POB 117, Quincy CA 95971. 916-287-4144.

McMartin B0592, 5 ch stereo, excel cond. Goodrich Ent, 11435 Manderson, Omaha NE 68164. 402-493-1886.

Gates 10 chnl stereo Executive, gd cond, $1000; Gates 10 chnl mono Diplomat, missing pwr transformer; Gates 8 chnl mono President, missing pwr transformer & most cards, gd for spare parts, $500/both. B Mountjoy, WIDD, POB 1240, Elizabethton TN 37644. 615-543-5849.

Want to Buy

Howe Audio 9000 parts needed desperately. H Gordon, WGY, 1430 Balltown Rd, Schenectady NY 12309. 518-381-4851.

DISCO & SOUND EQUIPMENT

Want to Sell

JBL Century L-100 in excel cond, $325; JBL D-120 12" low freq drivers (2), new cones, excel cond, $125/pr. R Glenn, WIER, 1718 Shenandoah, Wim FL 33598. 813-634-1940.

UREI 518 electr crossover, 6 cards, rack frame & PS excel, $250. P Appleson, Appleson Stds, 1000 NW 159 Dr, Miami FL 33169. 305-625-4435.

Complete mobile disco/sound reinforcement system, turnkey business opportunity w/CD players, mixers, elec, crossovers, lighting system, all cables, road cases & 32' Ford high qube van w/2 ton hydraulic lift gate, inventory list & photos avail, serious inquiries only, $35,000. P Appleson, Appleson Stds, 1000 NW 159 Dr, Miami FL 33169. 305-625-4435.

Studio Sound S-305 passive filter sets (2), matched pair, rack mount, very rare, $175 ea. R Katz, Allegro Snd, 15015 Ventura, Sherman Oaks CA 91403. 213-859-5543.

Graphic EQ, 12-band stereo, like new w/papers, $85; Holmes 75 W bass amp, $140. W Dougherty, WLD Recdg Std, Rt 1, Mill Spring MO 63952. 314-998-2377.

Burwen DNF-1201 dynamic noise filter, vgc, shipping included, $160. P Combs, Only Son Prod, 2316 Forest Home Ave, Dayton OH 45404. 513-236-2340.

dbx 500 sub harmonic synthesizer. R Lankton, WDUV/WBRD, 813-749-1420.

Orban 111b reverb unit, new, $268; Mic Mix XL-210 reverb unit, new, $268. G Chapekis, Digital Prod, POB 22122, Denver CO 80222. 303-689-9114.

Roland DEP-5 digital multi-effects processor, excel cond, $450. M Golladay, Circle Sound, Rt 2 Box 386, Newton Grove NC 28366. 919-594-1679.

FINANCIAL SERVICES

LIMITERS

Want to Sell

Texar RCF-1 Opt 5 card w/board, faceplate & manual, $175. R Rocks, KEMC, 1500 N 30th, Billings MT 59101. 406-657-2941.

Harris MSP 100 audio processor. D Johnson, WFYR, 130 E Randolph Ste 2303, Chicago IL 60601. 312-861-8132.

Moseley TFL-280 audio (2), $500; Harris AM & AGC Solid Statesman (2), $500. R Coleman, WGEN, 1003 S Oakwood, Geneseo IL 61254. 309-944-4633.

CBS 4450A Audimax automatic level control w/manual, $250; CBS 4000A Volumax automatic peak limiter, manual, $250. R Yaw, KOJM, Box 7000, Havre MT 59501. 406-265-7841.

Orban Optimod 8000A in gd cond, recently removed from service, $1500. G McCoy, KZEN, Box 100, Central City NE 68826. 308-946-3816.

Gregg Labs 2530 tri-band compressor, upgraded w/5534 IC's, $350; Inovonics 222 NRSC processor, as new, $400. P Patton, WAPO, 29 W Main. Jasper TN 37347. 615-942-5611.

Collins 310Z-2 FM exciter, in operation since 1976. H Hoppe. WHMH, Sauk Rapids MN 56303. 612-252-6200.

CRL FM 4G, SMP-800, (2) SEP-400 B, SPP 800, SG 800, excel cond, $4200. P Urso, 603-332-0930.

Harris MSP 90 (2), stereo AGC modules, stereo FM limiter modules, $800 ea/BO. D Greer, WDZZ, Ste 1930 Genesee Twrs, Flint MI 48502. 313-767-0130.

Dolby 334 FM processor; (2) RCA BA-45 AGC, (2) RCA 3A-43 pgm amps in rack mount mainframe; Volumax 4000A. R Lankton, WDUV/WBRD, 813-749-1420.

Gates Solid Statesman AGC's (2), $250/pr. H Widsten, KGNB, 1540 Loop 337 North, New Braunfels TX 78130. 512-625-7311.

Optimod 8000A, good condition. Call Mr. Ericson, 212-477-2489. $1200.

Want to Buy

Orban 8100 wanted, will trade 8000. A Stevenson, WHZT. 217-355-9402.

Versa-Count or similar, used, cheap but repairable, programmable FM exciter. J Crawley, WLSK, Box 680, Lebanon KY 40033. 502-465-5762.

Automated Bdct Control Sta-Max. Pat Parks, KYKR, 27 Sawyer, Beaumont TX 77702. 409-838-3911.

MICROPHONES

Want to Sell

Neumann KM-88, rare 3-pattern w/nickel capsules, hot-setup percussion mic, mint cond, w/orig case, $875/BO. R Katz, Allegro Snd, 15015 Ventura, Sherman Oaks CA 91403. 213-859-5543.

Shure W15HT/58/W20R wireless mics (2), handheld 177 & 183 mHz, SM58 heads, new, $525 ea. E Davison, Beatty TeleVisual, 135 N Illinois, Springfield IL 62702. 217-787-0800.

Telefunken tube CM-61 by Shoeps, very rare, uses std plug-in tube, w/custom pwr supply, mint cond, $2475/BO. R Katz, Allegro Snd, 15015 Ventura, Sherman Oaks CA 91403. 213-859-5543.

RCA 44A on original stand, gd cosmetics, works, $500; RCA 77C black & chrome, gd cosmetics, works, $400; (2) RCA 74 Junior, gd cosmetics, need ribbons, $100/ea; Shure Tri-Polar, 3 crystal, rare, original, works, BO; Asiatic D104 classic comm mic on original stand, excel cond, $75; EV RE16, dynamic cardioid, vgc, $60; EV RE55, dynamic omni, fine cond, $75; EV RE20, poor cosmetics, works fine, $30. W Kremer, Kremer Kraft, 301 SW 16th, Ft Lauderdale FL 33315. 305-524-5652.

Sennheiser MD-421 (2); AKG D-1000E mics (2), all in gd cond, BO. N Kuvshioff, Compact DJs, POB 2913, Salisbury MD 21802. 301-548-5352.

Shure SM-61LC (2) in vgc, built in isolation & pop filter w/cases & spec sheet, $160/pr or $85 ea. W Dougherty, WLD Recdg Std, Rt 1, Mill Spring MO 63952. 314-998-2377 aft 5:30 PM.

Crown PCC-160 Cardioid condenser boundary mic in original box, used only few weeks, $200. S Swanson, KBNL, Box 440029, Laredo TX 78044. 512-724-9211.

Sennheiser MD-421U w/case & clamp, vgc, $200; EV RE-20 w/case & clamp, gd cond, $200, plus shipping on both. J Emmel, WWAX, 509 Third St, Peckville PA 18452. 717-383-1118.

RCA ribbon mics including (1) 44-BX; (1) 77-D; KU3A10,0001; BK-11; BK-5; SK-46; WE639A, will trade for other high quality condenser, dynamic, ribbon mics & audio equip. Tracy Eaves, 615-821-6099 (evenings).

Want to Buy

Altec, RCA, WE, Neumann, Sony, etc, vintage mics. W Kremer, Kremer Kraft, 301 SW 16th, Ft Lauderdale FL 33315. 305-524-5652.

Will buy or trade for RCA 4 AA condensor mike no major missing parts please. J Webb, 15117 Hamlin, Van Nuys CA 91411. 818-769-6738.

RCA BK-5B w/windscreen, gd cond. R Laine, Box 10665, Golden CO 80401. 303-236-7830.

MISCELLANEOUS

Want to Sell

Kraco RPU ground plane 161.7 mHz, $100; (4) patch panels double, $50 ea. Delta Bdctg, POB 430, Helena AR 72342. 501-338-8361.

Harrison 6200 B DC pwr supply, 150; HP 0-40 V .75A, 0-20V 1.5A. M Norman, KCCU, 2600 W Gore, Lawton OK 73505. 405-581-2425.

Cummins 4B 3.9GC diesel generator, 40 kW, 4 cylinder, liquid cooler, 6 mos old, 417 hrs, excel cond, $7900. M Fleisher, WWBE, 333 Chestnut, Mifflinburg PA 17844. 717-966-1098.

B&W 210 audio gen, $200; B&W 410 dist meter, $300; Kintronic isocouplers FMC-7.5 at 103.9, $2500; Kintronic FMC-0.5B at 450.65, $1000; Eventide delay BD-931 6.4 sec, $800; GE dist meter, $100; Heathkit oscill 10-4560, $200; Elgin ERC-16645-4 recorder connectors, $60 ea. Clark, WFAS, Secor Rd, Hartsdale NY 10530. 914-693-2400.

RCA PG201, 16mm sound projector, exceptionally smooth running, projector cosmetics excel, case cosmetics fair, $175; (3) Altec N500 crossovers, excel cond, $75/ea. W Kremer, Kremer Kraft, 301 SW 16th, Ft Lauderdale FL 33315. 305-524-5652.

Telephone System, Executone 'Encore' recently removed from computer store, 12 phones, punch blocks, options, cords, installation jacks, etc., priced low. Goodrich Ent. Inc, 11435 Manderson St, Omaha NE 68164. 402-493-1886.

Metal 2' free standing letters KKRC & 1' free standing letters RADIO, w/mounting hardward, $100 plus shpg. B Schloss, KRRO, 1704 S Cleveland, Sioux Falls SD 57103. 605-335-6500.

Rack bays (2), 77" rack space, 82" overall, 17" deep, black wrinkle finish, one 61.5" rack space, 68" overall, 18" deep, gray finish w/yellow formica glued to sides. K Hart, WIEZ, RD 3 Box 1414, Mifflintown PA 17059. 717-436-9089.

Cushman Snowcat small two-man, for deep powder snow w/trailer, gd cond, BO. D Barton, KMTI, POB K, Manti UT 84642. 801-835-7301.

Radio Shack 17-604 NiCad battery for 17-200/1050 CT-300, 301 cellular phones, new $15. P Russell, Bowdoin College, Sills Hall, Brunswick ME 04011. 207-725-3066.

Anvil cases (10), 13 space, 22.75"x24", EIA rackmount, 2" foam lines shock mounted, mech excel, cosmetic poor, $300 ea. TJ Worrell, Multimedia, 7620 W 78th, Minneapolis MN 55439. 612-942-9681.

Extel weather wire printer. R Lankton, WDUV/WBRD, 813-749-1420.

Gentner SPH4, Bantam patch panel, ITC eraser/splice finder ESL IV & other items, BO. D Doelitzsch, WDDD, Marion IL. 618-977-8123.

Tellabs dual wideband repeat coil module 4425, still in box; dual row patch bay. Richard Lynn, 615-459-6616.

Cinema Engineering 9205-A bulk eraser. R Robinson, 203-269-4465.

Gray 20"x19" equip racks (2); (15) various sized metal cart racks; Gates 6' equip rack. R Lynn, 615-459-6616.

VHS video sales training tapes (6) 30 topics, $1500. R Trumbo, KNLF, POB 117, Quincy CA 95971. 916-287-4144.

Harmon-Kardon mixers, new DPR7; Meissner mixer five inputs-battery; Cannon plugs, 3 prong, male & female; 40 new tubes & resistors cheap; Lafayette TE22 audio gen; Sencore transistor & diode tester; manuals for Ampex, Pultec, Altec & others. Mr. Oliver 212-874-7660 in afternoons.

Grampian cutter heads, 1D feedback (tandberg); patch bays (4) 24 inputs single, also patch cords; Daven 600 ohms attenuators (silent) (8) excel; Presto 6N cutter lead screws; Edital blocks for recorders 1/2"; EV 12TRX speakers (2) & cabinets. Mr. Oliver, 212-874-7660 in afternoons.

Want to Buy

Glass dial plate for 1968 HH Scott 388 rcvr. Clark, WFAS, Secor Rd, Hartsdale NY 10530. 914-693-2400.

New FM seeks quality used studio/xmtr gear, 1 kW xmtr, boards, etc. B Jackson, WCDA, Box 12369, Albany NY 12212. 518-374-0898.

Digital VT Series video terminals & keyboards. P Russell, Bowdoin College, Sills Hall, Brunswick ME 04011. 207-725-3066.

MISCELLANEOUS . . . WTB

Wire marking machine. M Starin, WJYY, 457 Varney, Manchester NH 03102. 603-625-1165.

Jazz record collections, 10" LP/12" LP bebop, swing, dixie, highest prices paid. B Rose, Program Recdgs, 228 East 10th, NYNY 10003. 212-674-3060.

MONITORS

Want to Sell

Gates stereo mod monitor GTM 885 103.1, $100; FM freq monitor GTM 88F 103.1, $50; Pilot SCA freq comparator, $25. Delta Bdctg, POB 430, Helena AR 72342. 501-338-8361.

General Radio 681-B AM freq deviation meter. K Hart, WIEZ, RD 3 Box 1414, Mifflintown PA 17059. 717-436-9089.

QEI 675T200 RF & SWR monitor & PA voltage & amp monitor, fwd & rev SWR switch, 19" rack mount, 3" high, translator & up to 200 W use, $125. S Lawson, KAK Prod, 928 Hyland, Santa Rosa CA 95404. 707-528-4055.

McMartin 5500 aural mod monitor, TV chnl 6, $250 plus UPS. J Crawley, WLSK, Box 680, Lebanon KY 40033. 502-465-5762.

Motorola 1310 AM stereo mod mon in excel cond. G Ciapper, KKGR, POB 9032, Gresham OR 97030. 503-667-1230.

Bird 3128 wattcher alarm/RF power monitor, up to 10 kW, 450 kHz to 2300 MHz, mint cond w/manual, $350. R Sumner, CAVU Corp, 3322 Applegate Ct, Annandale VA 22003. 703-560-0233.

Belar FM mod monitors, FMM-1, FMS-1, SCM-1, RFA-1 all clean & current calibration; McMartin TBM3700, TBM2200 FM mod monitors. R Lankton, WDUV/WBRD, 813-749-1420.

McMartin FM mod monitors, TBM3500B main chnl, TBM2200A stereo, TBM2000B SCA, TBM4500A, all or part tuned & tested. Goodrich Ent, 11435 Manderson, Omaha NE 68164. 402-493-1886.

Potomac AM0—19D 6-tower DA-2 digital antenna monitor, $3800. Sony PVM-8200T professional color monitor, $900. Sony BVE-800, $400. Tektronix 1420 NTSC vectorscope w/case, $2100. L Morton, 805-733-4275.

Want to Buy

FM stereo monitor, gd, late mdl; also FM EBS rcvr. S Larson, KJLY, Box 72, Blue Earth MN 56013. 507-526-3233.

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

MOVIE PROD EQUIP

Want to Sell

Canon Scoopic 16mm motion picture camera, zoom, etc w/charger, excel cond, $750/BO. K Kushnir, Empire Comm, 2120 Bluebell, Santa Rosa CA 95403. 707-545-8300.

Siemans 2000 16mm interlock projector, excel cond, $575; B&H 70DR 16mm camera w/3 lenses & case, mint cond, $325. G Ormrod, GFO Prod, 432 East X St, Tumwater WA 98501. 206-352-8028.

Arriflex 16S 16mm w/12-120mm Angenieux pwr cord, lens shade & flight case, mint cond, $1500. R Williamson, R Williams Prod, 2809 Ross Ave S Ste 305, Dallas TX 75201. 214-871-9011.

RECEIVERS & TRANSCEIVERS

Want to Sell

Scientific Atlanta 7300/7325 2-piece, rack mounted rcvr & processing unit at 15.0 kHz, BO. G Fields, KDXI, Drawer 1306, Mansfield LA 71052.

Motorola Pagers Pageboy II's, Director II's & monitors, VHF system w/chargers, $40-90 ea, all in working order. K Kushnir, Empire Comm, 2120 Bluebell, Santa Rosa CA 95403. 707-545-8300.

Macintosh MR71 tube tuner in Pan-Loc case, all Mac tubes near mint cond, $400. W Kremer, Kremer Kraft, 301 SW 16th, Ft Lauderdale FL 33315. 305-524-5652.

Adcom SCPC agile demodulator, works in Harris 6550 satellite rcvr, gd cond, $350. W Long, WWMY, 7819 Natl Serv Rd, Greensboro NC 27409. 919-688-9450.

Communications Company 450.00 MHz antenna bases (2), not top whips or mounting hardware, have coax leads w/N-type connectors, $200 ea or $350/pr. A Wasilewski, KMWX, POB 1460, Yakima WA 98902.

Scientific Atlanta digital audio satellite rcvr w/downconverter, 15 K dual audio card, 7.5 K dual audio card, cue card, spare pwr supply, $4500/BO. T Ray, WTIC, Hartford CT. 203-522-1080.

McIntosh MR 77 FM stereo tuner, excel cond, $450. G Gabriele, WFOG, 215 Brooke, Norfolk VA 23510. 804-622-6771.

Motorola Micor N04RTB broadband tuned to 455.15 mHz, wiring for Marti compander board, has excel intermod rejection, $1100. E Swanson, WZTR, 520 W Capitol, Milwaukee WI 53212. 414-964-8300.

Heathkit FM-4 FM tuner in desktop metal cabinet; Fisher FM-90X FM tuner, signal strength meter, high impedance outputs. K Hart, WIEZ, RD 3 Box 1414, Mifflintown PA 17059. 717-436-9089.

McMartin TRE6B (6) SCA rcvrs on 67 kHz, all solid-state, simple crystal change to your freq. P Lierman, KCSP, 601 W Collins Dr, Casper WY 82601. 307-265-5414.

GE Exec II 40 W VHF on 2 meter repeater w/Hamtronics COR-4 board, $300. P Russell, Bowdoin College, Sills Hall, Brunswick ME 04011. 207-725-3066.

Scientific-Atlanta 7300 wideband w/PS/demod BSSC/downconverter/BPST rcvr/decoder modules; Scientific-Atlanta 7325 digital processing unit w/(3) 15 kHz dual audio decoders, (2) voice cue decoders, DMX, pwr supply. R Lynn, 615-459-6616.

Janiel SP2000 stereo sat rcvr processor, 2 chnl stereo rcvr; (2) Janiel BCR2000 sat TV rcvr; Microdyne 1100-FFC sat rcvr; Microwave Assoc (MAACOM) VR-3X sat rcvr; Maacom 4/MS sat rcvr, 6.2/6.8/1.2/2.4. R Lynn, 615-459-6616.

High quality micro-miniature 67 kHz SCA decoder, about 1" square, prewired & ready to install, $15. D Jackway, 5742 Fairoak, Springfield MO 65810. 417-881-1846.

Grundig Satellite 650, 1.6-30 MHz, 30 W audio, 60 memories, quartz clock, like new, original box, $650. R Thomas, Rebel Recdg, 5555 Radio Ln, Jacksonville FL 32205. 904-388-7711.

Johnson mobile/base/handheld two-way radios at discount prices, new. Mobiles, 15 W UHF, $399, 35 W UHF, $495, 25 W VHF, $385. W Hohnstein, Deremer Radio, 33 Mai, Seward NE 68434. 402-643-3338.

Want to Buy

BC-474A rcvr/xmtr, AVT-112 aircraft xmtr, AVR-20 aircraft rcvr, tech manual for MAR radio set. M Starin, WJYY, 357 Varney, Manchester NH 03102. 603-625-1165.

REMOTE & MICROWAVE EQUIP

Want to Sell

TFT 7810 digital remote R&C, $1500; Moseley TRC-15 system control, $1800; Scientific Atlanta 10' satellite dish w/feed assembly, $400. Delta Bdctg, POB 430, Helena AR 72342. 501-388-8361.

Circle 128 On Reader Service Card

Harris 6550 sat rcvr, complete w/pwr supply & 77.9 & 76.7 IF cards, manual, $1500. R Yaw, KOJM, Box 7000, Havre MT 59501. 406-265-7841.

Comrex LXT & LXR in excel cond, sold as package, $850/both. D Dobrowozski, WSSM-TV, POB 9089, Downers Grove IL 60515. 708-971-1829.

Zephyrus Open House Party downlink package w/dish (2) rcvrs & (2) LNB's, complete, $1750. D Lane, WMVO, POB 348, Mt Vernon OH 43050. 614-397-1000.

Pulse Dynamics remote bdct telephone w/(4) mics & one aux level input, $100. M Persons, KKIN, POB 930, Aitkin MN 56431. 218-829-1326.

Moseley PCL606C composite rcvr only, excel cond. Goodrich Ent, 11435 Manderson, Omaha NE 68164. 402-493-1886.

Micro Controls PTS-10C composite STL, 949.0 MHz, excel cond. $2000; Micro Controls DRCR-9 remote control, $1500; Micro Control 2001T/R 455.02 MHz STL, $1000. M Persons, KKIN, POB 930, Aitkin MN 56431. 218-829-1326.

Complete redundant Marti STL package, w/(2) TX,s, (2) RX,s, TX/RX splitter/combiner, custom audio switcher & (2) Mark SH872GN antennas, avail late January, BO. J Bisset, Multiphase Consulting, 703-379-1665.

Gates Attache 70; custom made 5 chnl remote mixer. K Hart, WIEZ, RD 3 Box 1414, Mifflintown PA 17059. 717-436-9089.

TFT 7700-B in excel cond, trans & rcvr on 997.50, will sell 7601 remote control w/packages, has 192 & 67 kHz SCA cards; Marti RPT-2, RPT30, all fully companded, will sell as package or separate. T Edmisson, WDKN, 106 E College, Dickson TN 37055. 615-446-0752.

Scientific Atlanta 7325 digital processing unit w/15.0 digital audio decoder & voice cue decoder; 7300 wideband BPSK rcvr w/various crystals, $5500. G Ayers, WWIT, POB 1369, Canton NC 26716. 704-648-3588.

Want to Buy

TV satellite uplink, prefer Ku-band, exciter, HPA, etc, truck unimportant. Ugly George Satellite TV, 314 W 52 St, NYNY 10019. 212-677-2200.

Harris 6550 chassis, pwr supply, down converter, agile FM demod, need immediately. RJ Miller, WRVI, Virden IL 62690. 217-965-3388.

STATIONS

Want to Sell

Partners/Investors wanted for new high-power FM in mountain states & for AM/FM combo in deep south, $10K minimum, serious inquiries only. L Fuss, KOOZ, POB 159, Fayetteville GA 30214. 404-460-6159.

AM and/or FM radio stations for sale in central Arkansas or will sell percent to active working partner. Vivian, 501-470-1525 or 501-568-5448.

For Sale By Owner in Youngstown-Warren Ohio market. 1 kW, 830 AM, excellent dial position, regional signal reaches Cleveland to Pittsburgh. Price $300,000-terms. Call daytime, Patrick Engrao, 412-981-3275 or 412-347-1800, evenings call Al Zippay, 412-347-3597.

Class B FM in Northern California, 3 county coverage, BE automation system installed, AC format. R Trumbo, KNLF, POB 117, Quincy CA 95971. 916-283-4144.

Midwest FM (2), upgrade avail to C-3, will finance w/down; also (1) AM FT, serious inquiries only. Radio, POB 459, St Charles MO 63302.

Olympic City/Atlanta Metro, AM station w/10 acres of land at tower/xmtr site & all station equip, $350,000. PO Box 52682, Atlanta GA 30355.

CPs for AM/FM combo located in resort area between major Montana markets, 10 kW AM, 50 kW FM w/possible upgrade, some equip included in package, BO. H McDonald, Broadcast Associates, POB 807, Veradale WA 99037. 509-924-8298.

FM 67 kHz subcarrier avail, Class A FM station xmtr locate in Queens County, NY, greater Nassau, Queens, Westchester & Southern Connecticut coverage. J Caracciolo, WDRE, 1600 Stewart, Westbury NY 11590. 516-832-9400.

Want to Buy

AM, FM or **LPTV** problem stations, turn arounds, daytimers, dark, etc, send complete details w/price & terms. J Powley, 1536 Logan, Altoona PA 16602. 814-944-8571.

CP, dark, etc. for Christian programming. P Morton, WMNV, Box 57, Rupert VT 05768. 802-394-7858.

Broadcast consultant w/extensive exper in all phases of broadcasting seeking to buy radio station, must be owner financed, AM's OK, ready to purchase today. Call 609-387-1275.

Seeking financing assistance for station start-up, willing to get started but no collateral or money. J Ballard, ALL Prod, POB 1786, Apl Vly CA 92907. 619-261-7787.

Looking for AM, FM, or combos to take over with no down. J Ballard, ALL Prod, POB 1786, Apl Vly CA 92907. 619-2617787.

STEREO GENERATORS

Want to Sell

Harris STX-1B, Harris built C-QUAM AM stereo exciter & BE AS-10 C-QUAM monitor, currently on-air w/manuals, $6500. P Patton, WAPO, 29 W Main, Jasper TN 37347. 615-942-5611.

CCA SG-ID stereo gen, $175 plus $15 shipping. M Gollub, WMJS, Box 547, Prince Frederick MD 20678. 301-535-2201.

RCA BTS-101 (2); RCA BTX-101 SCA. R Lankton, WDUV/WBRD, 813-749-1420.

SWITCHERS (VIDEO)

Want to Sell

Telemation TPS-12x3, working, $150/FOB. K Kuespert, A-V Prod, 1794 Russell, Baroda MI 49101. 616-422-2235.

Circle 12 On Reader Service Card

10 kW clear channel AM & Class A FM, can be upgraded to Class C-2-50 kW, either of both, owner financing possible to qualified buyers. 501-470-1525.

TAPES, CARTS & REELS

Want to Sell

Scotchcart II AC library & nostalgia, new in 1988, BO. P Urso, 603-332-0930.

Metal reels & boxes, (28) 14" in perfect cond, $140. H Widsten, KGNB, 1540 Loop 337 North, New Braunfels TX 78130. 512-625-7311.

Reels, 175 boxed 10" reels of bulk erased high quality tape, $350 plus shpg. A Lia, KDLM, Box 746, Detroit Lakes MN 56501. 218-847-5654.

Audiopak AA4 Super carts, 5000+, new shells, various lengths, take all or part, $3 ea. R Allen, TM Century, 14444 Beltwood Pkwy, Dallas TX 75244. 800-937-2100.

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Carousel cart rack woodgrain. 240 trays. $175; Lazy Susan wire cart rack, 200 trays. $50. Delta Bdctg, POB 430, Helena AR 72342. 501-338-8361.

Fidelipac carts (600), all lengths & conds, extra shells & parts, tape in gd to poor cond. most shells are usable, gray carts, $500/all. H Widsten, KGNB, 1540 Loop 337 North, New Braunfels TX 78130. 512-625-7311.

Adult contemporary music reels, 10.5", some in metal, BO. P Urso, 603-332-0930.

Fidelipac Mastercart, several hundred in various lengths, commercial thru music. $2 plus shipping ea/BO. C Condron, KLZX, 180 S 320 W Ste 400, Salt Lake City UT 84101. 801-580-3025.

ScotchCart II 3-7 min, new & used. Clark, WFAS, Secor Rd, Hartsdale NY 10530. 914-693-2400.

U-matic cassettes, like new, one pass only 5/10 min lengths, $2 ea; 15/20/30 min, $3 ea, plus shpg, cassettes includes library cases, some shipping cases approx 500 avail. J Powley, 1536 Logan, Altoona PA 16602. 814-944-8571.

Telex/Viking M4 & M6, new, double & single coated lubed cart tape, free shipping. E Davison, Beatty TeleVisual, 135 N Illinois, Springfield IL 62702. 217-787-0800.

Audiopak AA-3 carts, in all popular music lengths, 2:00 thru 4:00, hundreds ready to sell, none over 2.5 yrs old, $2 ea. R Sather, KPYR, 88 Union, Memphis TN 38103. 901-529-0098.

ABCO wire cart racks (3) on floor stands, holding 500 carts ea. $225 or all for $600; Scotchcart II's w/easy listening/lite-jazz library (1000), well recorded in stereo, $2/ea or $1800/all; L.E.L. alignment gauges (1 set) for Ampro cart decks, $15. P Wells, KJQY, San Diego CA, 619-238-1037.

Want to Buy

Capital Production Music 500 series old prod music libraries for TV/motion pictures/radio, especially Capital Q Series 500, other libraries considered, for personal music collection. S Richards, Super Sonic Prod, 1401 NE 149th, N Miami Bch FL 33162. 305-949-2040.

TAX DEDUCT EQUIP

Bdct training school for underprivileged needs any AM bdct equip for training students unable to attend regular bdctg schools, able to pay shipping on small items. F Smith, The Bdct Training School For the Underprivileged, 2408 Chamberlain, Chattanooga TN 37404. 615-6247126.

Equip for missionary radio station in South Pacific, FM xmtr 500 W or 1 kW, audio consoles stereo or mono, STL xmtr/rcvr, cart machines, R-R,s, many other items, call or write for list, tax-deductible receipt for all donations. J Goldring, Calvary Chapel-Spring Valley, 3400 S Jones, Las Vegas NV 89102. 702-364-9350.

Enclosed rack, 6', for xmtr, also exciter, Harris MS15 or equiv, working carts & play & R/P or sound PA equip, A Hagler, KMUD, POB 135, Redway CA 95560. 707-923-2513.

Educ FM needs equip of any type, will also trade. C Hubbeling, KTEQ, 501 E St Joseph,Rapid City SD 57701. 605-3942231.

Any/all bdct gear for new station, audio & RF, pieces & parts, will pay shipping. KGNV, Rt 2 Box 45, Washington MO 63090. 314-239-0401.

Monte Vista Christian School, would appreciate any donations of used TV broadcast equipment. T Quinn, 408-475-0423.

Eng student desiring donation of old bdct equip (anything)in repairable cond, will pay all shipping charges. EE student at Purdue. C Gill, POB 371, Indianapolis IN 46206. 317-923-2800.

TEST EQUIPMENT

Want to Sell

HP 5245L electr counter & HP 5253B freq converter. 50-500MC. $275/both plus $20 shipping. M Gollub, WMJS, POB 547, Prince Frederick MD 20678. 301-535-2201.

Leader 3060D digital storage oscilloscope dual trace, real time storage, on screen readout, cursers, GPIB D Groth, WPDH, POB 416, Poughkeepsie NY 12602. 914-471-1500.

Multi use freq counter new in box, $950. D Wolf, West Star Comm, 122 Crane, Panama City Bch FL 32413. 904-233-2051.

Leader LPM-880 radio freq pwr meter, scales 0-5 W, 0-20 W & 0-120 W, range 1.8-500 MHz, new, $125. S Lawson, KAK Prod, 928 Hyland Dr, Santa Rosa CA 95404. 707-528-4055.

Complete audio proof equip including B&W 410 dist meter, B&W 210 audio oscillator, Gates/Harris stereo gain set, all manuals, very clean. $1000/BO. D Sports, WCLA, POB 427, Claxton GA 30417. 912-739-3035.

Tek 1L20 spectrum analyzer plug in module in mdl 132 portable pwr supply unit; Singer MF 500/UR-3 spectrum analyzer; B & W 410 dist meter. R Lankton, WDUV/WBRD, 813-7491420.

RMT 506 mainframe, rack mount w/DM-502A freq counter, SG-505 audio signal gen, SC-502 oscil & AA-501 audio analyzer, avail late January, BO. J Bisset, Multiphase Consulting, 703-379-1665.

B&W 400 tube type dist analyzer, $50 plus UPS; HP 200C tube type audio oscillator 20 Hz to 2 MHz, $50 plus UPS. J Crawley, WLSK, Box 680, Lebanon KY 40033. 502-465-5762.

Sencore VA-62, VC-63, NT-64, complete video gen/analyzer, $2200. L Clinton, KARN, POB 4189, Little Rock AR 72214. 501-661-7500.

HP 5245L electronic counter & HP 5253B freq converter, $275/both plus $20 shipping. M Gollub, WMJS, Box 547, Prince Frederick MD 20678. 301-535-2201.

NLS MS-15 15 MHz single trace oscilloscope w/case, probe, book & battery. gd cond, $150. M Persons, KKIN, POB 930, Aitkin MN 56431. 218-829-1326.

Tek 323 portable, solid state 4 MHz single trace oscilloscope, AC or NiCad powered, w/manual & probe, $450; Tek 454 portable 150 MHz dual trace oscilloscope, cal sweep delay, mod 163, mint cond w/manual, $625; Tek 520A NTSC vectorscope, gd CRT, w/manual, $1895; Tek 529/RM529 TV waveform monitors, w/manual, $425 ea. R Sumner, CAVU Corp, 3322 Applegate Ct, Annandale VA 22003. 703-560-0233.

Eico 425 push pull oscil; Eico 1032 requlated pwr supply; 12 V pwr supplies, (2) separate units; Eico 1120 capacitor substitution box; Waveforms mdl 510-B oscil; RCA IF7084 small parts drawer cabinet; B&K DynaJet 607 tube tester in portable case; Precision 612 tube tester; B&K 907 transistor equip analyst; Precision E-200-C signal gen; US Army Signal Corps BC-221-N freq meter. K Hart, WIEZ, RD 3 Box 1414, Mifflintown PA 17059. 717-4369089.

Sony-Tek 335 dual trace portable oscil, w/case, probes, manual, like new, $750. B Dorsey, TVS, 195 Tenth Ave, NYNY 10011. 212-675-0437.

Hewlett-Packard 8591A 9 kHz digital spectrum analyzer w/tracking generator, RS-232 interface, storage cards, AM/FM demodulator, $18,500. Delta OIB-1 RF operating bridge w/18" leads, $1900. Hewlett-Packard 7470A digital plotter, $500. Holaday Industries HI-5000SX system including HI-3002 isotropic broadband field strength meter, E-field, H-field & low frequency H-field probes, HI-3320 datalogger, backpack, printer & case, $5200. Portable LORAN-C locator, $400. General Radio 1211-C 0.5-50 MHz unit oscillator, $300. L Morton, 805-733-4275.

Want to Buy

Complete board A3, reciprocal amp forHP 8690B sweeper; also want 8698B & 8699B plug-ins. Herb, CFQC TV, 216 First Ave N, Saskatoon, Sask S7K 3W3, Canada. 306-249-1656.

HP 606B tech manual. M Starin, WJYY, 457 Varney, Manchester NH 03102. 603-625-1165.

Potomac Instruments FIM-41 field intensity meter. F Spaulding, 883 San Simeon Dr, Mtn View CA 94043. 415-961-5018 voice/fax.

Book for Radio Specialties 1163-50-5 FM deviation meter. M Persons, KKIN, POB 930, Aitkin MN 56431. 218-829-1326.

TRANSMITTERS

Want to Sell

Harris STX-1B & STM-1B AM stereo exciter & monitor operating true C-QUAM system, excel cond, BO. B Bailey, KJEF, POB 1248, Jennings LA 70546.

Home brew **50 W AM,** set to your freq, adjusts 5-50 W, $500. J Cunningham, KEOR, Rt 2 box 113B, Stonewall OK 74871. 405-265-4496.

Sintronic FM 10 w/full metering, filters, cabinet, 89.3, $1000. Clark, WFAS, Secor Rd, Hartsdale NY 10530. 914-693-2400.

Collins 831C, 2.5 kW, great cond, $10,000. G Herpin, KRTY, 106 Royce St, Los Gatos CA 95030. 408-354-6622.

Phasemaster T-10,000-A-2-AS (2) for 3-phase conversion, handles 20 kW FM xmtr or 25 kW AM xmtrs, $2800 ea. G Arroyo, WONQ, 2483 John Young Pkwy, Orlando FL 32804. 407-297-1140.

RCA BTA 5F, excel cond in storage for immed shipment, w/all floor layouts, manuals, tubes, $9000 plus shpg. G Heidenfeldt, 2880 W Lake, Wilson NY 14172. 716-751-6187.

Collins 30K-4 2-30 MHz, 300 W CW or phone, fair cond, will trade for FM exciter, FM deviation meter or $800. J Cunningham, KEOR, Rt 2 Box 113B, Stonewall OK 74871. 405-265-4496.

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:_____

POSITIONS WANTED

Radio engineer w/major market exper seeking new challenges in new locations. Reply to: Engineer, POB 4882, Ocala FL 32678.

My dollars, time & mgmt, buy all or part of your station, community oriented. M Rimerman, 215 Wendwood, Statesboro GA 30458. 912-681-6378.

Student engineer w/resume, seeking engrg, prod, air shift employment in PA area, college & some exper, trainable, eager to work & learn, references avail. Askey, RD 3 Box 433, Bernville PA 19506. 215-488-7704.

Announcer w/5 yrs non-comm exper seeks comm FT position in St Louis MO or PT in NW GA. Eric, 404-924-7780.

Exper air personality seeking FT position, exper in news, morning & afternoon drive, prefer Christian or A/C but will work in other formats. Jason, after 4PM CST. 918-476-8849.

GM exper in sales, programming & engineering looking for position in Northeast. B Mooney, 207-942-1108.

Notre Dame grad, advanced degree, college baseball/basketball/football play-by-play exper, underwriting/sales, news, PR, 8 yrs exper, seeks university sports or bdctg position, teaching or professional staff. Len, 219-7623351.

Exper DJ/Sportscaster seeks On-Air position music/sports-baseball, football, PBP/color, will relocate. Phil, 415-587-3426 or 415-948-9250.

Production Director w/lots of writing & engineering exper now available, worked on Network programming & in NY market. B Ranes, 718-526-6501.

Metro NY 10-year air personality wishes to stay here, wants to provide listeners w/entertainment, companionship & smiles, will consider production work. Zal, 718-871-5419.

Experienced CHR/AC jock w/blazing energy, deep pipes, warm personality & great sense of humor seeks upstate NY FM w/No. 1 goals. Wayne, 716-338-1439.

Annc, Jock, started young, still going strong. AOR, CHR, AC, C&W exper, MD, OP, News, Sports, even cow chip bingo, will to relocate to larger market. M Doyne, 1328 High St Ste 1, Wmspt PA 17701. 717-323-7832.

Ancr w/6 yrs exper in north med mkts looking for position, hard worker & team player. Brian, 612-560-6569.

Seeking GM position w/option, small market. 29 yrs radio/23 mgmt exper, strong personnel, engrg, sales, news, sports, avail now. Wisconsin, midwest, references, personal/business. Rod, 608-647-4869.

HELP WANTED

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Expanding sales team looking for self motivated individual. Engineer/technician experience in operation/architecture of audio consoles a must. Sales ability, computer operation, and knowledge of manufacturing helpful. Broadcast knowledge required. Send resume to: WHEATSTONE CORPORATION, 6720 VIP Parkway, Dept. E, Syracuse NY 13211 (No calls, please)

CORPORATE CHIEF ENGINEER — Major market radio bdct company seeks hands-on corporate CE to direct & supervise all aspects of the technical operations of company's AM & FM stations. Min. 10 yrs varied exper as station and/or corporate CE. Knowledge of all aspects of FM & AM (including directionals) operations is required. Send resume w/salary history & requirements to: Radio World, POB 1214, Falls Church, VA 22041. Attn: Box 91-02-01. EOE

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Please send resume in confidence to Illinois Department of Employment Security, State and Gardner St., Franklin Square, Box 889, Quincy, IL 62301. Attn: Joanne Brock, Reference #V-IL2060-B.

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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 $10 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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TRANSMITTERS . . . WTS

Gates FM M-6095 exciter & M-6146 xmtr, 10 W, exciter gd cond, w/manual, 91.5 MHz, stereo gen needs some work, $250/BO. D Ransom, Box 6073, Riverton WY 82501. 307-857-5866.

RF-300A 300 W MosFET pwr amp, module 48 V, new for 60-165 MHz; EST-300 300 W xmtr, solid state, harmonic filter & pwr adjust. C Springer, KLMR, POB 890, Lamar CO 81052. 719-336-2206.

Harris FM-35K, only 2-yrs. old, like new; **Continental 802A,** exciter, excel; **McMartin B910 exciter,** low price; **USED LINE-** like new, 1 5/8", 3" & 3.5", plus 3" rigid. Priced to sell.
(816) 635-5959.

Collins 831G-1 20 kW in mint cond, completely record, all new cap's, no PCB's, new control cards, 97.1 MHz, spare parts & manuals, avail 1/91. R Kazda, Parker Comm, 2826 IDS Ctr, Minn MN 55402. 612-349-6500.

CCA FM-10DS 107.1 exciter, vgc w/manual, $400. D Sports, WCLA, POB 427, Claxton GA 30417. 912-739-3035.

New modulation xformer for BTA 5F xmtr in original crate, $600 plus shpg. G Heidenfeldt, 2880 W Lake, Wilson NY 14172. 716-751-6187.

McMartin BA1K 1 KW AM. Goodrich Ent. Inc. 11435 Manderson St, Omaha NE 68164. 402-493-1886.

Harris AM MW-1A 1977 in excel cond on 1500 kHz, used at 250 W, now on-air, call for availability. $9500. R Coleman, WGEN, 1003 S Oakwood, Geneseo IL 61254. 309-944-4633.

Plate transformer for Gates FM-10G xmtr. S Cichorsky, KPRL/KDDB, POB 7, Paso Robles CA 93447. 805-238-1230.

Continental 814R-1, 2.5 kW FM, 510R-1 exciter, 103.3 MHz, excel cond, $12,000. L Bush, KWOW, 400 Bowden, Waco TX 76710. 817-776-2640.

AEL FM 5K, working when removed. S Chichorsky, KPRL/KDDB, POB 7, Paso Robles CA 93447. 805-238-1230.

Jetronic TDD-5, carrier current or low pwr xmtr set to your freq, US Gov't surplus, rugged, 20-50 W AM. J Cunningham, KEOR, Rt 2 Box 113B, Stonewall OK 74871. 405-265-4496.

Johnson Thunderbolt 1 kW linear exciter, uses 4-400 tubes, w/case, gd cosmetics, all original, Johnson knobs, BO; Gonset Communicator III, 6 meter transceiver, 110 AC, 6/12 VDC, original manual, gd cosmetics, works, $75; Knight KN3560 tube CB 12V/110V, blue/silver, near mint, works, $75. W Kremer, Kremer Kraft, 301 SW 16th, Ft Lauderdale FL 33315. 305-524-5652.

Motorola 1300 AM stereo exciter excel cond. G Clapper, KKGR, POB 9032, Gresham OR 97030. 503-667-1230.

CCA VSWR watchdog, $150 plus $10 shipping. M Gollub, WMJS, Box 547, Prince Frederick MD 20678. 301-535-2201

Gates BC-5B 5 kW AM tuned to 580 kHz, gd cond w/spares, $2500/BO. D Barton, KMTI, POB K, Manti UT 84642. 801-8357301.

McMartin BK-50 50 kW, uses 4 tubes will come w/all electrical boxes, conduit, AC wiring & oversize external exhaust system, avail early 1991 & modified for AM stereo, BO. J Bisset, Multiphase Consulting, 703-379-1665.

Bext TEX20-NV 20 W in excel cond, $2000. T Edmisson, WDKN, 106 E College, Dickson TN 37055. 615-446-0752.

CSI/CCA FM-3000E 3 phase plate transformer only, 4600 volt secondary for up to 3.5 kW xmtr, gd cond, $375. K Fitzgerald, WKGB, POB 792, Great Bend PA 18821. 717-879-9925.

Gates FM1C 100 W, 96.7 MHz, gd cond, $300/BO or will trade for equip. C Hubbeling, KTEQ, 501 E St Joseph, Rapid City SD 57701. 605-394-2231.

Bird 8897 5 kW load 50 ohm, mint cond, $800. B Clark, Bullitt Bdctg, Rt 1 Bardstown Rd, Mt Washington KY 40047. 502-5384784.

Collins 316Z-2 FM exciter, 94.3 MHz, excel cond, $2000. M Persons, KKIN, POB 930, Aitkin MN 56431. 218-829-1326.

Thompson CSF 334583 chnl 2 TV xmtr w/synthesized offset, 10 W, excel working cond. R Paskvan, KBSB, 3516 Mill, Bemidji MN 56601. 218-751-3077.

RCA BTE 15A FM exciters (2). R Lankton, WDUV/WBRD, 813-749-1420.

Dummy load 20 kW air cooled electro w/wattmeter & 31/8" section. Goodrich Ent, 11435 Manderson, Omaha NE 68164. 402493-1886.

Collins 21-E in gd cond on skids, needs finals w/1000 W cutback on 1380 kHz, $4500; Gates BCI-F 1 kW w/500 W cutback on 1260 kHz, many spares, all gd iron & finals, $1000. T Edmisson, WDKN, 106 E College, Dickson TN 37055. 615-446-0752.

McMartin B-910 FM exciter's. C Goodrich, 11435 Manderson, Omaha NE 68164. 402-493-1886.

Two refurbished RCA TTG30H high band transmitters. Contact Don Newman, GE Support Services, 609-866-3144.

Bext has some show units at sale price. Full 2 yr warranty, like new. Exciters, amplifiers, STL's. First come first served only. Call for details. Bext, 619-239-8462.

Want to Buy

TRANSMITTERS . . . WTS

Crystal for 96.3 MHz for Gates M6095 exciter S Olszowka, WKQW. 234 Elm, Oil City PA 16301. 814-676-8254.

Low band 2-6 VHF TV xmtr, 100 W to 11 kW, exper eng can handle removal. J Powley, 1536 Logan, Altoona PA 16602. 814-944-8571.

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Harris MS15 FM exciter or equiv, 91.1 w/composite input, with or w/o stereo or SCA cards, to $1000. A Hagler, KMUD, POB 135, Redway CA 95560, fax: 707-923-2655.

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Amperex 6076 xmtr pwr tube, Gates FM5B, will need (2) soon, L Perkins, KWVR, 107 SW 1st, Enterprise OR 97828, 503-4264577.

Technics SP-10 MK II, new in original box, $800. B Weiss, KLSI, 3101 Bdwy, Ste 460, Kansas City MO 64111. 816-753-0933.

Russco Studio Pro Model B, 2-speed transcription TT, console mountable, new tonearm & counter weights, missing stylus & tonearm plate, $500/BO. A Wasilewski, KMWX, POB 1460, Yakima WA 98902.

RCA later mdls, (2) w/stands, preamps & tonearms, $150/both plus shpg. B Elliott, WRFX, 915 E Fourth, Charlotte, NC 20204. 704-338-9970.

Technics SL-1200MK2 (2) w/Encore Series P100 stereo preamp & extra needles, carts, $300/ea set. J Glogowski, KYND, POB 19886, Houston TX 77224. 713-373-1520.

Studer A727 prof CD player, rackmount (2), recently factory refurbished, $1200 ea. B Robinson, KLXK, 2110 Cliff Rd, Eagan MN 55122. 612-452-6200.

Rek-O-Kut G2 17", excel cond, $75; (2) Russco Studio Pro B, new idlers, excel cond, $150/ea. W Kremer, Kremer Kraft, 301 SW 16th, Ft Lauderdale FL 33315. 305-524-5652.

RCA Rumble Buddy puck drive 3 speed (3). R Lankton, WDUV/WBRD, 813-749-1420.

Bogen/Lenco B50-16; Columbia 204 record changer in portable in case. K Hart, WIEZ, RD 3 Box 1414, Mifflintown PA 17059. 717-436-9089.

Technics SP-15 w/base, arm, cart & stereo preamp (2), very little use, 5 yrs old, $700 ea. D Doelitzsch, WDDD, Marion IL. 618-997-8123

Gemini DJQ-1500 TT, similar to Technics SL1200 MKII, w/cartridge, stylus care kit. K Hart, WIEZ, RD 3 Box 1414, Mifflintown PA 17059. 717-436-9089.

VIDEO PROD EQUIP

Want to Sell

Sony VO8800 3/4" w/time code gen w/Porta-Brace case, $4500; Sony PVM 5300 3 screen monitor, $800. V Michael, WHTO, 575 Montgomery Pk, S Williamsport PA 17701. 717-326-8200.

Liquidation sale including Microwave STL-TSL. Sony V0-5600 & V0-4800, Fortel TBC CCDHP, Panasonic AG-6300's AG6100's, NV-A500 edit controllers, NV-8500 editor, Panasonic WVD5000 cameras, JVC GXS-700 cameras, tripods & dollies, knox Chromafont 200 titler, B&W & color monitors, used 3/4" tapes, ch 35 transmit antenna, Panasonic WJ-5500B SEG & more, for complete list or prices call J Andrist, KOTV, Box 273, Omak WA 98841. 509826-0100.

JVC RM82U prof video editing controller for JVC 3/4" editors, excel cond, $325. G Ormrod, GFO Prod, 432 East X St, Tumwater WA 98501. 206-352-8028.

Entire system including 1/2" & 3/4" VCR's, SEG, dist amps, sat rcvr, audio, cables, cameras, TBC, titler, audio mixers, 2-way radios, monitors, connectors, microwave STL/TSL & remote, more, for complete list call J Andrist, TV-31, Box 273, Omak WA 98841. 509-826-0100.

Iden 1VT-7 digital TBC, $1900; Sony editing system, complete w/BVE 500 & (2) BVU 200 editing machines, $1500. V Michael, WHTO, 575 Montgomery Pk, S Williamsport PA 17701. 717-326-8200.

CMX Edge editor, A/B roll BetaCam or BVU 800 interface, mech excel, cosmetic gd, $4000 pkg. TJ Worrell, Multimedia, 7620 W 78th, Minneapolis MN 55439. 612-942-9681.

Ultra Vision 2000 3 gun video projection machine by Image Amplification, needs HV transformer, gd tubes, $200; Sony SL2000 Beta R/P deck w/tuner/color camera. P Russell, Bowdoin College, Sills Hall, Brunswick ME 04011. 207-725-3066.

Sony Hi-band GCS-50 edit pak, twin decks, edit cntr, GCS-I camcorder, cables, like new, $1700. G Jackson, TV 13, 142 Main, Nashua NH 03060. 603-883-7435.

Perrott PE 300 dual, $250; PE 100, $385, dual silver zinc minichargers. R Sumner, CAVU Corp, 3322 Applegate Ct, Annandale VA 22003. 703-560-0233

VIDEO TAPE RECORDERS

Want to Sell

JVC CR4400U 3/4 port recorders (4) w/access, $800 ea/BO; (3) Sony RM-430 edit controllers, $500/BO. JVC BR-6400U VHS recorder, $1500/BO. T Quinn, Monte Vista Std, 208 Cherry, Capitola CA 95010. 408-475-0423.

JVC 3/4 w/editor control, several repairable units or for parts, $50 ea/FOB. K Kuespert, A-V Prod, 1794 Russell, Baroda MI 49101. 616-422-2235.

JVC CR-4400 3/4" portable in gd cond w/Porta-Brace case, AC adapter/charger, $500. R Jensen, Telecable Prod, 5812 21st St, Racine WI 53406. 414-632-3131.

Sony VP-1000, $100; VP-1200, $120; VP-2000, $200; VO-2630, $350; VO-2850, $300, VO-3800, $300; RM400, $200; BVE 500, $350; BVE 500A, $400; AV 3600, $200; AV 3650, $250; Panasonic NV-9100, $200. J Krepol, 6147 Walker, Philadelphia PA 19135. 215-624-1050.

Sony V0-5850 editing systems w/ECS-90 controllers, time code, gd cond, $5000 ea; Ampex VPR-2B 1" VTR's w/slo-mo & dynamic tracing TBC's, $16,000 ea or (3) for $40K. Ugly George Satellite TV, 314 W 52 St, NYNY 10019. 212-677-2200.

Sony BVU-110 3/4" bdct portables, time code, soft case, gd cond, $795; Sony BVU-50 3/4" record only bdct portables, soft case, T.C. avail, $195. Ugly George Satellite TV, 314 W 52 St, NYNY 10019. 212-677-2200.

Ampex VPR 2B w/TBC 2B, console, color monitor, presently in service, one w/stereo audio kit, $17K, one standard audio, $15K. R Beierle, KFYR, POB 1738, Bismarck ND 58502. 701-2555757.

Sony BVU 110, no batteries/AC supply, mech excel, cosmetic gd, $2000. TJ Worrell, Multimedia, 7620 W 78th, Minneapolis MN 55439. 612-942-9681.

TURNTABLES

Want to Sell

QRK 12C (2) in excel cond w/new felts, Micro-Trak tonearms & Stanton cartridges, $100/ea. G Hutchins, WZAP, POB 369, Bristol VA 24203 703-669-6950.

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ADVERTISER INDEX

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Page No.	Advertiser	Reader Service No.
10	A/V Technology Int'l Inc.	78
24-25	Arrakis Systems	143
7	ATI	50
3	Audio Broadcast Group	44
8	Audio Precision	149
14	Broadcast Electronics	140
27	Broadcast Services	54
9	BSW	14
4	Burk Technology	27
19	CCA Electronics	100
29	Computer Concepts Corp.	67
13	Conex	46
16	Continental Electronics Corp.	134
10	Cortana	35
28	Dataworld	119
11	EEV	117
30	Ellason Weather Radar	94
26	Eventide	113
1	Fidelipac	80
20	FM Technology	86
6	Harris-Allied Bdct Equipment	6,19
10	Harris-Allied Bdct Equipment	-
18	Harris-Allied Bdct Equipment	-
20	Harris-Allied Bdct Equipment	-
22	Harris-Allied Radio RF Products	102
28	Harris-Allied Bdct Equipment	-
32	Harris-Allied Bdct Equipment	17,81
34	Harris-Allied Bdct Group	22,79
18	Inovonics	97
21	ITC	141
7	Jampro	62
17	NAB	-
12	Orban	90
35	Pacific Recorders	48
31	QEI	137
38	Radio Systems	136
15	Russco Electronics	73
37	Shure	111
23	Studer Revox	93
33	Tannoy	72
17	Tascam	120
19	Tascam	52
3	Telos	33
36	TFT	132
2	Wheatstone	109
47	Wheatstone	89
48	Wheatstone	13

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