

Marketplace Ruling Sought

by David Hughes

Washington DC ... A petition for rule-making was scheduled to be filed in mid-July that would ask the FCC to abandon its "marketplace" approach and adopt a single AM stereo standard. The action was prompted by news that several receiver manufacturers, reporting low consumer demand and poor sales, have dis-

NABET OKs Offer

by Alex Zavistovich

Burbank CA ... After 16 months of negotiations, all but two contracts between Capital Cities/ABC and the National Association of Broadcast Employees and Technicians (NABET) have been settled.

The new package supercedes the previous national network agreement, which expired 31 March 1985.

Votes on the company's latest contract offer were tallied 9 July. Following the count, NABET announced that all proposals were ratified except the "C" contract—the AM radio writer-producer agreement in San Francisco, and the "T" contract—the radio program coordinator's agreement in Los Angeles.

The ratified package, which will affect more than 3,200 network employees, includes a four-year wage increase. Current employees will receive increases of 5.44% in the first year, 5.16% in the second, 4.97% in the third, and 4.67% in the fourth, according to NABET Network Coordinator Tom Kennedy.

The union had originally moved to reject the network offer, but adopted a position of neutrality 12 June, after off-the-record discussions with the company.

Cap Cities/ABC's bargaining spokesman Dick Freund stated in early June that the latest proposal was the company's "final offer." At the time, Freund had advised that, if the package was not approved by 31 July, the network would reserve the right to withdraw or modify its proposal.

NABET plans to meet with San Francisco and Los Angeles representatives to ascertain their reasons for not accepting the contract offers, Kennedy said.

Cap Cities/ABC currently owns radio stations in a number of major markets. However, according to FCC rules, some of the stations will have to be sold in markets where ABC or Cap Cities had already owned television properties.

continued manufacture of AM stereo radios.

The AM standard request, which, at press time, was scheduled to be filed by 18 July by Texar Inc., an audio processing equipment manufacturer, claimed that recent developments by some AM receiver manufacturers, including Sony and Pioneer, to discontinue stereo models has created a sense of urgency to reach a single standard.

The FCC's marketplace approach was intended to develop a single standard, and, to date, three of the original five proponents have dropped out. Texar President Glen Clark argues, however, that both Kahn Communications Inc. and Motorola seem to have the funds, and the desire, to continue their AM stereo system fight well into the future.

In response to industry complaints that the public acceptance of AM stereo was being hurt by the lack of a single standard, FCC Mass Media Bureau Chief James McKinney has previously suggested that one firm buy out the other to solve the problem of two remaining AM stereo systems. However, neither AM stereo firm seemed receptive to that idea.

The failure of the industry to reach a standard, with only about 10% of the nation's AM stations now broadcasting in stereo, could cause even more receiver

manufacturers to abandon their plans for AM stereo, Clark said.

The current situation, in which AM stereo has penetrated stations in some markets and not others, has not resulted in uniform, strong sales on a nationwide basis, Clark said. "It's not enough for some stations to do well with AM stereo. The truth is that everybody's got to do it. It's got to be a national effort."

After taking out an advertisement in the 15 July issue of Radio World (and more recently at least one other trade publication) seeking industry backing for his campaign, Clark said he has received calls of support from "several major broadcasters and two major manufacturers."

Clark said that his petition does not

suggest which AM stereo system the FCC should choose—the Kahn/Hazeltine ISB system or Motorola's C-QUAM. Kahn has recently reported more than 80 stations using ISB, while Motorola numbers more than 280 using C-QUAM.

"The petition is a non-partisan approach," Clark said. "There are knowledgeable people who are proponents of both systems."

Officials from Kahn Communications would not comment on the petition. However, a Motorola official said he was "very pleased to see this action and would welcome any other actions toward establishing a single AM stereo standard."

"Most GMs are afraid of picking an
(continued on page 4)

FCC Acquits C-QUAM

Washington DC ... The FCC has dismissed a complaint filed by Kahn Communications alleging that Motorola's C-QUAM™ AM stereo system violates FCC type acceptance rules concerning adjacent channel interference.

"No interference or bandwidth problems" were discovered in field tests the FCC conducted, according to Bruce Franca, of the Commission's Office of

Engineering and Technology (OET).

The FCC informed Kahn and Motorola of its finding in a letter dated 18 July, Franca said.

Thomas Stanley, chief of the OET, which supervised the tests, would not reveal any details about the tests, including whether equipment manufactured by C-QUAM licensees was included.

The tests also indicated that there were no problems with the FCC's type acceptance program, which certifies that AM stereo generators and exciters operate within specific emissions limits, he said. Therefore, any problems discovered in the field would have been the responsibility of
(continued on page 10)

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Regulatory News

Some Xmtr Mods Deregulated

by David Hughes

Washington DC . . . The FCC has proposed allowing broadcasters to make some electrical or mechanical modifications to their transmitters without filing an application for a construction permit.

The plan, unveiled 19 June, would allow a station to make relatively minor transmitter improvements without prior FCC approval, providing that the equipment operates properly and does not create "harmful interference."

"The purchaser of the equipment, not the manufacturer, has the continuing responsibility to keep equipment operating properly," the Commission said in its Notice of Proposed Rule Making, which seeks comments on FCC Rule Section 73.1690.

While the rule change would apply to AM mono and all FM and TV operations, AM stereo transmission modifications are excepted.

The Commission stressed that it will not extend the rule relaxation "to permit modifications of AM transmitters to interconnect an AM stereophonic generator to a type-accepted or notified AM transmitter."

"At this time, only 10% of the domestic AM stations have chosen to broadcast in stereo, providing us with insufficient experience to deregulate this modification," the FCC maintained.

John Reed, of the FCC Technical Standards Branch, added that the Commission is concerned about the "frequency stability" of transmitters connected to AM stereo exciter/generators.

"The (new) rules do not allow broadcasters to use non-type-accepted AM

stereo equipment," he said.

Reed said that the deletion of AM stereo equipment was not because of any particular piece of equipment.

However, in March, Reed told one AM stereo generator/exciter manufacturer that "it is the responsibility of the broadcaster to ensure that, regardless of what processing is performed in the signal, the resulting emission complies with the occupied bandwidth standards of Section 73.44."

In any case, whether the new plan is approved or not, AM stereo transmission equipment will still be covered by the FCC's type-acceptance procedures, according to FCC Engineer Michael Lewis.

According to the new plan, broadcasters wanting to make "minor electrical and mechanical changes" to AM mono or FM transmitters will be required to perform tests to show compliance in accordance with the rules under the type-acceptance procedure, the FCC said.

Those results would then be retained for the life of the transmitter, it added.

The Commission said it wants to clear up inconsistencies in its transmitter modification review procedure.

For example, current rules allow an FM or TV broadcaster to connect a stereo generator to a transmitter without prior approval, the FCC said. However, if that connection requires minor electrical and mechanical changes to the main transmitter, the licensee may have to file Form 301 and wait for Commission approval.

The new rule, if approved, would eliminate the need to receive prior FCC approval for these minor changes. However, other modifications "which could

possibly cause the broadcast equipment to operate out of tolerance with the Commission's standards" would still require licensees to file Form 301 and obtain prior FCC approval.

The Commission said its plan would "reduce the regulatory burdens placed on broadcasters while not increasing the potential for harmful interference." The rules defining which changes are permitted without FCC approval "may be unnecessarily narrow."

"We believe that broadcasters can be equipped in a way that will meet this responsibility," the FCC added.

FCC docket number is MM 86-264. Comments are due 4 August, with replies due 19 August. For further information, contact Michael Lewis at 202-632-9660.

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FCC Clips

Expired STA License Crackdown

The Commission's Private Radio Bureau said it will no longer "routinely" issue special temporary authorizations (STAs) to cover expired licenses in the private land mobile and general mobile radio services.

STAs provide authorization to operate radio facilities temporarily during emergencies and other extraordinary short-term circumstances, according to the FCC.

However, the Commission said it receives many STA requests from licensees who have let their licenses expire and want operating authority without waiting for normal processing of a new or a reinstatement application.

In order to simplify the licensing procedure, the FCC introduced in 1984 a short-form renewal application (Form 574-R) for the private land mobile and general mobile radio services, it said. Therefore, as of 1 August, the Commission will "no longer routinely issue STAs to cover expired authorizations."

After 1 August, applications for STAs for an expired license "must be accompanied by a detailed explanation of the unique and/or emergency situation involved," the FCC added.

For more information, contact the FCC's news media information office at 202-254-7674.

Station Totals

There are 10,002 licensed radio stations in the US, according to the most recent broadcast station totals released by the FCC on 31 May.

The figures indicate that there are 5,164 FM stations (1,247 of which are noncommercial operations, with 3,917 commercial) and 4,838 AM stations.

FCC and the Economy

The Commission's Office of Congressional and Public Affairs and the Office of Plans and Policy have released a joint study titled, "The FCC and the American Economy."

The study, according to the FCC, examines the "increasingly important role which the FCC plays in the national economy," including its management functions, the value of radio services, methods used to control noncommunications spectrum use, and monitoring and enforcement functions.

It also details the Commission's role in overall regulatory policies, including the telecommunications equipment markets.

The document is available for purchase from International Transcription Service, FCC, 1919 M Street NW, Washington DC 20554. Call 202-857-3800.

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Regulatory News

Pre-/Deemphasis Decision Near

by David Hughes

Washington DC . . . The National Radio Systems Committee (NRSC) has almost finished developing a voluntary AM pre-emphasis-deemphasis standard, which could receive final approval by January 1987.

The NRSC, which is comprised of broadcasters, represented by the NAB, and receiver manufacturers, represented by the Electronic Industries Association (EIA), has been examining the development of a 75 μ sec preemphasis/deemphasis standard to improve the overall fidelity of AM broadcasts.

The committee's Methods and Procedures Subgroup, meeting in Washington, DC on 10 July, agreed to a "modified" 75 μ sec preemphasis curve for transmitters, according to NAB Engineer Mike Rau. One modification involves a 9,500 Hz shelf level. Discussions also involved including a ± 10 kHz limit on the radiated power spectrum.

The subgroup, in a 3 June report, indicated that such a limit would "significantly increase the listenability of AM stations now subject to overlap of equal power sidebands in the first adjacent channel."

At its 10 July meeting, the subgroup also tentatively agreed to a 75 μ sec deemphasis curve standard for receivers. The group has been discussing the possibility of including a standard requirement for a notch filter at ± 10 Hz to reduce carrier whistles from adjacent channels.

Rau added that the subgroup still has more work to do before it formally pre-

sents the pre- and deemphasis proposals to the full NRSC at its 10 September meeting, to be held at the NAB-sponsored Radio '86 show in New Orleans.

"We (the subgroup) must still address bandwidth questions and the overmodulation tie-in before we present the proposals to the full NRSC," Rau said. The next Methods and Procedures Subgroup meeting is slated for 14 August.

If the full NRSC approves the standards, a 90-day comment period would be established. "That paves the way for adoption of the formal standard, which could come in January," Rau added.

Stations with state-of-the-art audio processing could upgrade to the voluntary preemphasis standard for only about \$500, Rau said. However, stations with older processors may find it advantageous to purchase new equipment before they can comply with the standard, he added.

Receiver manufacturers could get units meeting the deemphasis standard on store shelves in about a year, Rau added. Chrysler and Delco (GM) have provided prototype receivers for NRSC tests.

In its June report, the Methods and Procedures Subgroup also recommended that dual bandwidth radios be provided, thereby allowing the listener to have the advantage of added fidelity in the wideband mode and protection from adjacent channel interference in the narrowband mode.

Rau added the subgroup would eventually develop a second set of standards to take effect three or four years after the first set of standards, when there would

be greater use of wideband radios.

"But we haven't begun to focus on that yet. In the meantime, we have gotten the ball rolling on preemphasis," Rau said.

Several other AM improvement projects are underway or almost completed.

The NAB's tests on accentuated groundwave AM antenna are still being set up, Rau said. An antenna developed by Washington, DC-area consultant Richard Biby will be tested at a site in Aldie, VA, about 40 miles west of Washington, DC. It includes a circular electric screen around the main antenna and several smaller antennas.

Another antenna, developed by Ogden Prestholdt, with the Washington, DC firm A. D. Ring & Associates, will be field tested near Beltsville, MD, about 10 miles northeast of Washington, DC. The design includes placing a horizontal phasing element near the top of the antenna.

Additional tests on overmodulation/splatter interference and contour

overlap have almost been completed, Rau added. Results will be presented at the Radio '86 show.

Work has just started on a NAB/EIA test to examine whether the highest percentage of listening is done in urban areas to relatively strong signals or in rural areas to relatively weak signals. The results will be used by receiver manufacturers to determine whether to produce more wideband receivers, which are more prone to adjacent channel interference.

In other AM improvement related news, the FCC extended the deadline for comments to its AM improvement report, which was released in April. The original 1 July deadline was extended to 1 August. Several groups requested the extension because of the diverse nature of the report and its length.

For more information about the NRSC and the NAB's AM improvement activities, contact Mike Rau at NAB: 202-429-5346.

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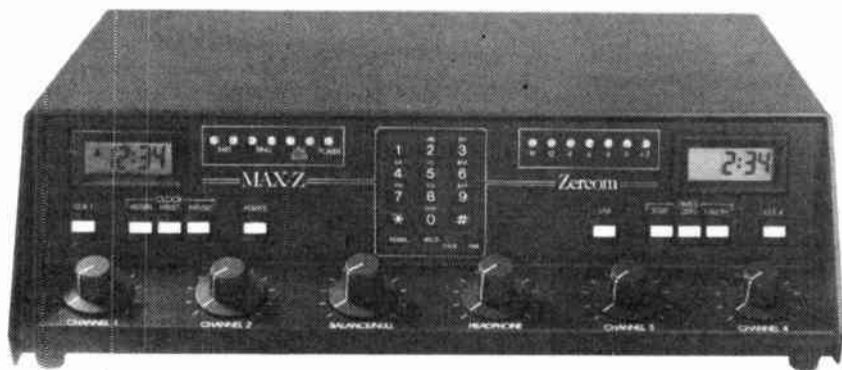
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Marketplace Decision Sought

(continued from page 1)

AM stereo system, which can cost \$10,000, and then finding out that they picked the wrong one," Clark said. "Until the issue is resolved, few new stations will go AM stereo."

However, the FCC's McKinney called that argument a "cop out," adding that "I do not understand."

Broadcasters, just like other citizens, have to make difficult economic decisions, he said. If ordinary people can make the decision to spend \$10,000 for a car, then a radio station can make a decision on an AM stereo system, McKinney maintained.

If enough broadcasters would decide on an AM stereo system—more than the 10% that have already done so—then the FCC's marketplace strategy would be more effective, he said.

"The marketplace has worked. It forced three AM stereo manufacturers (Haris, Belar and Magnavox) to give up," McKinney said.

He added that while it would be "very difficult" for the FCC to "reenter the fray at a time when there are two systems remaining," it would give "full consideration" to Clark's petition.

Eb Tingley, VP/Engineering of the Electronic Industries Association (EIA), which represents receiver manufacturers, would not comment specifically on Clark's proposal, but admitted that there was only a "slim chance" the FCC would reverse its marketplace decision and pick an AM stereo standard, largely because of antitrust implications.

As broadcasters continue to debate the merits of competing AM stereo systems, or sit on the sidelines and wait for a de facto standard to emerge, receiver manufacturers are discovering an overall low level of consumer interest and demand

for AM stereo receivers.

"I've spent time on the phone with receiver manufacturers and I can tell you they are very frustrated," Clark said. "Mass desertion is possible. AM stereo could go the way of FM quad or the videodisc."

Sony, for example, has discontinued two of its three home-type AM stereo receivers.

"Yes, we have seen a slow-down in consumer demand (for AM stereo)," said Sony Audio Division President John Briesch. "The demand from the public has not been tremendous. There has been a minimal response."

Even with AM stereo, FM stereo is still perceived by the consumer to be much better, he acknowledges. "Most consumers haven't seen the need for AM stereo receivers."

"A lot of (AM) stations that have gone stereo have launched consumer awareness campaigns, but the consumers have not followed through with the purchasing," he said.

The two Sony home model receivers discontinued include the SRF A-100 and the AM Stereo Walkman. The firm still produces its CFS-6000, a radio/cassette "boom box," in addition to two car dashboard AM stereo receivers.

All Sony receivers are multimode. Only Sony and Sansui had made receivers capable of receiving both the Kahn/Hazeltine and C-QUAM systems. All other receiver manufacturers make C-QUAM-only units.

Briesch said that while Sony is no longer "actively pursuing" AM stereo, it will continue producing some AM stereo products. He noted that there is still some demand, although not as big as Sony would like, in rural areas where AM stations still dominate.

Even though Sony's products receive both the ISB and C-QUAM systems, Briesch said that the existence of only one standard would be "easier for consumers to accept."

Pioneer has also discontinued its only AM stereo receiver, the KE-433-AM in-dash car radio.

However, Pioneer North America VP/Development Bart Locanthi said the failure to set a single AM stereo standard was not the main cause for the poor consumer response to the unit.

He placed most of the blame on "poor consumer awareness" caused by a variety of factors, including car dealers who know nothing about AM stereo, in-store receiver displays that do not feature external antennas to permit clear AM stereo reception, and the consumer press which, he said, has not explained the issue.

"Delco is placing a lot of AM stereo receivers in new (General Motors) cars, but the dealers don't know anything about AM stereo," Locanthi said.

Because of the poor demand for the KE-433-AM, which sold for \$299 and was not a top-of-the-line unit, Locanthi said Pioneer is "losing interest" in AM stereo, at least in North America.

However, Clark added that Pioneer still produces and sells an AM receiver in Australia, which picked the C-QUAM system as a national standard.

Don Duncan, planning and marketing manager for Ford's car audio division, said he has seen "absolutely no demand" from consumers for AM stereo receivers. "I've had no indication from dealers that people are asking for AM stereo receivers."

Ford has two C-QUAM AM stereo models, both of which are offered as upgrade equipment.

Since not all AM stereo broadcasts can

be received by Ford's receivers, and since not all customers live in areas with AM stereo transmissions (at least during the daytime hours), he said Ford decided not to offer the receivers as standard equipment.

Duncan reported some demand for AM stereo receivers in mountainous areas, that have poor FM reception, "but it has been a very small demand."

He added that Ford's AM stereo customer demand figures for 1986 are difficult to tabulate because one AM stereo receiver also offers cassette capability, and it is not possible to tell whether customers buy the unit for the tape features or the AM stereo.

Likewise, Delco Sales and Promotion Manager Mike Williams said his firm has seen "no major groundswell" for AM stereo receivers. "Our research shows that there is neutral consumer opinion."

While AM stereo radios are rarely requested by the consumer, "they are a welcome addition" if they are included with a vehicle, he said.

Delco, which supplies audio equipment to the General Motors divisions, offers several variations of a top-of-the-line, 5-band graphic equalizer C-QUAM AM stereo unit.

"AM stereo is not a crucial enough reason to determine between a (receiver) sale or no sale," Williams added.

"I bet if you stopped 100 people on the street in New York City, only one or two would know what AM stereo was," said Almon Clegg, GM of Matsushita's technical center. The firm manufactures receivers under the Technics and Panasonic labels.

However, there are no Technics or Panasonic AM stereo receivers. "We've never introduced AM stereo in the US because the market awareness is not there," Clegg said.

Matsushita has manufactured AM stereo units on an OEM basis for other firms, but never under its own brands, he said.

Clegg admitted that GM's Delco has been "a significant factor" in familiarizing car buyers with AM stereo, but a general shift in AM program content away from music has worked against any gains in AM stereo.

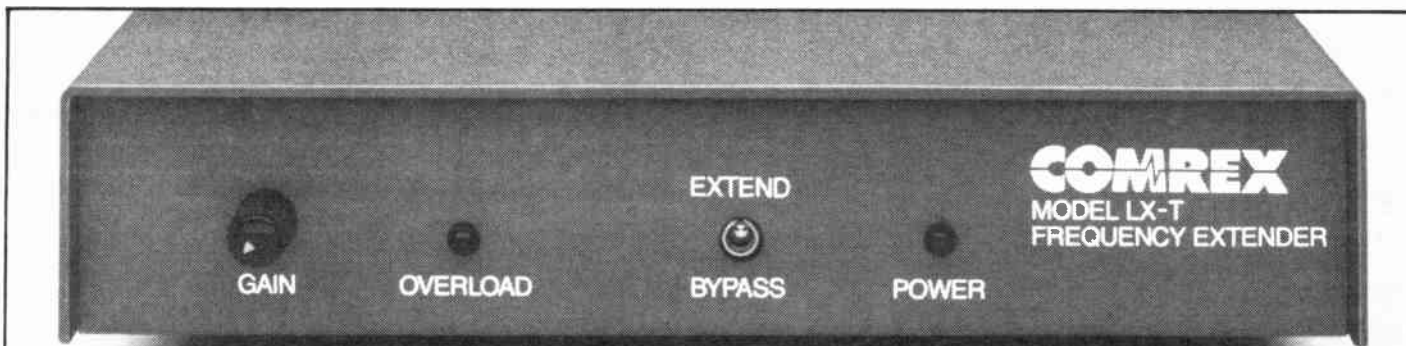
Before AM stereo can succeed, broadcasters and receiver manufacturers must work on overall AM improvements, he said. Clegg pointed to the National Radio Systems Committee (NRSC), of which he is a member, and its development of a pre-/deemphasis standard as an example.

Agreeing that, unless more AM stereo stations go on the air that there is a possibility that some manufacturers will stop making receivers, EIA's Tingley said, "everyone hates uncertainty."

Tingley pointed out that one reason the TV stereo field is growing rapidly is because of the existence of only one broadcaster-used system. Broadcasters and receiver manufacturers can promote the fact that they offer stereo because anyone with a TV stereo set can receive over-the-air stereo broadcasts, he said.

He also maintained that receiver manufacturers are more receptive to technological improvement standards if they are developed within a "finite length of time."

For more information on Texar's rule-making request, contact Glen Clark at 412-856-4276.



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When the horse is dead . . .

Dear RW:

I am sitting here after reading the latest edition of "Radio Wars." It amazes me to watch the Kahn crusaders continue to breath life into a system that the numbers clearly indicate won't make it. I picture these diehards driving home in their Edsels, feeding their pet rocks, and burning up the phone lines in an undying effort to find their favorite movies on Beta.

While there is no doubt the Kahn system is a good one, what makes the difference is the numbers. The Edsel was a great auto, but the market wouldn't support it. AM radio, unlike the auto industry, must have a standard, and that standard is clearly C-QUAM.

WKLW went on the air in March of 1985 with the C-QUAM system, and I can say that it has done everything I expected it to do and more. Before you can see the full potential of any system, you have to have your audio chain in order.

What looks good on a scope may or may not sound right when you consider that what's feeding your processors is much different than perfect tones. I've heard some C-QUAM stations that—if they were mine—I would fix the processing or turn it off. On the other hand, I've heard some C-QUAM stations, mine included, that I would stack up against any FM.

My Dad always said the truth is in the numbers. He also said, when the horse is dead, get off. The numbers clearly indicate that C-QUAM is going to be the

standard. They also indicate that the Kahn system is in a coma, and the only decent thing to do is to pull the life support and let it die a respectful death.

Alan Burton, Pres/GM
WKLW Radio
Paintsville, KY

FCC Fees

Dear RW:

Regarding fees connected with FCC authorizations (RW, 1 May): anytime that monies are paid for any authorization, whether it be called a filing fee or by any other name, the payor is purchasing a right in that authorization.

This is specially prohibited by Section 304 of the Communications Act of 1934, as amended. This is the reason why a Certification of Waiver appears before an applicant's signature in any FCC application form, and rightly so.

Watch it, broadcasters! So-called deregulation may end up costing you much more than you bargained for.

Chester J. Stuart
Consulting Comm. Eng.
Susanville, CA

Potential for disaster?

Dear RW:

In regard to the article, "Avoid FM Downtime" (RW, 1 May) by Ken Blake, I would like to congratulate him on some innovative circuitry design. However, I
(continued on page 8)

Texar, Inc.'s appeal to the FCC to select a standard and end the ongoing AM stereo battle is a positive move. The intent, to force a quick settlement of the AM stereo situation, provides the industry with a possible exit from a serious, crippling conflict.

Texar's plea highlights the obvious—that the FCC's "marketplace" approach, after successfully eliminating three of the five original AM stereo system contenders, has degenerated into a battle that no longer represents a measure of the effectiveness of that marketplace.

As Texar points out, little consumer demand for AM stereo has developed to support AM stereo receiver manufacturers' efforts. This is reaching a point such that several major receiver companies—Sony and Pioneer—are pulling back from the market.

AM stereo is running out of time. The bottom line does not rest on which system is "better." While broadcasters argue, the market for AM stereo could disappear.

AM Stereo Support Eroding

The evolution of multichannel television sound (MTS) proved that the industry's two lobbying organizations—NAB and EIA (Electronics Industry Association)—are capable of getting together to work out a common standard, despite efforts by some MTS system proponents to

confuse and complicate the decision process with the threat of lawsuits.

The FCC, given its current deregulatory posture, was able to recognize this industry consensus and, by protecting the pilot frequency of the Zenith TV stereo system, essentially validated the industry's choice. Something along these lines should be workable for AM stereo as well.

NAB and EIA, in order to serve the industries they represent, should forget about threatened legal suits and forge ahead, by supporting the Texar plea, and select a "winner" from the two remaining proponents. If the need is indicated, AM stereo stations can be found to participate in system evaluation, or stereo generators can be bought, if necessary, to perform laboratory testing of the two systems.

Each organization can and should handle the legal fallout, if any arises. That is their responsibility.

Fair or not, the current "marketplace" situation is no longer serving the interests of the industry in its attempts to make a sound business decision or even to pick the "best" system. It is time for an aggressive change in policy.

If the battle over AM stereo continues, enthusiasm from broadcasters, receiver manufacturers and consumers will continue to be eroded. And AM stereo may die.

—RW

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Engineer's Role Re-examined

by Jim Sorensen

Fort Lauderdale FL . . . John Shepler's column in the 1 June issue—his assessment of the situation in the engineering community—hit home.

Like John, I have also been in the engineering business for the past 20 years and made a decision early on that I wanted to be a chief engineer and potentially the CE of a major-market station.

This decision was premised on advice given me by one of the "teaching engineers" John alluded to in his article. His mention of the "old-timers" brought back some good memories . . . not to mention some memories of some mistakes I would as soon forget. These guys seemed to have an uncanny ability to fix anything. Some had the ability to fix things by simply being in the same room with them.

It is indeed regrettable that the opportunity for those of us who are younger

Jim Sorensen is CE of WJQY-FM, Ft. Lauderdale. He can be reached at 305-484-8107 or 305-621-8107.

to take in an apprentice seems to be gone.

However, a problem arises with that approach. Many techs simply don't want the responsibility of a chief's job. They want to work with technology. Many

Guest Editorial

chiefs, me included, see little of technology in the field. Many of us are administrators who spend our time worrying about budgets and schedules, and going to meetings with other staffers who know little about engineering and who care even less . . . as long as the noise comes out of the speakers.

If there is blame to be laid for this, and the other ills outlined in Shepler's piece, let's look at some facts:

- The NAB, by rightly representing the needs of the industry, pushed long and hard for the relaxation of some of the licensing requirements. Since this was in the works as early as the 1960s, it is

obvious that manufacturers had to satisfy the FCC's desire for equipment that would perform well in an almost unattended setting.

With this came the quicky schools for First-Phones, along with the beginnings of the "high tekking" of broadcast equipment. Much of it, to that point, had been fairly tweeky brute force circuitry that required a "real" engineer to maintain. It needed periodic work. Mere cleaning was not enough.

The combination of the advances made by the manufacturers in response to the demands of the marketplace resulted in a generation of sophisticated equipment that required little or no work other than cleaning, and equipment that you couldn't fix in the field anyway . . . other than frogging cards around from your supply of spares.

- This situation resulted in the birth of the "contract engineering consultant." I was actively involved in this part of the business for more than 10 years solely because managers of smaller stations
(continued on page 6)

Opinion

Re-examining Role

(continued from page 5)

could save the price of an engineer's salary by paying me by the hour to do the work done by that guy.

Was this good? Not really. Much of what I did was routine work that a fairly competent engineer would have taken care of with his service ritual. Since there was no engineer, there was no routine work being done.

The other angle of this is that most major repairs were after a catastrophic failure, a failure that possibly could have been prevented by more regular inspection by someone qualified to evaluate the status of the equipment.

- The competition from workplaces out of the normal broadcast channels has stripped the industry of some top people. I know of at least three well-qualified engineers who decided to seek employment out of the industry simply for regular hours, better pay and a retirement plan.

The radio industry, particularly in the small markets, has traded on the "mystique and magic" of broadcasting. Many of us remember being offered restaurant trade and gas trade in lieu of decent compensation. A retirement plan was unheard of in many stations and still is in

some. It is primarily because most station managers come out of a sales background—a background which is temporary and catch-as-catch-can—that it is difficult for them to understand that not everyone is willing to work under those terms.

For all of that, there is still a problem that must be addressed. Shepler's ideas of in-house training are good, but pretty much a pie-in-the-sky solution. Not many of us work with budgets that will allow that. His idea of teaching in a local college or tech school is about the best of the lot. That way we as engineers can broaden our own horizons and bring "the word" to students who might make a decision toward our industry. It also gives the CE, as a potential employer, a chance to weed out the local marketplace.

There is one facet of the "state-of-the-art" that John failed, in this article, to address . . . that being credentials.

I recall sending in my license last year to get a permanent ticket. Mine did not have a service record on the back; it was not needed. My orange ticket no longer said "First Class" on it, but, rather, "General."

The idea of being responsible to the FCC to at least tell them where I lived

every five years was gone.

I remember talking to others in the craft who shared the feeling that another era in the industry had passed. I recall saying that it was, "bad enough having to put up with paperhangers whose licenses looked just like ours," for so many years . . . and now this.

The work being done by SBE and

“
*My orange
 ticket no longer
 said 'First Class.'*
 ”

NARTE in certification of engineers will do much to re-instill a level of confidence in managers when hiring personnel. One of the major complaints I have heard for years has been that managers do not really know who was qualified and who wasn't up front. Certainly, the possession of a license, or even a degree, does not make one a good engineer, but it's a far better place to start than with a person who can only tell you he is qualified. It would seem that there are several

things that need to be done. One is support of qualified agencies that will issue valid credentials. The other is to remind the FCC that by laying the onus of this obligation on the industry, they satisfied a portion of the marketplace, but denied another portion their birthright to earn respect in that industry.

It would seem to be up to us, as working engineers, to make certain that the industry has the respect for our craft that it should have. We can only do that by working hard to advance the industry and our part of it.

Managers and owners need to be reminded of the importance of engineering. Hell, we're the ones who make the "radio." The proper use of staff meetings in which engineers participate is essential.

Engineers, on the other hand, must not place themselves in a shell, and must communicate, as an equal, with others on the staff. Our industry was formed and grew originally by this "family" team effort. We must not lose it now. To be sure, the family has been restructured to an extent, but we can both live with it, and prosper with it.

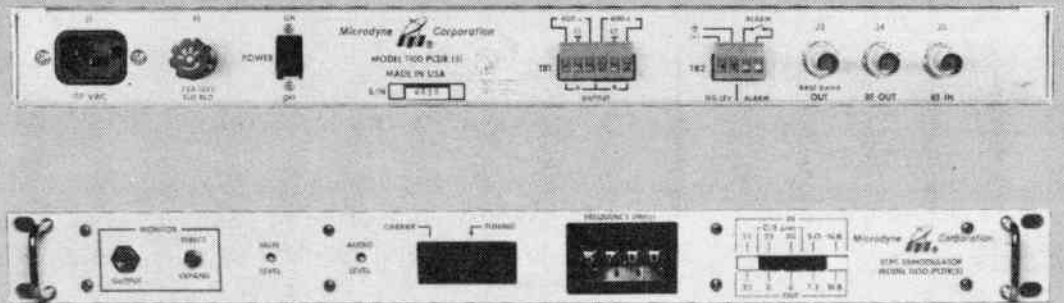
It is indeed encouraging to see articles like the one offered by John Shepler. It makes one think. A continued awareness of the industry as a whole . . . not just the E-lab . . . is too easy to forget. John has made it that much easier to keep a perspective, and for that I thank him.

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NAB Revises Payment Schedule

by David Hughes

Washington DC ... Responding to exhibitor complaints, the NAB has reversed its decision requiring that exhibitors submit payments earlier than planned for booth space at its 1987 spring convention.

The NAB originally told exhibitors, in a letter dated 30 June, that the first of two 50% payments for floor space at next year's Dallas show was due 14 days after receipt of the letter (by mid-July), with the second payment due by 15 September.

However, in response to complaints from the NAB Exhibitors Advisory Committee, comprised of exhibitors' representatives, the original payment plan was "modified," according to NAB Exhibits Director Ed Gayou.

Exhibitors who were contacted said they resented the NAB holding relatively large sums of money for an unnecessarily long period of time.

New letter

Gayou said that a second letter, which he said was dated 3 July, was mailed correcting the first letter. In it, the NAB advised exhibitors wishing to keep their same exhibit space that the first 50% payment date was revised to 1 August, with the second payment due 15 January 1987.

Gayou stressed that exhibitors who did not make their first payment by 1 August would lose their floor space reservation for the 1987 show, which will be held 28 March to 1 April at the Dallas Convention Center.

He added that additional mailings will be made after the 1 August deadline to sell the remaining floor space.

Gayou maintained that the original plan, with the earlier deadlines, was an attempt to "step-up the procedure ... by moving everything back."

Exhibitors complain

However, Exhibitors Advisory Committee Chairman Al Fisher, of Ampex, said the earlier deadlines would cause payment problems for many exhibitors, particularly smaller, cash-tight firms.

After receiving the first mailing in early July, some exhibitors complained that the NAB could generate additional interest on the funds if they were to be paid by the earlier deadlines.

"There was no reason given in the (ori-

ginal) letter (for the earlier deadlines)," Fisher said, "and it was not what we had agreed to earlier."

Gayou added that exhibitors could deduct the \$500 nonrefundable space deposit they made in May from the first payment.

The contracts, he said, require that 50% of the total space fee be paid by the first deadline.

Fisher said many exhibitors questioned whether they could deduct the original deposit from the first 50% payment or whether it had to be taken out in equal chunks from both payments.

"Essentially, what matters is that half the total fee is paid by August 1," he said.

Additional advisory committee meet-



ings are planned with NAB officials, but no timetable had been formulated, Fisher added.

In other news, NAB officials said they were considering opening the 1987 spring convention exhibit area on Saturday, the same day the engineering conference traditionally opens.

However, as of press time, a firm decision had not been made.

However, NAB Engineer Ed Williams said that opening the show a day early could interfere with the traditional Saturday engineering sessions.

For more information on next year's exhibit area, contact either the NAB exhibit office in St. Louis: 314-721-7717, or in Washington, DC: 202-429-5353.

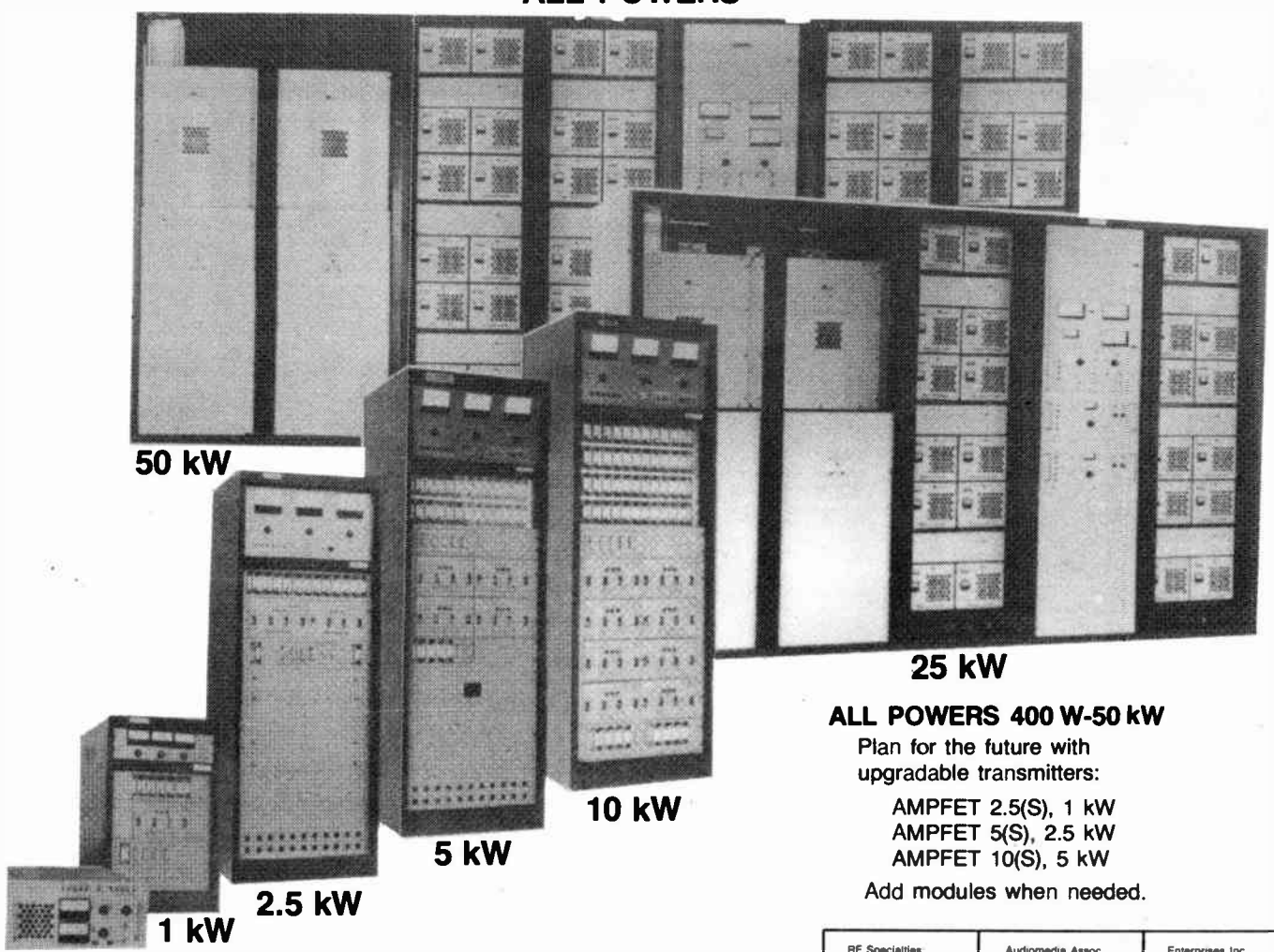



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More RW Letters . . .

(continued from page 5)
see the potential for disaster.

First, I would suggest operating both units with gel-cells, or an inverter backup system, to eliminate the possibility of false triggering of the 556 during very short power interruptions (of which this particular package is prone).

A false trigger of the studio unit could result in the auxiliary transmitter coming on the air with audio, while the main transmitter remained on the air with no modulation.

This would cause havoc to the signal due to random adding and subtracting of the two signals in the listening area. A false trigger of the transmitter unit could result in the auxiliary coming on with no audio, and then dropping back off the air in six seconds.

Second, although we all know that telco personnel never make mistakes, sooner or later—probably during drive-time while an ARB is in progress—someone is going to “butt in” on the program line with a tone generator, again placing two carriers on the air.

This time, both being modulated with different audio, the additive affect of all

those car radio buttons being pushed at one time would probably sound like the Great California Earthquake.

A safer approach may be to have the studio unit delay the program feed by one or two seconds, while a dual tone is sent down the line to activate the transmitter unit.

Fred Greaves
Asst. Dir. of Eng.
Susquehanna Radio Corp.

RW replies: Ken Blake responds:

“We didn’t document all the time that was spent in experimenting with the ‘Murphy’s Law’ items you mentioned. These were all considered and eliminated.

“For instance, the telco could enter the circuit with a tone generator. If you are using an automatic device, does this make telco less guilty of performing a stupid act? If you never build this device, you should still be very upset with anyone who would foul up your program line. But why worry? Listeners will tune out whether you are automatic or manual.

“If the main transmitter has no audio

(as in your hypothesis), how can the auxiliary transmitter be activated while the main is still transmitting a pilot tone? Think it through.

“So what if your auxiliary may come on for six seconds? It is still convenient that it is automatic in operation.

“Please give us credit for not having designed the circuit on a restaurant napkin and throwing it together in an hour. Many tests were utilized to assure proper operation.

“When it was first put in service, I was called at night by the duty operator telling me that the FM transmitter was dead but that he was still receiving program off the air. He was advised to check the auxiliary and found that it had come on without his intervention. This satisfied me that the unit was functioning as intended.

“This unit was designed with simplicity in mind; I make no apology for that approach, and have almost two years of faultless operation to confirm it.”

Safety, continued . . .

Dear RW:

I am in agreement with David Molvik’s letter in the 1 May issue. The transmitter that I maintain requires several adjustments to be made with a front panel off, and with the transmitter on with high voltage. This includes driver cathode bias, driver tune, coupling controls and the PA efficiency adjustment. All of these controls are located several inches above a 7.5 kV capacitor and, if you’re

not careful, your elbow can bump an interlock that has high voltage on it.

The operating manual says that some of these adjustments are to be made with the transmitter in a “standby” situation—in other words, plate volts off. But I have found, as Mr. Molvik has, that I have to make final adjustments with the transmitter at full power with plate volts on.

I have found out from the manufacturer that they use a special panel to make these adjustments at the factory. I have also found out that you can get hold of one of these panels from them if you ask strongly for it. They also recommend that the panel not be used during normal operation of the transmitter, but only during setup adjustments.

I have not bought the panel yet. What good is the panel if it can only be used during setup adjustments? I have found during the course of a week that my particular transmitter may need some minor tuning at times when I can’t shut it down, exchange panels, perform setup adjustments, exchange panels again, and then go back to normal programming. The only way I can perform these adjustments is to stick my hand in, and hope I don’t drop a tool or slip and fall.

In the future, our station will be looking for a new main transmitter. I decided long ago that I will look closely at all maintenance procedures, and steer clear of transmission equipment that forces one into dangerous situations.

John A. Graham, CE
WFCJ-FM
Dayton, OH

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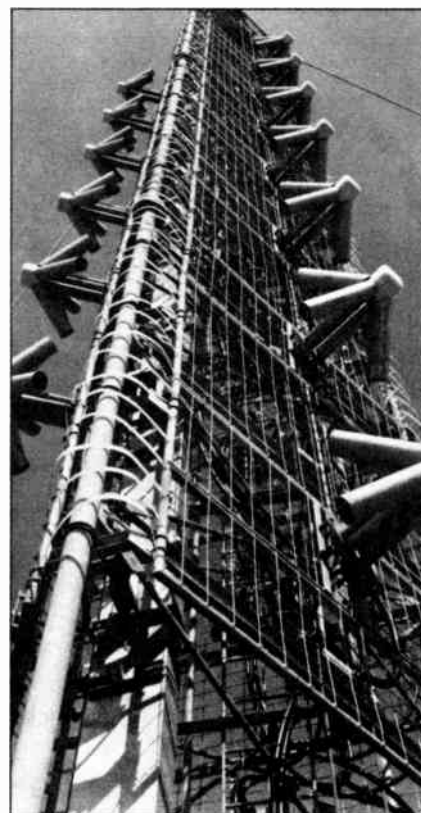
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Comments Sought on FCC Fees

by Alex Zavistovich

Washington DC ... The FCC is asking for comments on 11 proposed procedural changes and additions to a schedule of charges, along with comments on the proposed charges, that will apply to broadcast permittees and licensees next year.

The FCC plans to begin collecting the fees by April 1987, with the public receiving advance notice before the plan goes into effect. The schedule of charges was approved 7 April 1986, following President Reagan's signature of the Consolidated Omnibus Budget Reconciliation Act of 1985.

Brent Weingardt, attorney in the FCC's management planning office, said that comments on the Commission's proposals are due within 30 days of publication in the Federal Register. He estimated that publication would take place in mid-July.

Included among the new fees affecting radio broadcasters are a \$6,000 fee for all FCC public hearings, and \$2,000 and \$1,800 fees for major CPs by AM and FM stations, respectively. Minor facility modifications would require a \$500 fee.

Additionally, stations using satellite transmissions will have to pay \$3,000 to apply for transmit/receive earth stations and \$1,350 for transmit-only earth stations.

According to the new FCC proposals, a chargeable application or filing must be accompanied by full fee payments. Partial payments or installments would not be permitted. Separate payments would be required for each application or filing, except for package applications from the same applicant requesting the same action in the same radio service.

Applicants in the Special Emergency Radio and Public Safety Radio services would be exempt from charges. Likewise, applicants or licensees for noncommercial educational AM, FM or TV stations, as defined by the Commission's rules, would be exempt from fees required of commercial radio or TV

applicants.

Other proposals involve retention and refund of charges, method of payment, waivers and penalties for late or failed payment.

The FCC stressed it plans to conduct fee collection in the most cost-effective manner possible, and will not impose

any additional paperwork on the public.

The Commission added that it will also take pains to ensure that the application processing and equipment authorization schedule is not adversely affected.

For more information, contact Brent Weingardt at the FCC at 202-632-3906.

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Circle Reader Service 4 on page 32

Circle Reader Service 3 on page 32

Copter/Plane Use Unchanged

by Alex Zavistovich

Washington DC . . . Despite the recent deaths of two reporters, airborne traffic advisory continues to play an important, but hazardous, role in broadcasting.

On 4 June, at 6:18 AM, KFI/KOST, Los Angeles air traffic reporter Bruce Wayne, 52, died in the unexplained crash of his Cessna 177 Cardinal. He was returning to the air to begin his second traffic report of the day.

Less than two weeks later, on 16 June, at 6:44 AM, Julie King, 26, a traffic reporter at WAPE-FM, Jacksonville, was killed in the crash of WTLV-TV's Hughes 500C helicopter. The aircraft fell from the sky after the failure of its tail rotor drive shaft flexible couplings.

Pilot William Buddy Smith, 34, also died in the accident. WTLV photographer Brett Snyder, 22, survived, but was last reported to be in serious condition at Jacksonville's University Hospital.

Dangerous profession

Walt Starling, airborne traffic advisor for WCLY-FM, Washington, DC sees such incidents as ever-present concerns for the industry's estimated 80 air reporters. A 13-year veteran, Starling estimates

there has been an average of one fatality per year among air traffic reporters.

On 26 September 1976, at 7:05 AM, the engine of Starling's own Cessna 150 airplane "seized up" over Silver Spring, MD, forcing him to make an emergency landing on a nearby golf course. He was uninjured.

He now flies a Cessna 172, which he maintains is the safest single-engine aircraft built.

Regardless of the inherent dangers of air traffic reporting, many station officials view aircraft as necessary for maintaining a competitive edge in the industry. The struggle for that edge often includes deciding between fixed- and rotary-wing vehicles.

Jeremy Burnham, special projects engineer at KIIS-AM/FM, Los Angeles, said the importance of air traffic reporting lies in "the idea of having reports, rather than the reports themselves."

KIIS began airborne reporting three years ago. The station uses a Hughes 300B helicopter.

Burnham said helicopters have an advantage of maneuverability. Unlike fixed-wing aircraft, helicopters can hover over a scene and can provide low coverage.

They are also, however, more expensive. Starling said there has been a trend towards fixed-wing aircraft in the broadcast industry, primarily because planes are one-quarter to one-half as expensive to own and maintain as their rotary-wing counterparts.

Other options

Some stations are augmenting their airborne service with ground-based reporting. Tampa's WRBQ-FM has instituted a program known as "Cellular Traffic Force," in which cellular car telephone owners call in reports using a toll-free number.

WRBQ Legal and Technical Operations Director Ralph Beaver said the one-month-old operation has the advantage of giving the station "5,000 additional reporters on the street." He added that, to date, they have not received a single crank call.

However, the station still maintains a Cessna aircraft on contract. The Cellular Traffic Force, Beaver acknowledged, is not a replacement for airborne reporting.

Starling agrees that ground-based reporting is supplementary. Airborne reporting simply offers a much broader area of coverage.

"Anything based on the ground," he said, "is second-best. We've used cellular reporting in the past, but what I can do from the air can't be duplicated on the ground."

FCC: C-QUAM Acquitted

(continued from page 1)

ity of the individual stations to correct, not the manufacturer, Franca added.

Kahn had filed a complaint against its chief AM stereo system competitor, Motorola, with the FCC on 14 March. However in a 10 April letter, the Commission dismissed the complaint.

On 11 April, Kahn filed a second complaint which he said contained additional information in support of the alleged

type acceptance violations which involved what he said was C-QUAM's failure to adhere to carrier frequency requirements in FCC rule section 73.44.

At RW press time, it was not clear if the full report of the FCC's field tests would be made public. Stanley had earlier said that the FOB's report would "probably" be made available to the public.

For more information, contact Bruce Franca at 202-632-7060.

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RPU Setup Minimizes Problems

by Ronald F. Balonis

Wilkes-Barre PA ... Remote broadcasts are a way of life for many radio stations; they're a good way for a station to promote itself, and a good way to get listeners.

Remote broadcasts are also a way of life for many advertisers; they're a good way for an advertiser to promote the business and an efficient way to reach customers—the station's listeners—instantly and directly.

The task of engineering remotes is, and always has been, a challenge. Even so, it can be one of the satisfying tasks in the radio engineer's toolbox, for remotes give the engineer an opportunity to get out of the station, to make a visible contribution to the station's operation and to help its image. Good remotes work for everybody.

But since deregulation of the telephone companies, engineering remotes has become much more of a challenge. The telco line was always the easiest way to get a remote on the air.

When the costs of the lines went up, their apparent low quality became a factor since, at the new cost, there was no way to rationalize their worth, in dollars or quality. So, for many engineers, an RPU system has become the method of choice due to price and quality.

New considerations

However, an RPU system as the remote program link is not without its costs, financial and otherwise. The RPU system is neither as simple nor as easy

Ron Balonis is CE at WILK, Wilkes-Barre, PA and a frequent contributor to RW. He can be reached at 717-824-4666.

as the telco lines: it is more complex at both the studio and the remote locations; there is more station equipment involved; there is much more to go wrong, and, finally, there are remote locations, signal-wise, that are poor or nearly impossible for an RPU system, but which weren't for telco lines.

Fortunately, the problems of engineering remotes with an RPU system are not insurmountable. It just takes—depending on the station, the location and the market—some engineering inventiveness.

For me, it meant a solution with two parts. The first is the same solution that many others have found necessary to solve a common problem. The second is a little different than most and is the impetus for this article.

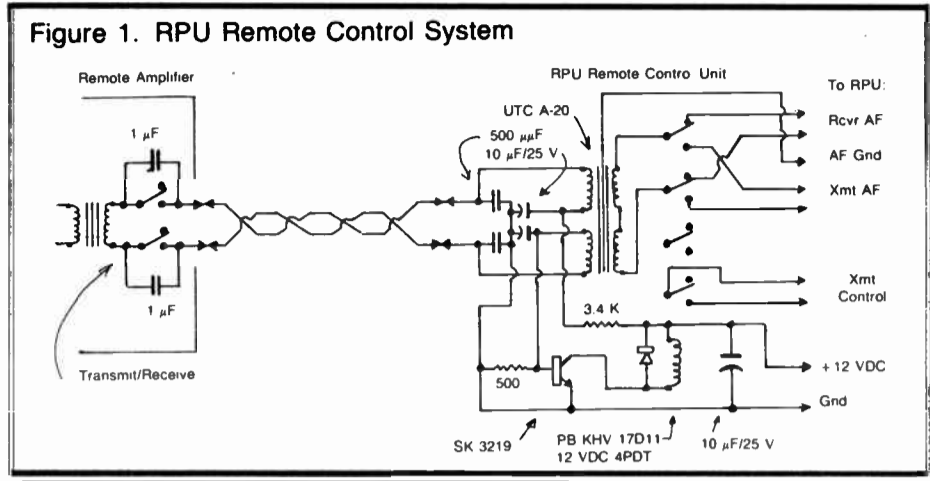
After many trial-and-error attempts to overcome the signal problems posed by some locations, along with the problems of setting up more equipment at a remote, the first part of my solution was to install a high power RPU (100 W) in the station van with a permanently mounted antenna on its roof.

Second problem posed

That, for most locations, solved the problem of getting a good, usable signal back to the studio, and minimized the setup complexity somewhat, but it imposed another problem.

The van-mounted RPU system limited remote setup locations to the outside or to the front of an advertiser's store. Generally, these are the best locations for the advertiser and the station, but occasionally a remote requires a location inside the store and, consequently, remote from the van.

That problem led to the second part of my RPU remote broadcast system; an



RPU Remote Control System (see Figure 1). It allows operation of the van RPU system by wired remote control from the inside-the-store remote location. It removes almost all restrictions on where an RPU remote broadcast can be set up. The only limitation it has is the length of wire and the path over which the wire can be safely run.

The RPU Remote Control System's design is a copy of those found in DC-wire remote control systems of the 1950s and '60s. It uses a single-pair cable to make two isolated circuits: one AC to carry the audio to and from the RPU system, and one DC to control the transmit function of the RPU. It is a basic junk-box design;

nothing in it is very critical, and the parts were chosen more for their availability than for their electrical characteristics.

The remote (and modified) amplifier used has a switch that connects and disconnects the line to it (opens and closes the line's DC path). The switch, when on (DC path closed), puts the RPU system on the air. In standby (DC path open), the RPU system air cue feeds to the remote amplifier, allowing talk-back.

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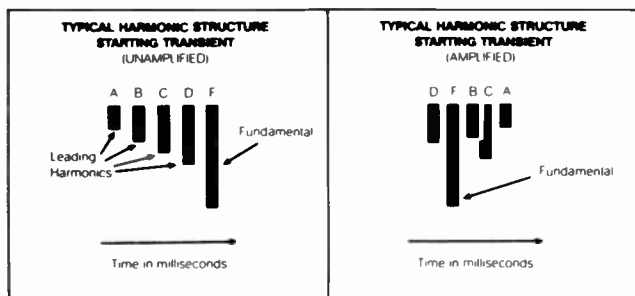
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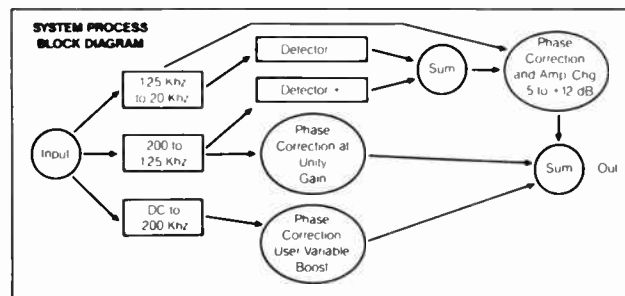
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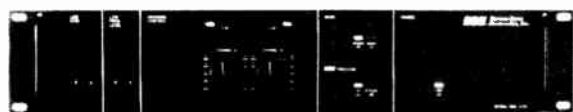
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Audio Processing Tasks Not Dissimilar

by Steve Keating

Part 4

Tarzana CA ... About 10 years ago, when the first radical advancements in audio processing equipment began to appear in the marketplace, some of the new devices were touted as "magic black boxes" capable of achieving vastly superior performance over previous designs. Each box was swathed in its own mystique, which centered on the nature of the active components used to achieve these advanced results.

Though the majority of analog audio processing units, then and now, contain many similar stages and employ similar techniques, in most cases the actual electronic components that perform the active processing functions are packaged in such a manner as to be unidentifiable in their physical and electrical composition. To divulge this information would easily disclose the very essence of what differentiates one manufacturer's product from a competitor's.

Audio 'conditioning'

In this series on the evolution of and modern approaches to audio processing techniques, I will detail some of the techniques intended to accomplish those common demands at the component level stages found in a sampling of currently available commercial audio processing equipment.

All types of compression, leveling or peak-limiting "amplifiers" must contain

Steve Keating is CE of KMET, Los Angeles. He can be reached at 213-464-5638.

circuitry to accept incoming audio information from the chain of equipment connected ahead of it, and must then condition the processed product for use by the equipment following it.

The input and output stages serve only to link the outside world with the processor's internal circuitry, and should not "color" the signal information in any way, such as by adding appreciable noise or distortion, or by limiting fidelity.

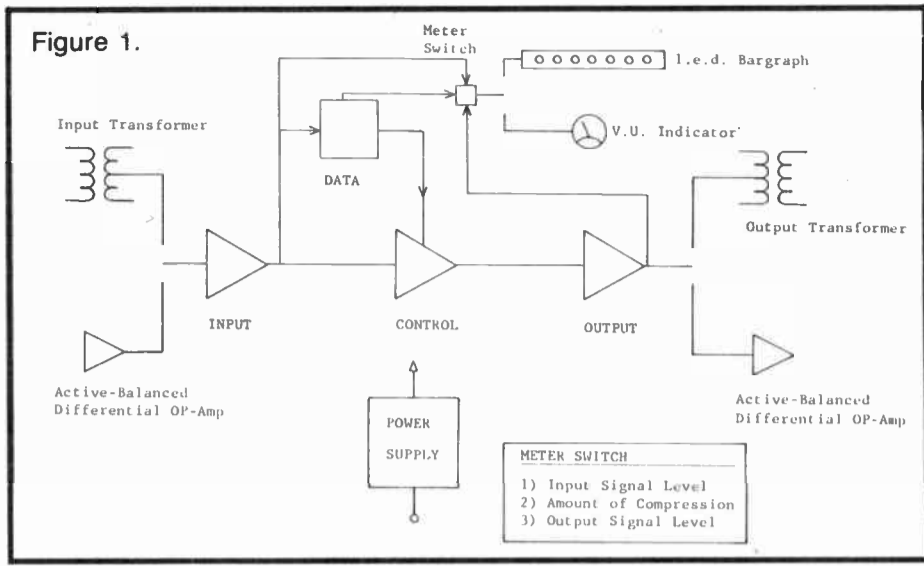
Presently, this is most often done with a combination of high-grade audio transformers or balanced opamp circuitry which electrically appears very similar to a high-grade transformer, but without the potentially degrading slow action which transformers can exhibit. In op-amp talk this is known as "slew rate," or the speed with which the rapidly varying audio signal levels are tracked by the active amplifier(s) and reproduced with gain, but without undesirable by-products.

Metering

Often associated with these input and output interfacing stages is a means of displaying to the user the incoming and outgoing signal levels, either using a conventional analog meter, using meters for two-channel units, or by using some scheme utilizing LEDs to indicate relative signal levels entering and leaving the device.

These indicators, while seldom precise, do provide valuable information regarding the approximate amplitude range of the audio volume levels. This data aids the user in adjusting the controls provided for individually "tailoring" the performance of the unit in a given system.

In addition to the input and output in-



terfacing and indicating circuitry found in several modern processing units, "passive" components are used ahead of the active input circuitry, and after the active output circuitry, to filter out undesirable high-frequency radio or electrical energy that could potentially enter the device and interfere with its operation, or add unwanted audible noise to the processed signal(s). This is especially desirable in products intended for use near high RF energy fields, such as transmitter and antenna sites.

Incoming primary AC power also is often filtered to reduce the possibility of unwanted noise becoming inadvertently coupled through the unit's power supply to the active amplifying and controlling circuits, and appearing with the program signal at the output.

Once the incoming audio information has been adequately "transformed" for more efficient use by the active processing section, it begins its journey through the usually complex array of electronics designed to produce the targeted results. It is at this point that the "magic" of the individual device begins to take shape. It is also the point at which the widely varying processing schemes originate to perform their unique manipulation of the dynamic program content.

Active-control components

The actual combination of electronic components constituting the active control sections of the audio processor are usually proprietary, as they make up the most pronounced difference between

(continued on page 14)

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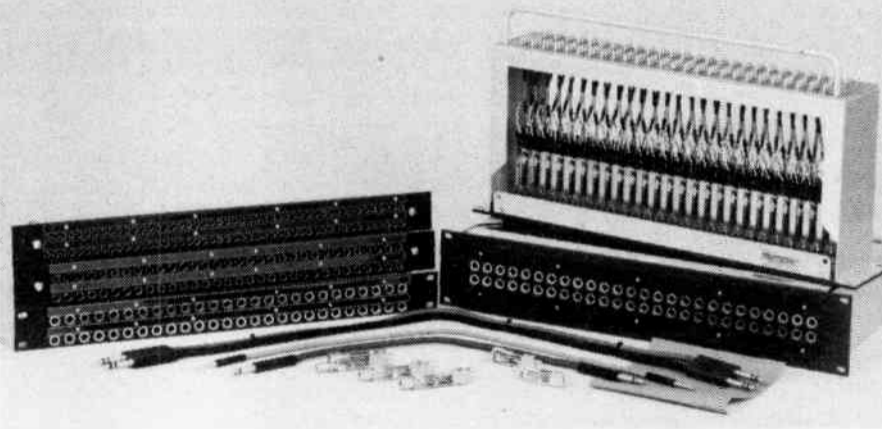
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Most Processing Tasks Similar

(continued from page 13)

various manufacturer's units.

Among the most popular individual components used for voltage and current control of the audio electrical energy are; special transistors known as JFETs and VFETs; light dependent resistors (LDRs); voltage controlled operational amplifiers (VCAs) and custom components developed for specialized functions.

Whatever the individual ingredients brought together within the "heart" of the processing device, it is ultimately their unique combination and aggregate activity that gives each device its own special set of merits, shortcomings and individual characteristics that decide the degree of acceptance and general application in the industry.

Prior to detailing the basic elements of a typical audio processor, I should mention two primary schemes used for deriving the control information needed to operate the variable gain devices, and ultimately to determine the amplitude limits of the output.

Variable gain controls

The type of scheme employed to extract the necessary control data in the majority of audio processing devices is an altered form of the actual program

signal content being fed into the unit.

Since this effectively constitutes a closed-loop control path, one can quickly see that, should the incoming audio signal level rapidly increase from one extreme to the other, circuitry producing the control data required to act on this variation must play "catch-up."

Even though solid-state devices are capable of extremely fast operation, the inherent flaw in this scheme is the necessity of having to quickly act on something which has essentially already happened. Since nothing is 100% efficient, there is always some evidence of the lag time between the "action" and the "reaction."

A newly introduced method of improving on this problem employs a very short analog delay scheme to allow the control circuits to "read" the incoming amplitude variations, adequately manipulate their amplitude changes as required, and then pass the precisely adjusted level to the output stage(s).

Knowing "ahead of time" that a transient or sustained increase or decrease in signal amplitude is coming via a short time delay between the incoming and outgoing signal allows adequate time for the control circuitry to more easily readjust the active amplitude controlling

stages.

Although not commonly used, this unconventional method of "feeding-forward" the control information (made possible by significant semiconductor component design advances) could become more widely accepted in the broadcast industry due to its radically faster performance and more "invisible" operation.

Regardless of the method chosen to derive the control information needed to determine how much amplitude readjustment is necessary to compensate for widely varying program signal levels, it must then be efficiently coupled to the components performing the signal amplitude gain change.

As previously mentioned, these components can be specially developed designs proprietary to an individual processing unit and/or manufacturer, or may be common "garden-variety" devices such as JFETs, VFETs, voltage controlled opamps or light-dependent resistors. In recent years, LDRs have not been widely used since they are much slower acting than most other components.

VCAs

VCAs are the most popular analog signal amplitude control devices in use today. Their speed of operation, lack of undesirable by-products, cost-effective packaging and overall superior perform-

ance make them very popular with audio equipment designers, manufacturers and end users.

Shown in Figure 1 is a typical single-channel audio limiting amplifier. The input and output stages are coupling, conditioning, and level indicating circuits only; the active analog control stage is the heart of the device where the actual signal manipulation takes place.

The data section derives the information necessary to perform the amplitude control. The power supply provides the DC potentials required to energize the active circuitry and indicators.

Typically, the input impedance of modern processing amplifiers is anywhere from 10K ohms to 100K ohms, balanced-bridging, and must have a 600 ohm resistor installed if the equipment ahead of it requires such a terminating load.

The output is usually active, differential balanced, and very low in impedance, often 10 to 100 ohms. This allows for optimum insertion in the audio chain and helps to eliminate unwanted hum and/or noise from entering the system. Use of an extremely low impedance and balanced output allows very long cable lengths to be driven with minimal signal degradation.

Now that we have a basic understanding of the workings of audio limiting and peak-controlling amplifiers, it's time to insert them in the audio chain and set their controls for optimum performance and effect.

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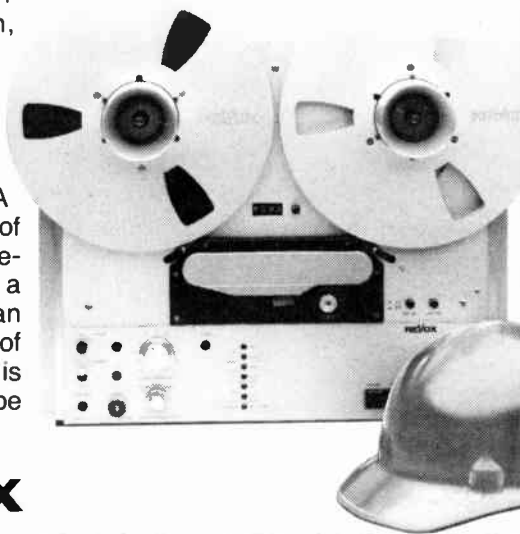
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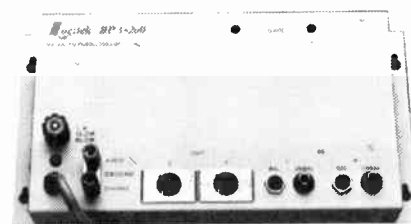
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When it has to work right

Complaint Referral a Success

by Bill Betlej

Virginia Beach VA . . . "We want to extend the concept of the marketplace," said Dan Emrick, the assistant engineer-in-charge of the FCC field office in Norfolk to participants in the 1986 Virginia Association of Broadcasters Engineers Convention, held in July in Virginia Beach.

Emrick was referring to the complaint referral program set up between the FCC and the VAB last summer. He reported that the program is working smoothly and has achieved a major goal, "to get stations involved in solving problems."

Complaints concerning interference received by the Norfolk Bureau are filed and forwarded to the VAB. The VAB then contacts the individual stations involved and tries to help with solutions. (Complaints regarding programming content are handled directly by the FCC office.)

Although the exact number of referrals was not available, Emrick estimated that over a dozen such cases have been resolved since the program was started last summer. "I am very enthusiastic about the program," said Emrick. "It promotes cooperation and gets people working together."

Emrick believes that the potential for correction of the problem in the interference cases greatly increases with the help of the VAB.

The VAB can offer a wider range of help, such as technical assistance, in finding a solution.

Bill Betlej is director of Group Engineering for the Shenandoah Valley Broadcasting Co., Staunton, VA. He can be reached at 703-886-2377.

With spectrum space becoming increasingly crowded, the likelihood of interference problems has also increased. "It is almost inevitable that sometime you will intrude on someone else's signal," said Emrick.

The cost of sending out a field representative from the FCC office to check out each complaint continues to increase at a time when funding for each bureau

continues to decrease. It was for this reason that the complaint referral program was begun.

Listener education

The FCC recognizes that often the answer to an interference complaint is education of the listener. Though the solution may be as simple as having the listener move his receiver a few feet or

properly connecting the antenna, this educational work is important, said Emrick. By going out to the complainant's house, the station reaps the benefits of good PR.

The educational process is good for the station in another form. Those involved in correcting any problems will also be sharing information and jointly increasing *(continued on page 32)*



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Circle Reader Service 50 on page 32

Circle Reader Service 27 on page 32

Phase Fixer Field Reports Good

by Wally Kabrick

Quincy IL . . . Radio stations using the Harris Phase Fixer in their on-air chain are reporting good results with the system.

Designed to keep carted music clean on stereo receivers by reducing the heavy L-R content found in systems suffering phase shift problems, station CEs have reported that mono listeners like the clean high end that results from no out-of-phase cancellation in the programming. Since most fringe area FM is heard in mono, the stations added that clean mono-sum recombination in stereo programming is still very important.

Scott Hollingsworth, on the engineering staff at WSOC/WSOC-FM in Charlotte, NC, reported that the station is carting nearly all of its music from vinyl discs, except for a few from CDs.

"Our production and operations people like the way the high end sounds, especially when listening to the station in mono," Hollingsworth said. "Keeping the phase error out of the air signal improves separation, and the programming sounds much better to them in stereo."

Jim Free, CE of KVEG/KFMS, Las Vegas, said the station's music is recorded from records to carts in their C&W format. "The Phase Fixer really performs, correcting all cart phasing errors for a more defined and consistent stereo sound than we had before installing the system," he noted.

Ray Winters, WWNK-AM/FM, Cincinnati, CE, reported that all of the stations' music is on carts, and that the staff

Wally Kabrick is manager, Technical Sales Support, Audio, for Harris Broadcast Group. He can be reached at 217-222-8200.

has very good control of the phasing on them. He added that the Phase Fixer is invaluable in spotting the bad carts that occasionally creep into the system.

A lot of WWNK's music is simulcast in the two stereo stations, Winters said, and the Phase Fixer's protection in the AM stereo air signal, where most listeners are still using mono receivers, is really appreciated.

"We have no negative feelings about the Phase Fixer, and are happy to have it in our air chain," Winters added. "It causes no problems in our programming with or without encoded material."

What is a Phase Fixer?

The Phase Fixer consists of two rack-mounted units: an encoder, which may also be desk mounted, and a decoder.

The encoder records a 19 kHz pilot signal 27 dB below nominal program recording level on both the left and right channels of the tape. Any stray 19 kHz programming is notched out with the filters in the encoder prior to piloting.

The encoder is connected to one or more production machines with interfacing to make its operation follow the recorder action, so the operator does not have to touch it. A bypass switch on the encoder allows it to be conveniently switched out for any recording that is desired without a pilot.

The decoder is inserted between the output of the mixing board and the input of the audio processing, where all programming passes through it. Non-piloted program segments simply pass through the decoder without causing any corrective action or signal degradation.

Piloted segments on carts or machines generating 0.15% or more flutter will have that reduced by at least four times—typically more—until it reaches the

0.03% flutter threshold of the Phase Fixer. Piloted segments passing through elements in the air-chain with interchannel delay (phase error) are corrected to within 16.6 μ sec of 0 phase error. Thus, the Phase Fixer prevents significant degradation of the high frequencies on many taped program segments.

Is a Phase Fixer needed?

Even when a majority of your listeners use stereo auto receivers, many frequently hear you in mono. Many stereo auto receivers use one of several methods to automatically reduce noise, such as muting the L-R channel or "high blending" when low signal strengths are encountered.

Practically all of these methods result in the receiver going—at least at the high frequency end—into the mono-sum channel mode. Unfortunately, this action is triggered even in your prime coverage area due to multipath.

With any significant interchannel delay or phase error, the highs in your air signal are alternately cancelled (with noise reduction activated) and restored (when the noise reduction is released). The rapid change in signal strengths in multipath areas provides direct comparison between your good (stereo) and poor (mono) high end audio signals. This is very obvious to most listeners, and a real turn-off to many of them.

In a documented test, 100 new carts were recorded and played back at random on well-maintained cart machines. All of them were from a top-rated series of carts/machines. At the end of five weeks' play, 37% exhibited from 25 to 65 μ sec of interchannel delay error, which represents a spread of 90° error at 10 kHz to complete cancellation at 7.7 kHz.

Of these, 32% were all in one direc-

tion (negative on the Phase Fixer meter), a typical trend on most types of cartridges. A total of 45% exceeded the 16.6 μ sec threshold of phase correction and would cause corrective action in the Phase Fixer decoder.

Some station engineers claim all of their cart machines play back within $\pm 5^\circ$, or some other close tolerance. With a selected cart or two, such as good, stable test cartridges, this is easily achieved. The azimuth alignment on nearly all current vintage cart machines is stable. The carts are what cause the problems—some types much more than others.

John Pate's series on reducing stereo phase error, published in RW 1 and 15 January 1985, contained a good analogy which puts the tape tracking error into perspective. Assume you want to maintain $\pm 45^\circ$ at 15 kHz, an interchannel delay error of 8.33 μ sec maximum at 7.5 ips. This would require that information on the left track be within 62.5 μ in of in-phase information on the right track throughout the entire length of every cartridge in your library!

Few of us can visualize something as small as 62.5 μ in in a static situation, let alone one that is moving at 37.5'/min. Let's scale this up to dimensions we can fathom; multiplying all elements by 7,660 times will make the 1/4" tape 159' wide. The tape head will be 300' tall—the length of a football field. The tape will be moving across the head at a speed of 3,264 mph, and a 60-second spot will use 54.4 miles of tape. The 62.5 μ inches of lateral error allowable between the left and right tracks on the tape—now on 64' centers—is only 0.48 inches!

The tortuous path of the tape in an NAB cartridge will simply not allow its travel past the head without a little angle variation, which will cause interchannel delay or phase errors—often quite in excess of $\pm 45^\circ$ at 15 kHz.

Some of the eraser/splice finders exert too much tension on the tape at times, causing it to stretch unevenly across the grain. Repeated playing of cartridges may cause the tape or other elements to become stress-relieved, which changes the angle of the tape path across the head. This probably accounts for the 32% shift in one direction referenced earlier. Dropping and rough handling of the cartridges account for much of the phase error encountered.

Phase Fixer users contacted agree that the answer to the question, "Is a Phase Fixer needed?" is "no" if you fit into one or more of the following categories:

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- All of your stereo music and other programming is from impeccably maintained reel-to-reel sources; or
- You are unconcerned about the perceived sound quality of your station.

Ron McGrew, engineering supervisor of WBNS-AM/FM, Columbus, Ohio, reports that 60% of the AM station's 2,000 cart library is now pilot encoded.

(continued on page 32)

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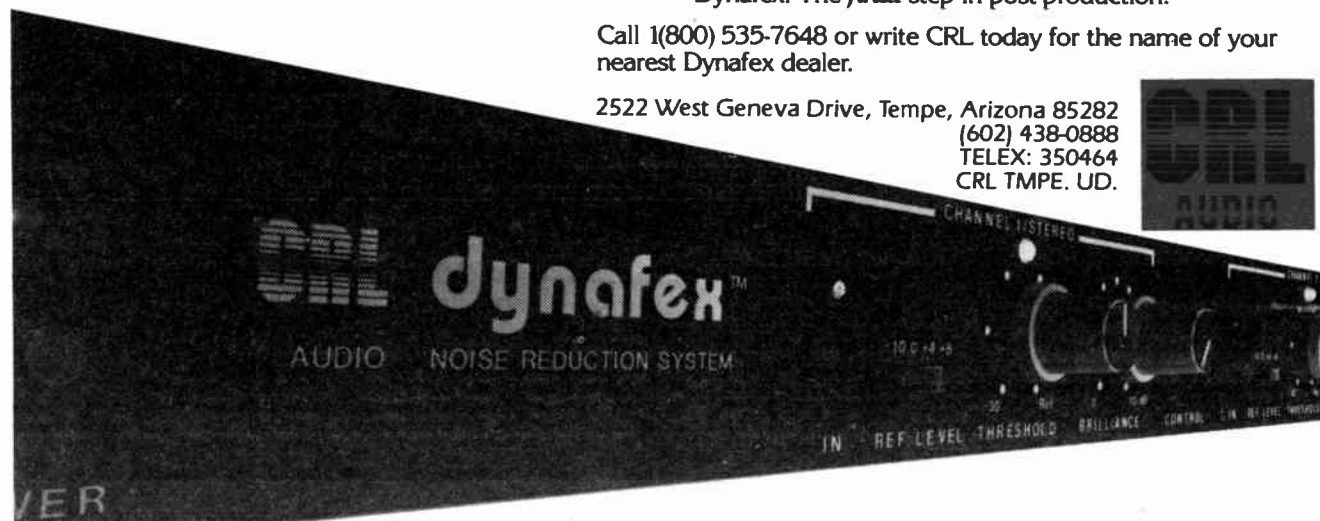
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Phono System Input Valuable

by John "Q" Shepler

Rockford IL ... Last November's column on noise coupling in high impedance circuits brought forth some interesting comments. In the 15 January Reader's Forum, John Andrews of

Q-Tips

WTAG noted that the 47K ohm impedance spec of a typical phono preamp does not tell the whole story, since you need to consider the much lower impedance of the cartridge to analyze the effect of cable capacitance on the phono signal.

John also proposed the idea of using a balanced differential input for phono circuits to help solve the hum and noise problem.

Well, much to my good fortune, I received even more input from L. Scott Hochberg, president of Logitek. Logitek

“*The 47K ohm impedance spec of a typical phono preamp does not tell the whole story.*”

makes a balanced input phono preamp. Scott provided some technical comments that I think you'll also find valuable. To make sure nothing is lost in the translation, I'll quote from the letter:

"The cartridge/preamp loop is indeed a low-impedance circuit, since, as Mr. Andrews points out, the source impedance of the cartridge is low. Nonetheless, a 47K load impedance is required at the input to the preamp to extract sufficient signal level from the small coil, and to give the cartridge its correct frequency response.

"Since the cable length is short, and the cartridge source impedance low, some people assume that cable capacitance is not important. Yet, we've found that load capacitance is more important here than in virtually any other location within most stations. This is because the frequency response of the cartridge itself is significantly affected by the load capacitance it sees, and typical cartridge load specs are around 200-500 pF."

Scott also sent a page from his BPA-200 instruction manual which emphasizes the difference between line-to-line and line-to-shield capacitance. Interesting stuff. In fact, it prompted me to do some deeper digging into my files on phono equipment to get a better understanding of what is going on. Let's see if I under-

stand it well enough to explain it to you.

There are a lot of schemes for making phono pickups, but only a few are of interest to broadcasters. The most popular style is called "moving magnet." It works like a generator. The stylus is attached to a small magnet that wiggles in tune (no pun) with the groove modulation of the record. This assembly can't have much mass or it won't be able to move fast enough to stay in the groove.

The motion of the magnet causes a varying current to be induced into two coils fixed solidly in place in the cartridge case.

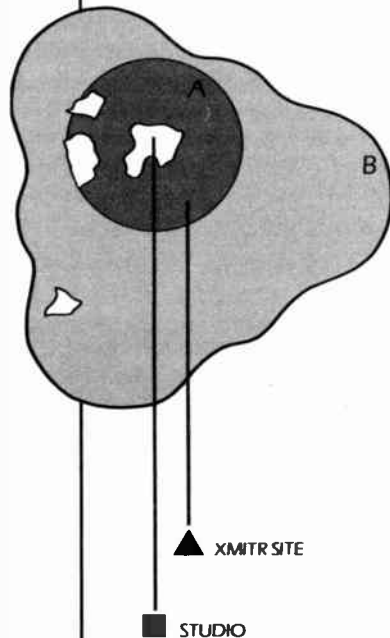
One coil is for the left channel audio and the other is for the right channel. The current is so small that even with a 47K ohm load the voltage developed is only a few millivolts. The impedance of the coils depends on the number of turns and wire size. However, a typical value is the

approximately 1,300 ohms and 930 mH quoted for a high quality cartridge like the Stanton 681A.

While 1,300 ohms isn't a very low impedance compared to an opamp output—which may be a fraction of 1 ohm—it is only about 3% of the rated load impedance for the cartridge. The cable capacitance is in parallel with the phono preamp input load, which is all
(continued on page 18)

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John Shepler is a broadcast consultant, teacher, writer and former CE. He can be reached after 8 PM at 815-654-0145.

Phono System Input

(continued from page 17)

most always 47K, and the cartridge resistance of 1,300 ohms. It is also in parallel with the cartridge inductance, which is a substantial 930 mH.

Just for fun, I plugged 930 mH and 275 pF into the familiar equation for resonant frequency.

$$F = \frac{1}{2\pi\sqrt{LC}}$$

The answer is about 10 kHz. The important point about these impedances is that the cartridge you use is designed for flat response only at a particular capacitive and resistive load. If you don't provide exactly the right load, the frequency response will either roll off below 15 kHz or give a false peak above 10 kHz.

Providing the right impedance sounds easy, since nearly all phono cartridges are spec'd at 47K and nearly all phono preamps are also spec'd at 47K. However, that applies only to the specified resistive load. Capacitance is also critical, although it is often just a matter of luck when the phono system is properly matched.

Consider the drawing in Figure 1. It shows a moving magnet cartridge connected to a balanced preamp with a resistive load of 47K ohms. In between is a length of shielded cable of unknown

capacitance.

Actually, there is no reason that the capacitance has to remain unknown. The cable catalog tells how much distributed capacitance exists in each foot of cable. Page 34 of the trusty Belden catalog says that the popular 8451 shielded pair is 34 pF/ft between conductors and 67 pF/ft between one conductor and the other conductor connected to ground.

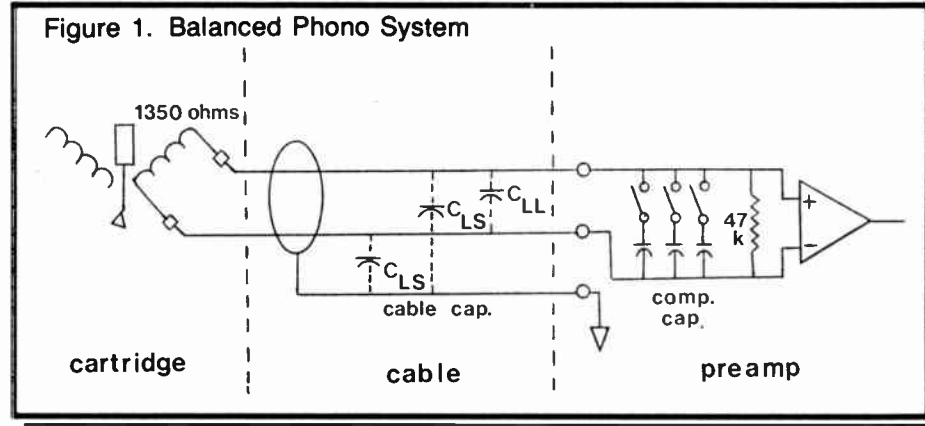
Different capacitance value

What this means is that you have to consider a different value of capacitance, depending on whether you are operating the system with a balanced or unbalanced phono input.

Let's say we're using an unbalanced preamp that has 50 pF built into its circuit. With 2' of cable between the cartridge and the preamp, the cart sees $(67 \times 2') + 50 \text{ pF} = 184 \text{ pF}$. That's not the right load. If you were forced to run 6' of wire, the capacitive load would be even further off at 452 pF.

Does this mean you have to treat phono leads like antennas and trim the wires for a perfect match? In this case you would cut to 3.358' for 275 pF, including the preamp. A better approach is to use the shortest convenient cable length and add extra capacitance at the phono input to make up the difference.

Some preamp manufacturers such as Logitek have made this easy by provid-



ing switchable input capacitance within the preamp.

One other point about cable capacitance; we used 67 pF per foot in this example because the unbalanced preamp needed only 1 wire plus shield. For a balanced preamp, the correct capacitance is the wire-to-wire spec of 34 pF/ft. Tonearms that come with precut phono cables should specify what capacitance they contribute.

Preamp adjustment pots

Some preamps now come with a high-frequency adjustment pot. This is not a variable cap on the input. It is an adjustment to the RIAA equalization curve in the preamp. The curve is meant to be a complement to the standard RIAA recording curve, similar to preemphasis and deemphasis in FM.

The adjustment is meant to correct for component tolerances to correctly match the standard curve. However, it is tempting to twist that pot to try and make the system response flatter. But look out!

If your system isn't flat when playing the test record, the problem could be an incorrect load capacitance on the cartridge, rather than an EQ change in the preamp. Adjusting the curve to compensate will make the response look better on the VU meters, but the cartridge still won't have the right load and won't

sound as good as it could.

If you want to read more on high quality phono systems or perhaps try your hand at building a preamp, I'd recommend a project by John Roberts in the March 1981 issue of *Popular Electronics*. It is a balanced input preamp with switchable input capacitance. The output may not have enough "oomph" for 600 ohm board inputs, so you may have to build a booster if you want to try this design in your studio.

That same warning applies to any equipment designed for home stereo use. If the output connector is the usual RCA phono style, it was meant to drive a 10K ohm or higher impedance. Jamming it into one of your board lines may result in distortion and poor low frequency response.

Use a higher impedance line input or pad down a microphone input, or add a booster. A 5534 opamp wired as a voltage follower will do. Or, you can buy one of the ready-made drivers designed to interface CD players with balanced 600 ohm broadcast equipment.

Once again, thanks to Scott Hochberg and John Andrews for their valuable input on phono systems. If you would like to add some thoughts to this discussion, please feel free to write me c/o RW or my home address, 5653 Weymouth Drive, Rockford IL 61111.

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Aid Manager/Engineer Interface

by Tim McCartney

St. Cloud MN . . . Managers and engineers frequently fail to see eye-to-eye on important station concerns.

As a former manager, I was regularly confused by the engineers' actions. As a CE, I now find myself better able to understand this logic. As a graduate student in training and human resources development, I try to identify resolutions to problems stemming from the differing points of view.

Below are some true and/or typical scenarios which highlight these seemingly inherent differences.

Manager: Our transmitter building electrical costs had been very high during the winter months, partially due to a space heater for the fussy exciter.

At one point, the engineer mentioned the procedure for managing antenna icing, simply turning on the antenna heater elements in October and off in April. For convenience, the engineer chose both the simplest and most expensive route. In so doing, the electrical bill soared and the heater element life of

Tim McCartney is CE at KSJR (a Minnesota Public Radio station), Collegeville, MN and a graduate student in Training and Human Resources Development at St. Cloud University. He can be reached at 612-252-6602.

the six antenna bays was seriously reduced.

Is that really "managing" antenna icing?

Engineer: We have a serious antenna icing problem and had frequently been off the air due to excessive VSWR. The manager strongly emphasized the top priority of remaining on air (no surprise to me) and to do so *at any cost* (a real surprise to me).

So, I turned on the heater elements until spring—and over the past two years we haven't had a single icing problem. Instead of congratulations, complaints surfaced about the electrical bill. I reminded the manager of the "at any cost" ultimatum, but received no response.

I once ordered an automatic ice sensor to interface with the heater element control, but the order was cancelled due to cash flow problems.

Manager: I don't understand the engineer's priorities—they're not the same as mine. Two examples come to mind.

Once I went to the transmitter building and found snow blowing in through the 1/2" cracks around the air conditioner. Worse yet, it was blowing directly into the exciter, which was unprotected with its top cover removed. I actually saw snow on the exciter's components!

Another time our only cart record machine went down and we couldn't cut any spots. The engineer wasn't interested

in resolving the problem immediately—signifying to me a lack of understanding about the connection between spots and revenue.

Engineer: I have so many projects underway that it's impossible to keep the manager constantly informed.

For example, one day I was trying to complete a cable run before the ground froze. The manager complained about snow on the exciter. I pointed out that five months earlier I had requested funds to hire a contractor to tighten up the transmitter building, but was refused. I also mentioned again that the 18-year old exciter needed to be replaced because of its terrible temperature sensitivity problems.

On another harried day, I was out with a contractor repairing the transmitter building fence when I learned that the station's only cart record unit had failed. I needed to remain with the contractor. The manager then became upset when I was not able to immediately look at the problem, conveniently forgetting my earlier advice that one record cart unit was not sufficient.

Imagine a manager who doesn't

understand the importance of spots in earning station income!

Manager: We must have a thousand spare parts, but never the ones needed for a job. Is our engineer ordering the wrong parts?

Engineer: Every time I need parts for a project, the manager wants to know why the ones we have won't do. I wish it could be understood how small our spare parts supply is compared to the total number of parts in use in the station equipment. I also wish he would recognize that an investment in spare parts is quite small when compared to an investment in new equipment.

Manager: Why does the engineer need to go to the NAB show when no plans exist to purchase new equipment?

Engineer: If there's station money for the manager to attend state radio conferences, why isn't there money for me to attend the NAB show? After all, it's one of the best ways to stay current on engineering technology.

Manager: Some of our engineering projects take four or five months to complete. That seems too long.

Engineer: Sometimes every conceivable roadblock emerges during the same project. While I am reluctant to offer specific excuses, I may print up an *engineer's* **(continued on page 26)**



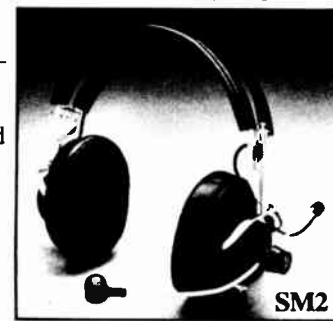
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LPB Xmtr Eases PSSA

by Perry L. Moore

Pittsfield IL ... Like many other AM daytimers, WBBA received an authorization for nighttime operation at a power significantly below daytime.

Our PSSA is 12.1 W, a power we initially achieved by a simple resistor network (see Figure 1). This system served its purpose well by economically giving us an idea of the coverage attainable at PSSA, but I had a problem accepting the fact that most of our RF was going up in BTUs.

About a year ago I helped a friend get an older LPB carrier current transmitter set up, and decided I just had to try one in a PSSA application. I located just what I was after at a college in New York, an older LPB RC-25B, 1971 vintage. Cost of the project was now at \$200.

While the transmitter was on its way, I ordered the rest of the goodies to make the whole thing a reality, I hoped.

As illustrated in Figure 2, K1 is a Dow-Key relay, a coax switch easily capable of handling my power requirements. This relay is furnished with S0-239 connectors and a set of DPDT auxiliary contacts that were used for interlocking, as shown. The coil is 120 VAC.

K2 is an ATC 328 time delay relay. K2 allows delaying of coax transfer until the filaments in the LPB are warmed up.

K3 is a B&W 377 coax relay, commonly referred to as a T-R switch. It is also equipped with S0-239 connectors and a line voltage coil. This relay is used to change the sample loops in each transmitter to provide drive to the modulation monitor.

Perry Moore is CE at WBBA-AM/FM, Pittsfield, IL. He can be reached at 217-285-2157.

K4 is a small RF relay used to provide line current measurement through an RF ammeter. This relay was out of the parts cabinet, and its 120 VDC coil required the use of a simple rectifier/filter.

I was ready for the transmitter at this point, but the college we had purchased it from was very slow about shipping it. Over 60 days went by before I had a chance to get my hot little hands on it.

A bench inspection showed it to be in very good condition and exceptionally clean. Step 1 was to get the transmitter retuned from its present 640 kHz to WBBA's 1580.

A call to the folks at LPB and here comes surprise number one; crystals became unavailable 30 days ago! I ended up ordering a crystal (from ICM in Oklahoma City) with solder-in leads and 0.005 accuracy. A very good buy for \$12.

While waiting for the crystal, I talked again to the folks at LPB and got the necessary data to retune the transmitter. It involved replacement of three silver mica capacitors in the oscillator tank, final tank shunt and output coupling, plus shorting several turns on the tank inductor. The guys at LPB were great about helping me, though I think a bit skeptical.

The crystal arrived and, after installation, the transmitter tuned up just dandy, but was 100 Hz above center. Shunting the crystal with 100 pF silver mica brought things back the other way to 100 Hz below center.

Coming from several generations of blacksmiths, I modified a compression mica capacitor by removing one of the stator plates. With the help of my trusty digital capacitance meter, I soon had a 15-75 pF variable. I soldered it across the

(continued on page 26)

Figure 1.

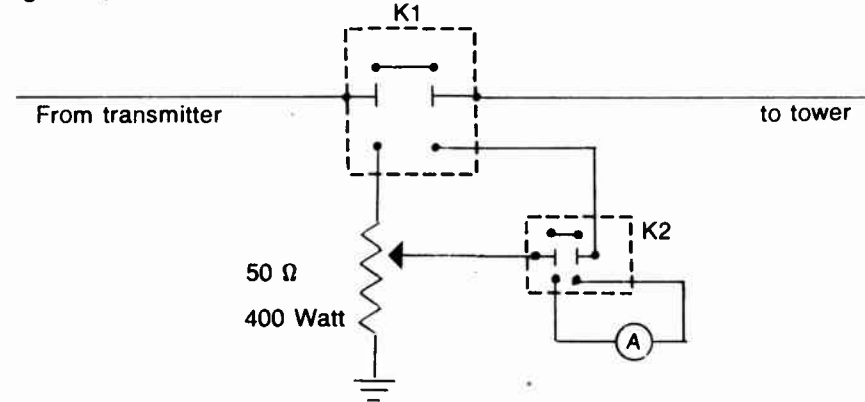
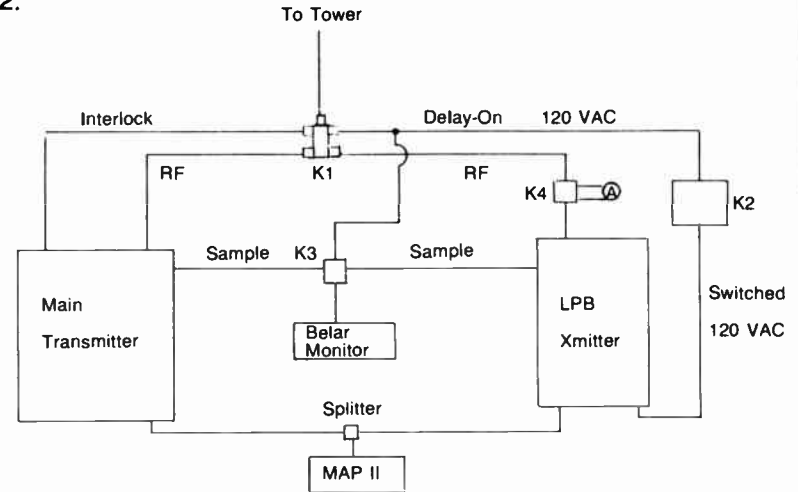


Figure 2.

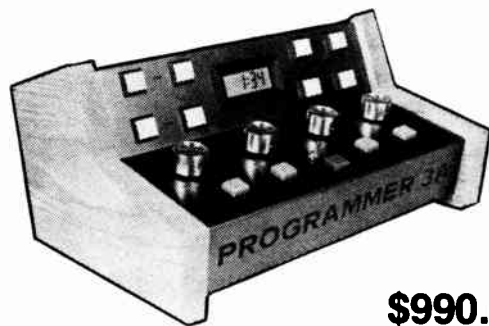


Notes

- 1.) For simplicity, line neutrals omitted
- 2.) Transmitter RF to K1 thru RG-8U. 1/2" heliax from K1 to tower
- 3.) Sample RF to monitor thru RG-58U

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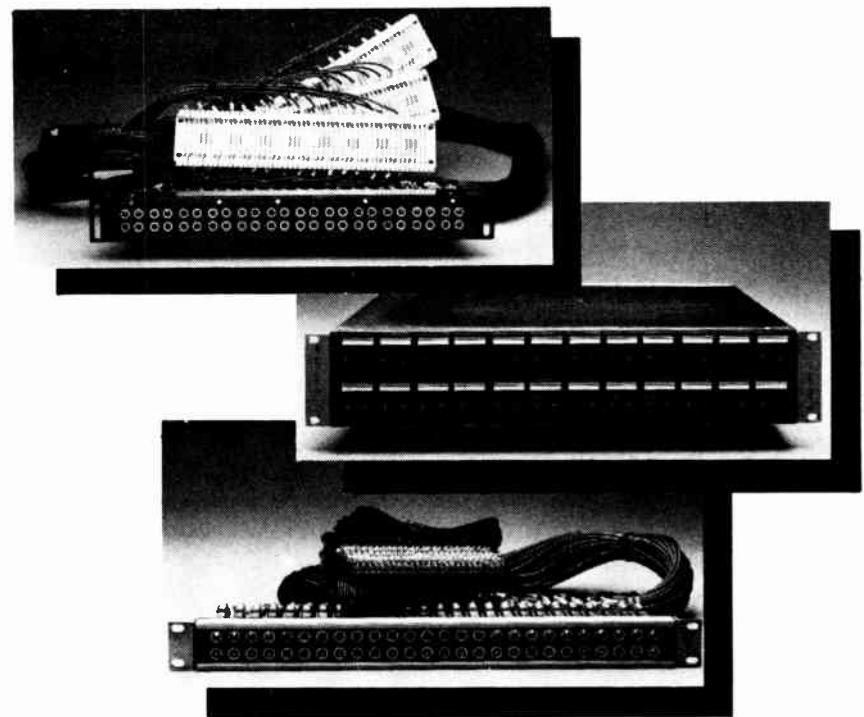
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Circle Reader Service 11 on page 32

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Circle Reader Service 34 on page 32

Broadcast Computing

Make Metric Easier

by Richard H. Houston

Durango CO ... There's lots of converting going on these days! Now that the FCC has officially made the switch to the metric system on broadcast applications, a progressive step with which I certainly don't disagree, engineers are working their calculators hard. The problem is that the forms must contain metric things, but the sources of data still have lots of "English" in them.

The 7.5" topo maps nicely give you the choice of miles or kilometers, but the elevation data is in feet. The new FCC curves are in kilometers and meters, but they are largely useless. (Ever notice that Section 73.313 says that the curves in 73.333 *must* be used, although Section 73.333 says they *must not* be used?)

Of course the conversion is trivial—once you look up the possibly long-forgotten conversion factors—but it is still a nuisance if you have a fair number of figures to convert.

Having made a lot of such conversions, I finally decided that my computer

Richard Houston is president/owner of High Country Engineering, Durango, CO. He can be reached at 303-247-9159.

should do what it's so good at and make the conversions for me. To avoid having to go to the computer over and over, I decided that the program should accept my input figures and print out those figures and the converted ones in a list that I could then take back to my desk for use.

The accompanying program is the result. It asks for the conversion you wish to make and then prints out the appropriate headings at the top of two columns. Then it asks you to enter your figure to be converted, does the conversion and prints out (on the printer) both figures in their respective columns. As a convenience for reading the figures, the program adds a space after every five entries.

With my penchant for making programs do as many things as they can, I included several common conversions besides those that might be used for broadcast applications. You can eliminate any of them or add others that you may need.

You may have to do some translation to your dialect of BASIC, so a few remarks about the program are in order. Lines 40 through 400 are the main menu. There is plenty of room after line 150 to

```

10 'MISCELLANEOUS CONVERSIONS -- MISCONV/BAS
20 CLS:PRINT TAB(23) "MISCELLANEOUS CONVERSIONS PROGRAM"
30 PRINT:PRINT "ENTER NUMBER FOR DESIRED CONVERSION (BREAK TO
STOP)"
40 PRINT:PRINT TAB(10) "1. MILES TO KILOMETERS"
50 PRINT TAB(10) "2. KILOMETERS TO MILES"
60 PRINT TAB(10) "3. FEET TO METERS"
70 PRINT TAB(10) "4. METERS TO FEET"
80 PRINT TAB(10) "5. INCHES TO CENTIMETERS"
90 PRINT TAB(10) "6. CENTIMETERS TO INCHES"
100 PRINT TAB(10) "7. OUNCES TO GRAMS"
110 PRINT TAB(10) "8. GRAMS TO OUNCES"
120 PRINT TAB(10) "9. DEGREES TO RADIANS"
130 PRINT TAB(9) "10. RADIANS TO DEGREES"
140 PRINT TAB(9) "11. FAHRENHEIT TO CELSIUS"
150 PRINT TAB(9) "12. CELSIUS TO FAHRENHEIT"
400 PRINT TAB(15) "YOUR CHOICE ";
410 INPUT " ",A
420 CLS:ON A GOTO 450,460,470,480,490,500,510,520,530,540,550,560
450 A$="MILES":B$="KILOMETERS":DEF FNA=A*1.609347:GOTO 1000
460 A$="KILOMETERS":B$="MILES":DEF FNA=A*.6213699:GOTO 1000
470 A$="FEET":B$="METERS":DEF FNA=A*.3048006:GOTO 1000
480 A$="METERS":B$="FEET":DEF FNA=A*3.280833:GOTO 1000
490 A$="INCHES":B$="CENTIMETERS":DEF FNA=A*2.540005:GOTO 1000
500 A$="CENTIMETERS":B$="INCHES":DEF FNA=A*.3937:GOTO 1000
510 A$="OUNCES":B$="GRAMS":DEF FNA=A*28.34953:GOTO 1000
520 A$="GRAMS":B$="OUNCES":DEF FNA=A*.03215071:GOTO 1000
530 A$="DEGREES":B$="RADIANS":DEF FNA=A*.0174533:GOTO 1000
540 A$="RADIANS":B$="DEGREES":DEF FNA=A*57.29578:GOTO 1000
550 A$="FAHRENHEIT":B$="CELSIUS":DEF FNA=(A-32)*5/9:GOTO 1000
560 A$="CELSIUS":B$="FAHRENHEIT":DEF FNA=A*9/5+32
1000 LPRINT A$,B$:LPRINT
1010 C=#
1020 PRINT "ENTER ";A$;:INPUT " ",A
1030 LPRINT A,FNA:C=C+1
1040 IF C=5 THEN LPRINT:C=#
1050 GOTO 1020
1060 END

```

add other choices. The null string followed by a comma in line 410 suppresses the question mark in my particular BASIC. If you change the menu, you will also have to change the ON-GOTO list

in line 420 to match.

Lines 450 through 560 are where the actual conversions are specified. The appropriate formula for each conversion is **(continued on next page)**

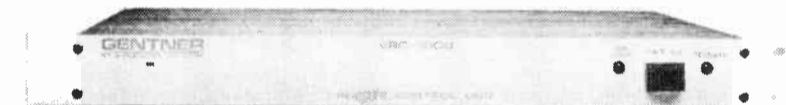
We Can Provide Remote Control for All Occasions

Moseley MRC-1600 Terrific value at a modest price

- 16 Status channels
- Programmable status alarms
- 32 control functions (16 raise & 16 lower)
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- Automatic indirect power measurement computation programmable

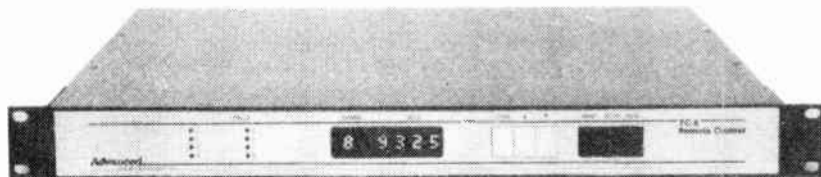


VRC-1000 Now Available Remote Control from Anywhere



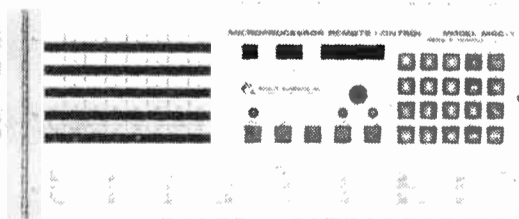
- Perfect for multiple studio site operation
- For Group Directors of Engineers
- For Contract Engineers
- For Back-up Remote Control of larger systems

Advanced micro-dynamics inc. TC-8

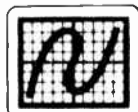


The Advanced Micro-Dynamics TC-8 is designed to provide highly reliable transmitter control at a modest cost. Eight metering channels are displayed on a large, easy to read dot-matrix array. The status display provides continuous tally for eight on/off inputs.

Moseley MRC-1 Remote Control System



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NORTHEAST BROADCAST LAB, INC. PO Box 1176 South Glens Falls, NY 12801

Broadcast Computing

"FM Expert"

Typing & Translation Services has released its latest software, "FM Expert."

Along with the new "TV Expert" software, "FM Expert" is designed as a low-cost solution to meeting transmitting requirements on bands II, III, IV and V.

The menu-driven programs take into account local typography, local height limits, user preferences and DA systems.

Worth a Scan

Additional features include automatic selection of the optimum type of coaxial feeder, connectors and accessories. The program takes into account antenna efficiency and compensates for the loss in the feeder run, depending on the height of the antenna mast.

Two main options provided from startup include allowing the lowest cost system to be designed from scratch, with each unique solution cost-analyzed. The user may then use either his own pricing for system components or use program default values, based on an average of manufacturers' prices.

The other main option allows the predicted performance of a proposed or existing system to be evaluated for field strength, power, antenna gain or height versus target distance. Accuracy achieved is generally within 5% of FCC data.

The "Expert" is able to choose from a wide variety of transmitter powers, from 20 W to 60 kW.

Initially available under PC-DOS for IBM and compatible microcomputers, FM Expert (and TV Expert) are priced at \$225 each, air-mail post-paid. MS-DOS versions are now in production.

For more information, contact Clive Warner, systems programmer and broadcast engineer, or Sandra Warner, proprietor, at Typing and Translation Services, 75 Willow Road, Solihull, West Midlands, B91 1UF, England or call 021-704-1399.

Timeslot Personnel

Microtek Computer Consultants has released an enhanced version of its Timeslot Personnel scheduling program.

Version 2.6 allows scheduling of up to 350 employees per department, with user-defined job titles, union parameters and employee job level skills.

Timeslot runs on IBM PC/XT/AT and compatibles with 256K and either floppy or hard disk. List price is \$1,495.

For more information, contact Microtek Computer Consultants, PO Box 603, Medford NJ 08055 or call 609-953-0946.

(continued on page 24)

Program Thinks Metric

(continued from previous page) included in a DEF FN statement, with A as the variable. These lines also assign strings for printing the column headings. You can change or add to these lines to produce any conversion that can be expressed in a formula. There is plenty of room after line 560 for additional conversions. Again, be sure you coordinate the

lines referring to these defining lines.

Line 1030 does the actual calculation. The counter variable C in lines 1010, 1030 and 1040 does the spacing after every five printed lines.

Obviously, this is no major breakthrough in programming, but I think you'll find it as useful as I have if you do much FCC form work.

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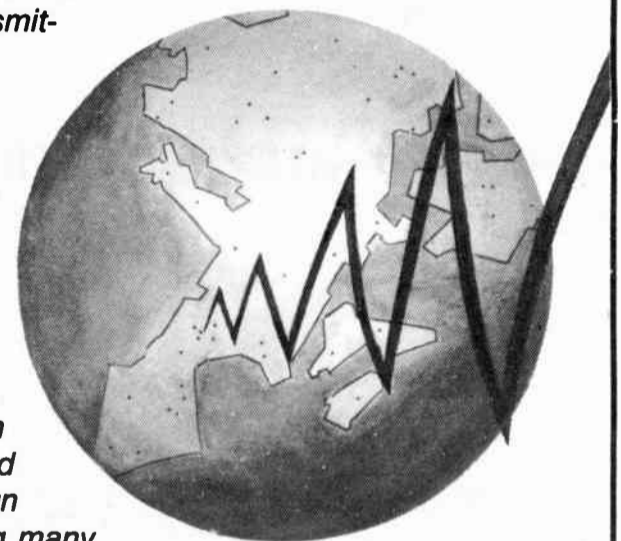
More than 1,000 CSI AM and FM transmitters are spread throughout the world, featuring innovative design features for today's broadcaster.

CSI transmitter design is straightforward, using time-proven stable circuits and mechanical design features, assuring many years of superb performance.

CSI transmitters are designed for the broadcaster, with standardization of parts so that all are interchangeable for ease of operation; simplicity of design to control maintenance cost; and proven reliability.

You can count on CSI transmitters for many exceptional features, such as front panel circuit breakers, lighted pushbutton switches, high-low switch and local-remote switch that enables the operator to disable the remote control for safety purposes.

CSI is celebrating its 10th anniversary this year and now is part of the Cutler-Federal family of companies, headquartered in Lakeland, Florida.



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Broadcast Computing

Find Bias Network

by Ken Hollan

Austin TX . . . To calculate the bias network for a transistor class "A" amplifier which will operate over a given temperature range, a few things are necessary. You either need the transistor specs and a little time to do the calculations, or you need the specs and a nifty computer program which will do these calculations.

The program below was written on a TRS-80 Model 4, but will work on any computer. However, if your BASIC is different, there may be a few changes required.

Though there are quicker methods of design, there are more accurate and dependable methods, although they do take a little more time. I chose the latter in designing this program.

Equation (1) would occur at the lowest operating temperature and is representative of the lowest operating condition. The bias current I_E will be at its lowest value if the transistor's $h_{FE} = h_{FEmin}$ and $V_{BE} = V_{BEmax}$; therefore, at the lowest temperature:

(Equation 1)

$$V_b = (R_b / (h_{FEmin} + 1)) + RE * (I_{Emin} + V_{BEmax})$$

I_E will have its maximum value at the highest temperature of operation, and the worst-case bias condition will occur

Ken Hollan is president/owner of Hollan Electronics. He can be reached at 512-454-0229.

(Equation 2) if $H_{FE} = H_{FEmax}$ and $V_{BE} = V_{BEmin}$. Therefore, at the highest temperature:

(Equation 2)

$$V_b = (R_b / (h_{FEmax} + 1)) + RE * (I_{Emax} + V_{BEmin})$$

Now R_b can be determined by combining these two equations:

(Equation 3)

$$R_b = ((I_{Emax} - I_{Emin})R_e + (V_{BEmin} - V_{BEmax}) + ((I_{Emin} / h_{FEmin} + 1) - (I_{Emax} / h_{FEmax} + 1)))$$

To use the program, you will need the transistor specs to get the information that the program asks for. You will also have to arbitrarily pick the temperature range desired, the emitter current desired, the emitter resistor (if used), the desired V_{CE} , the power-supply voltage and the collector load value. The items you pick will need a little thought (or common sense).

You will need the following from the transistor specs:

- The H_{FE} range over the desired temperature at the desired V_{CE} .
- The change per degree in V_{CE} .
- The V_{CE} at ambient temperature (25°C).

Some of you will say, "Gee, you gotta be an engineer to figure all that out!" Anyway, the program is great and it will save you broadcast engineers a little time with your designs (I hope).

```

10 CLS
20 PRINT "FOR THIS PROGRAM, AMBIENT TEMPERATURE IS ASSUMED TO BE
25 C.
30 PRINT
40 PRINT
50 PRINT
60 INPUT "TEMPERATURE RANGE (10, 25, ETC) IN DEGREES C";DEGREES
70 CLS
80 INPUT "ENTER THE VBE VOLTAGE CHANGE PER DEGREE IN MILLI-VOLTS";
VOLTS
90 VOLTS=VOLTS*10^-3
100 CLS
110 INPUT "VBE AT 25 DEGREES C (AMBIENT)";VBEA
120 CLS
130 INPUT "DESIRED LOAD RESISTOR (RL)";RL
140 VBECHANGE=DEGREES*VOLTS
150 CLS
160 INPUT "CHOOSE A SUITABLE VALUE OF VCC (VOLTS)";VCC
170 CLS
180 INPUT "CHOOSE A SUITABLE VALUE OF EMITTER RESISTOR";RE
190 CLS
200 INPUT "MAXIMUM EMITTER CURRENT (IN MA.)";IEMAX
210 IEMAX=IEMAX*10^-3
220 CLS
230 INPUT "MINIMUM EMITTER CURRENT (IN MA.)";IEMIN
240 IEMIN=IEMIN*10^-3
250 CLS
260 INPUT "MINIMUM HFE";HFEMIN
270 HFEMIN=HFEMIN*(IEMIN/IEMAX)
280 CLS
290 INPUT "MAXIMUM HFE";HFEMAX
300 HFEMAX=HFEMAX*(IEMAX/IEMIN)
310 CLS
320 RB=((IEMAX-IEMIN)*RE+(VBECHANGE))/((IEMIN/HFEMIN+1)-
(IEMAX/HFEMAX+1))
330 CLS
340 PRINT "RB =";RB;"OHMS"
350 VBEMAX=VBEA+(VOLTS*25)
360 VB=(RB/(HFEMIN+1)+RE)*IEMIN+VBEMAX
370 R1=RB*(VCC/VB)
380 R2=R1*(VB/(VCC-VB))
390 PRINT "R1=";R1;"OHMS"
400 PRINT "R2=";R2;"OHMS"
410 PRINT "RE=";RE;"OHMS"
420 PRINT "TO CHECK MINIMUM VOLTAGE BETWEEN C AND E (VCE) FOR
CHOSEN LOAD"
430 PRINT "AND CHOSEN VCC PRESS ANY KEY."
440 IF INKEY$="" THEN 440 ELSE 450
450 CLS
460 VCE=VCC-((RL+RE)*IEMAX)
470 PRINT " 1. VCE=";VCE;"VOLTS"
480 PRINT
490 VC=(IEMAX*RE)+VCE
500 PRINT " 2. VOLTAGE FROM COLLECTOR TO GROUND (VC)=";VC
510 PRINT
520 PRINT "IF YOU WANT A HARD COPY PRESS <Y> THEN <ENTER> ELSE
PRESS <N> AND
530 INPUT "THEN PRESS <ENTER>";Y$
540 IF Y$="Y" THEN 550 ELSE 690
550 CLS
560 LPRINT
570 LPRINT
580 LPRINT "R1=";R1;"OHMS"
590 LPRINT "R2=";R2;"OHMS"
600 LPRINT "RE=";RE;"OHMS"
610 LPRINT "RL=";RL;"OHMS"
620 LPRINT "HFEMAX=";HFEMAX;"** PLEASE NOTE THIS IS A CORRECTED
NUMBER."
630 LPRINT "HFEMIN=";HFEMIN;"** PLEASE NOTE THIS IS A CORRECTED
NUMBER."
640 LPRINT "VCC=";VCC;"VOLTS"
650 LPRINT "IE MAX=";IEMAX*10^3;"MA"
660 LPRINT "IE MIN=";IEMIN*10^3;"MA"
670 LPRINT "THE VBE CHANGE PER DEGREE IS";VOLTS*10^3
680 LPRINT "TEMPERATURE RANGE DESIRED=";DEGREES/2;"DEGREES +/-
AMBIENT."
690 CLS
700 PRINT "IF YOU WANT ANOTHER CALCULATION PRESS <Y> THEN <ENTER>.
TO END"
710 INPUT "THE PROGRAM PRESS <N>, THEN <ENTER>";Y$
720 IF Y$="Y" THEN 10 ELSE 730
730 CLS
740 PRINT "                END OF PROGRAM"
750 END

```

Scan Newest Products

(continued from page 23)

Compusonics' New "CSX"

Compusonics recently demonstrated a new, patented digital video/audio recording process that significantly extends the storage capacity of any digital medium/floppy disk, CD-ROM and optical disk.

The new process, called "CSX"™, stores data at a much lower rate—about 120,000 bps for both digital video and digital audio information—compared to the standard 800,000 bps.

At the recent CES in Denver, Compusonics Video showed that it was possible to record 2 minutes and 40 seconds of audio/video data on a standard 5¼", 3.3 megabyte floppy disk.

The digital audio signal has a frequency response of 4,000 Hz and a dynamic range of over 90 dB.

For more information, contact Compusonics at 303-753-0093, or Bob Griffin at 212-255-8491.

Damaged Disks?

Data Retrieval®, from Data Protection Services, is a process that will return a damaged computer disk to a condition where it can be mounted and the data can be successfully read.

The damage can be from a head crash, fire, flood, impact, software crash, etc.

Data Retrieval works with hard or floppy disks and tape. The process reads around portions of the disk where the oxide coating has been lost, but retrieves valuable data not damaged. The process neither reads nor copies data.

The process can be accomplished within a two- to five-day period.

For more information, contact Gary Gepelt, Data Protection Services, 1507 E. 7th St., Tulsa OK 74120 or call 918-496-3475.

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Phono Preamplifiers

Circle Reader Service 39 on page 32

AN OPEN LETTER TO AM BROADCASTERS:

It appears at long last that the battle over AM stereo is nearing an end. This is not the good news that many had hoped it would be. Unfortunately, it does not mean that we as broadcasters have resolved the issue of not having a national standard system. What it means is that AM stereo receiver manufacturers have begun withdrawing from the market due to lack of consumer demand.

Pioneer has discontinued production of the KE-443A in-dash car radio, their only AM stereo product. Sony, once an ardent supporter of AM stereo, has discontinued two of their three AM stereo receivers. Removed from production were the SRF-A1, AM stereo "Walkman," and the SRF-A100, the hand-held receiver over which most broadcasters first listened to AM stereo. Some industry watchers had theorized these were discontinued to make room for a newer AM stereo product to be released soon. This theory is not based on fact. These products were discontinued due to lack of demand. No replacement products are waiting in the wings.

An editorial in the June issue of *Broadcast Engineering* magazine likened the battle over AM stereo to "... the Hundred Years War." The same editorial went on to say "... AM radio is getting killed in the marketplace." It continued "AM stereo must get off the ground in a big way, and soon. Otherwise, the receiver manufacturers that have gone out on a limb and produced high-quality AM radios will conclude AM isn't worth the trouble." The cover story of the June 16th issue of *The Pulse of Broadcasting* magazine opened with the statement "AM stereo, that noble experiment, appears to be failing." The title of the article was "AM Stereo is Dead ... Long Live AM Stereo."

The birth of AM stereo presented an awkward "chicken-or-egg" dilemma. No station could see financial benefit to implementing AM stereo unless consumer receivers were available in quantity. Similarly, manufacturers would find no demand for their receivers if no AM stereo service were available for the listener. One group or the other would have to perform an act of faith and act first, believing that the other group would follow. Someone had to go out on a limb.

The receiver manufacturers took the initiative with enthusiasm and produced AM stereo receivers in all shapes and sizes. Manufacturers from Radio Shack to J.C. Penney produced in-home receivers. VW and SAAB made AM stereo standard in some model cars. Chrysler included AM stereo at no extra charge with every FM stereo radio sold.

When it came time for AM broadcasters to do our part, a grim reality presented itself; we did not have a national standard. Many stations which would have converted to an AM standard did not, because it was not and is not clear which system would eventually have the greatest number of receivers in the field. Two of the original four proponents of AM stereo systems have withdrawn, leaving many broadcasters with a multi-thousand dollar investment in a transmitting system which no one can hear.

Ten-thousand dollars is a significant amount of money, even to the largest station. No one wants to guess wrong on the remaining two systems. No one wants to spend the money until it is clear that it will be of value to the station for at least longer than it takes to install it. So most AM broadcasters sit and wait ... and watch. To this date, only about 10% of licensed AM stations have invested in AM stereo.

Another reality is that the fixed costs of a manufacturing production line are prohibitively high. Without demand for the product produced by that assembly line, the manufacturer has no choice but to close it. "It can't happen here" is simply not a realistic outlook. Those who doubt this should look to the disappearance of the television video disc player.

The point is not that large electronic manufacturing firms are losing money and we as broadcasters have a moral obligation to bail them out ... to make their unprofitable divisions profitable. The point is that one day AM broadcasters will resolve the issue of a national standard and will find that it no longer matters. Receivers will not be available in sufficient numbers or from a sufficient variety of sources to make it a competitive medium. Once the receiver manufacturers are gone, the damage will be permanent and irreparable. Once burned, the receiver manufacturers will not return. Our inability to organize ourselves may also negatively impact the image which manufacturers have of us, and dampen their enthusiasm for the next time we need new products, such as perhaps FMX receivers.

Some ideas are simply bad ideas and *deserve* to die. AM stereo is not a bad idea. It is simply an idea without an established standard.

It is not our purpose to become embroiled in the midst of the holy war that the choice of an AM stereo system has become. Certainly there are knowledgeable and honorable people who advocate each of the remaining two systems and it is not too difficult to imagine that *both* of the two remaining systems work sufficiently well to get the job done.

The purpose of this letter is not to advocate one system over the other, but to say that we need ONE NATIONAL STANDARD, and we need it very soon. Without it, AM stereo will die, very soon ... and so will AM radio as we have known it.

Your government in Washington can best help you if you help them. Let them know how AM stereo is doing (or not doing) in your market. If you have an opinion regarding the current state of AM stereo, or if you have other information which you believe would be of interest to the Commission regarding AM stereo, please send it to:

Mr. William Tricarico
Secretary
Federal Communications Commission
1919 M Street, N.W.
Washington, D.C. 20554

It is true that the more thought that appears to have gone into a letter, the more credibility it is likely to receive when read. A dispassionate presentation of your opinion or facts is to be preferred over emotion-packed rhetoric. FCC staff members are people too and an emotion-packed letter is just as draining to read for them as it is for you. Your letter will be more effective if it advocates the positive aspects of one viewpoint rather than ridiculing another ... if it addresses what can be done in the future, not what has happened in the past.

If you have something to say, please say it now. AM stereo and AM radio can still be saved, if we are able to unify behind a national standard. But we must act now.

TEXAR

616 Beatty Road, Monroeville, PA 15146-1502
(412) 856-4276

LPB Xmtr Saves on PSSA Costs

(continued from page 21)

crystal and we were in business.

Let me say at this point that ICM did some pretty fancy shooting on this crystal, because the specs I was able to get from them were vague at best.

Putting the whole thing together went very smoothly. The key was to keep the system simple for the operators and reliable in operation.

The audio was routed to both transmitters from the MAP II processor by using an LEL 200 passive splitter. For those of you not familiar with this little beauty, it gives isolated 600 ohm outputs for a single 600 ohm input and has about 3 million uses in an AM/FM facility.

Audio level was set by adjusting the MAP II for correct main transmitter modulation. This level was also fed to the input potentiometer on the LPB. Correct modulation was set through this control, which is on the back of the transmitter and is locknut protected from unauthorized fiddling.

Modulation monitoring of the LPB was accomplished by hand winding 30 turns of 24-gauge enamelled wire in a 1" diameter donut, and mounting it on an adjustable bracket near the PA tank.

The sample loops from each transmitter are routed to the Belar monitor via K3. The loops were oriented to provide equal amounts of drive, thus eliminating the need for the operator to readjust the

carrier level when power is changed.

To enhance simplicity and provide transmitter protection, the DPDT auxiliary contacts on the main coax relay, K1, were used to provide automatic high voltage shutdown on the main transmitter when the antenna was transferred to the LPB. By the same token, the LPB cannot be brought up without a load.

The change to PSSA goes like this. The operator saunters into the transmitter room when it's time to go to PSSA

and turns on the LPB.

When the power switch comes on, K2 begins a 12-sec time delay that matches the filament warmup time of the LPB. Just as plate current starts up on the LPB, K2 closes, transferring the antenna to the LPB, opening the control circuit of the main transmitter high voltage and switching the modulation monitor to the LPB.

After a few minutes, the operator turns off the main transmitter filaments.

Since we also use the LPB for PSRA in the morning, the procedure is to depress the plate ON button and, while holding it in, turning off the LPB for immediate change to high power.

Well, the best part of the whole thing is that the system works great. The changeover is very smooth, with no dead air, and the audio quality is as good as the main transmitter, an older Gates 250 that has been gone through, with the result being distortion around 2% and response within 2 dB from 50-7500 Hz.

Cost of the low power system was about \$500. I consider it to be a very worthwhile investment.

Aid Engineer/Manager Differences

(continued from page 19)

excuses T-shirt.

- Parts delayed
- We couldn't afford it
- Wrong parts came
- No technical manual on it
- Parts lost
- Weather delays
- I was on another project
- It's not a priority
- We want to be on-air at any cost!
- All of the above

A movable, Velcro-style ✓.

Resolution

A resolution to these stories seldom requires a personnel change, although that is often a tempting route. Rather, both manager and engineer have to do some

work.

Both must communicate better and more often with each other in person and in writing. The emphasis must be on resolutions rather than on assigning blame. Both must be patient.

The *manager* must involve the engineer in long-range planning and goal setting. The manager must also ask questions, and take interest in and learn more about engineering.

The *engineer* must set up engineering goals in synch with organizational goals. The engineer must ask questions, take interest in and learn more about management concerns, such as cash flow, budgets and their overall impact upon the station.

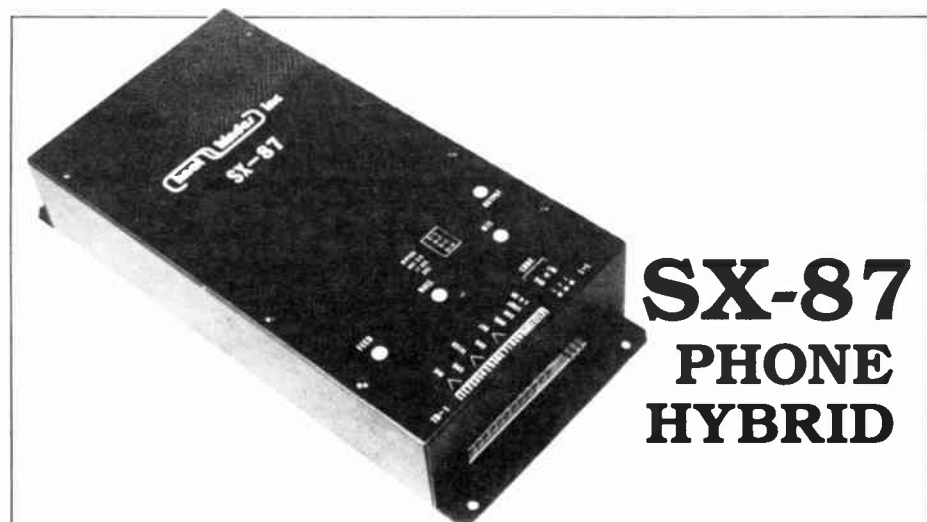
For example, the antenna icing problem could have been resolved had the engineer repeatedly made the case for the

automatic ice sensor, even after being turned down the first time. Presumably, the manager would have eventually responded.

The snow on the exciter and cart record machine episodes could have been resolved if the manager had followed up on the engineer's earlier concerns for some needed expenditures. Even so, the engineer must regularly make a case for this needed equipment while taking temporary, precautionary measures to keep snow off the exciter.

In all cases, the least effective but easiest route is *blame fixing*. Rather, the orientation should center on open discussion of problems in order to find *resolutions*.

Engineers and managers need each other and both have to do more to improve their working relationships.



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Circle Reader Service 17 on page 32

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Circle Reader Service 41 on page 32

Output Network Often Neglected

by Joe L. Bellis

Part II

Cape Girardeau MO . . . Of the numerous approaches to broadbanding AM transmission systems, many tend to ignore the output network of the transmitter. In order to provide a cleaner sound—with brilliant, crisp high frequencies—the complete AM transmission system must be thoroughly examined and systematically attended to.

Any AM transmitter in operation today can be made to perform *par excellence*, provided it is properly tuned into a reasonably wideband load (and it has been maintained to manufacturer specs). On the other hand, a brand-new, super-deluxe transmitter can sound worse than the replaced transmitter when fed into a poor antenna system.

Transmitter manufacturers are aware that many antenna systems are less than ideal, and therefore design the transmitter output networks with nominal latitude to compensate for the antenna system defects.

The various manufacturers use almost as many different network designs as there are manufacturers. Seldom is any information about the output network parameters published. There are basic design parameters incorporated into all the output networks;

- Low Q at the plate end (usually a Q of 5 to 10);
- Overall network phase shift of -135° to -225° (to minimize interaction between the plate tuning and the plate loading controls);
- Harmonic and spurious radiation suppression (usually -70 dB to -80 dB below the fundamental frequency); and
- Ideal performance into an optimized load (resulting in a sideband VSWR of 1.2 or less at 10 kHz to each side of the carrier frequency).

The actual design parameters are not really important; only the operational parameters of your transmitter at your installation are of importance.

Before any attempts are made to verify and/or incorporate an optimum load (PA sideband symmetry), the transmitter manual and related schematics should be studied. An understanding of the operational purposes of the network components and the manufacturer's tuning procedures is essential for maximum results from the transmitter.

The transmitter output network will accomplish:

- Impedance matching from the final tube output to the antenna (transmission line) with some degree of tolerance to the complex antenna load; and
- Harmonic and spurious signal reduction.

Some manufacturers have added third harmonic resonator circuits and related traps in order to increase the overall effi-

ciency of the transmitter.

It is quite obvious that the transmitter must be fed into a good nonreactive dummy load, and that all parts of the output network be properly adjusted to manufacturer's specifications before any attempts are made toward optimum loading. The dummy load is the theoretical optimum load for all comparative measurements.

Although the effectiveness of the har-

monic traps depends to some extent upon the impedance characteristics of the antenna system and the harmonic frequencies, the transmitter *must* be fed into a dummy load and the traps adjusted according to manufacturer's specifications for maximum harmonic reduction.

If the service manual does not provide for a particular method of trap adjustment, the following method may be used, with all power removed from the

transmitter.

Connect a signal generator, tuned to the harmonic frequency, through a series resistor (1000 to 10,000 ohms) to the plate of the final tube of the transmitter (with the final tube in its socket and all networks connected).

Sample the output of the transmitter into a field strength meter or a communications receiver (with AGC defeated),

(continued on page 28)



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Joe Bellis is owner and chief engineer of RMF Associates, a technical consulting firm providing broadcast services throughout the Midwest. Call him at 314-651-4272.

Examine Output Net

(continued from page 27)

tuned to the harmonic frequency. Adjust the trap for a minimum indication on the field strength meter or the communications receiver S-meter. Once the harmonic trap is adjusted for minimum indication, it should not be changed.

Adjusting harmonic circuits

Adjusting the third harmonic resonator circuit (if the transmitter has such a circuit) will require a signal generator and an oscilloscope.

The signal generator output, tuned to the third harmonic frequency, is fed to the plate circuit through an appropriate series resistor. The output of the third harmonic resonator circuit is grounded.

The scope is coupled to the resonator network. The network is adjusted for maximum signal.

Adjustments to the harmonic circuits, without power applied, will be much more accurate and safe.

After the harmonic circuits are properly adjusted and all the test equipment is removed, apply power and adjust the plate-tuning and plate-loading controls per the manufacturer's instructions.

It should be noted that with some transmitters, it appears possible to obtain several combinations of control settings which will yield nominal power output, due to the interaction between the plate tuning control and the plate loading control.

However, use the combination that delivers the desired output with minimum plate current (maximum efficiency) that follows the manufacturer's instructions. Some manufacturers recommend that the plate tuning control be adjusted for minimum plate current and then tuned slightly off resonance for the best stability and overall efficiency; check the

manuals.

The neutralization circuit should be adjusted, again following the manufacturer's instructions.

The following method can be used with a high degree of success if considerable care is exercised. Remove the B+ going to the final tube. Loosely couple the scope across the output of the transmitter.

Apply power to the transmitter and carefully adjust the neutralization control for minimum signal on the scope.

This procedure is very simple if the transmitter has a front panel neutralization adjustment. If the transmitter requires that the neutralization adjustment be made inside the transmitter, remove the power each time an adjustment is made, prior to making the adjustment.

Transmitter load optimization

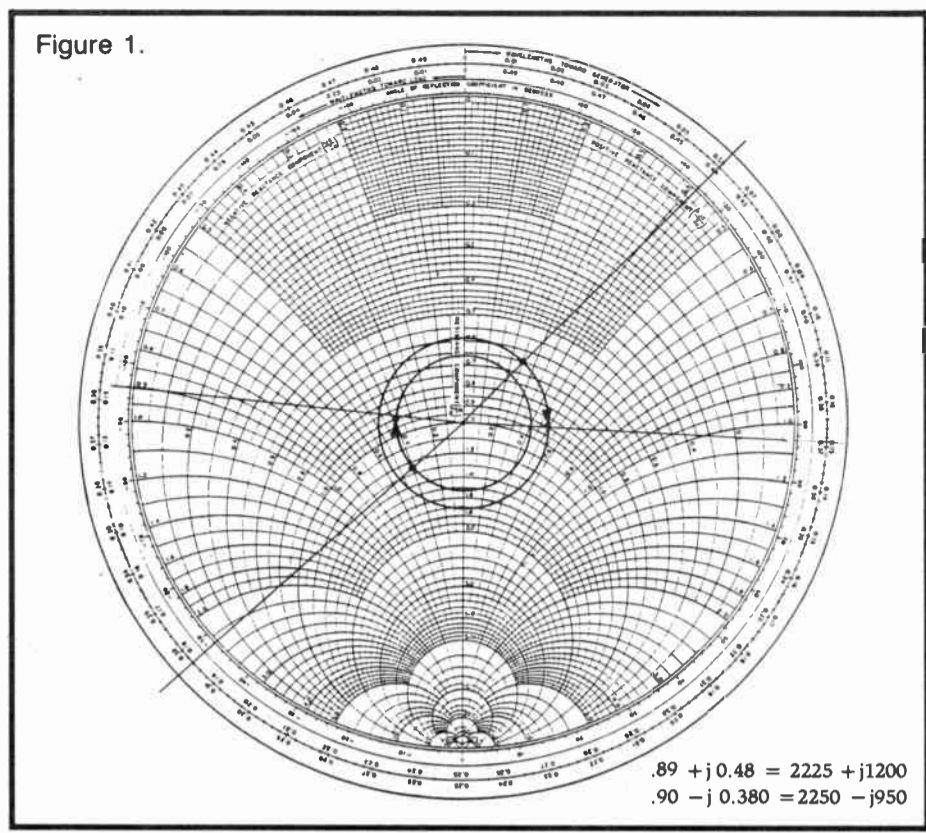
Once the transmitter is properly tuned and adjusted into the dummy load, the power can be shut down, the dummy load removed and the antenna reconnected. This assumes that all the other stages of the transmitter have been found to be in proper working order.

Transmitter load optimization is simply the process of adjusting the antenna system load so that the 10 kHz sideband load resistances are equal, and the 10 kHz sideband reactances are equal and opposite in sign when presented to the final plate circuitry with a sideband load VSWR of 1.3:1 or less. It can be accomplished in the majority of most AM antenna systems by adjusting the phase shift across the antenna tuning unit.

The output load impedances can be verified using the following procedures.

With all power removed from the transmitter and the antenna system connected to the transmitter, connect an RF

Figure 1.



impedance bridge across the final plate circuit with an appropriate signal generator connected to the RF bridge. The final tube(s) must remain in circuit so that the tube capacitances are presented.

Measure the plate impedances ± 20 kHz each side of the carrier frequency. The initial plate impedance can be reasonably calculated, as a starting point, by dividing the DC final plate voltage by two times the final plate current.

$E_p 2445 \text{ Ohms} = 5400 \text{ V } Z_{p1} = 2 I_p 2 \times 1.1 \text{ A}$

If the RF bridge is not capable of direct impedance measurements, the impedances can be brought within range of the bridge by placing a noninductive resistor across the PA circuit.

Do not use a smaller-value resistor than the impedance to be measured. The

lower the resistor value, the lower the measurement accuracy will be. Overall measurement accuracy will be slightly reduced with the parallel resistor, but if care is exercised, reasonable results will be obtained.

The impedance measurements should now be plotted on a Smith Chart (see Figure 1). If the measurements are valid, the points will travel clockwise from low to high frequency.

Be sure the reactances are corrected at each frequency according to the type of RF bridge used. The example below indicates impedances that might be measured at the PA (final stage) output of the transmitter:

Frequency Z (ohms) Z (normalized) VSWR

990 kHz 1625 + j750 0.65 + j 0.3 1.7

1000 kHz 2500 + j0 1.00 + j0 1.0

1010 kHz 3125 - j1000 1.25 - j 0.4 1.5

In order to determine the amount of phase shift change across the antenna tuning unit, the procedure is as follows:

- Plot the normalized impedances on the Smith Chart;
- Draw circles through the plotted points from the reference point;
- Draw lines from the center of the chart (the reference point) to the outer rim of the chart marked "Angle of Reflection Coefficient in Degrees";
- Move each 10 kHz point equal amounts around the circles until one point is directly above the other point. This is the point where the sideband reactances will be approximately equal in magnitude and opposite in sign;
- Draw a line from the center of the chart through the new point to the rim of the chart.

Count the degrees traveled from the original intersecting point on the outer rim to the new intersecting point on the rim. The distance traveled will be clockwise from the original point. Divide the degrees counted by two. This will give the additional phase shift necessary toward the generator (clockwise on the chart).

In the example given, the approximate additional phase shift of -24° will be

(continued on page 32)

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Agile Radio Downlink Justified

by Fred Baumgartner

Part I

Englewood CO . . . I wish I had written down where and who said that "to be in the communications business means to be in the satellite business." I doubt that too many stations are without any downlink capacity these days.

The larger story here is one of engineering management. As so often happens in engineering management, we can be either responsive or reactive. Before I get into the nuts and bolts of an agile radio downlink system, I want to spend some time on the basic management concepts that justify an agile system.

In reactive management, the need drives the process. In this case, the need to downlink a given program would have meant that the engineering department would have researched and purchased a fixed dish and fixed-tuned receiver.

The next program would have produced the same process. Three needed programs and we would have three dishes. Pretty soon we have a lot of money tied up in rather nonversatile gear and significantly less usable land.

The other approach is to respond to the situation. We know that we will need to downlink one program, and we will more than likely need more in the future. We do not know on what satellite the new services will be, or what transponder, and we can only reasonably guess at the formats (SCPC, digital, subcarrier).

Advantages to planning

In our planning process we can expect to gain some advantages over the, "Gee, we need a dish . . . let's plant one," reactive thinking.

The first advantage is to programming. An agile system removes the barriers of time and cost. With an agile system, one merely inputs the new parameters.

With the multiple fixed dish method, it takes time (at least a week, more often months) to purchase and plant the new dish. Cost is involved as well, of course. Because of the cost and time delay, a PD will most often think long and hard before adding another satellite service. Once done, if the program proves wrong for the station, the PD will have some reservations about dropping the show.

Another advantage is that special events programming doesn't wait. Having the ability to "cherry pick" among the networks (major national, minor statewide and special networks) provides the programmer with a definite advantage.

Redundancy, costs

The second advantage is in redundancy. In most operations, one or two fixed-service downlinks are necessary. In our case, CBS, a digital service, and MBS, a SCPC service, are on fixed

downlinks. Because WIBA runs the "Larry King Show" with CBS news all night, and uses both CBS and MBS news feeds all day, dedicated dishes are used.

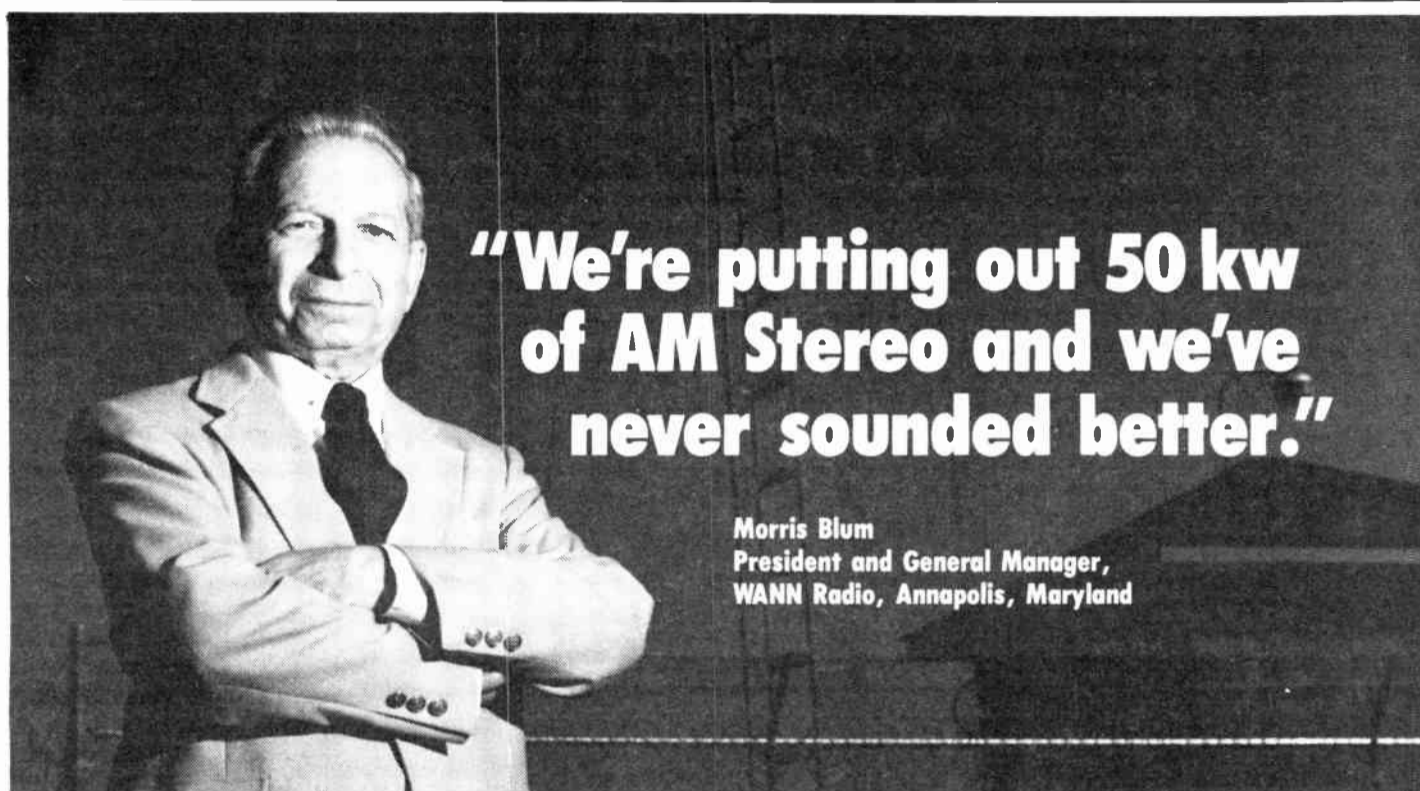
The agile system provides redundancy for the digital system from dish, LNA, lines and downconverter. The agile dish completely backs up the MBS system. Furthermore, because of this redundancy, the MBS system is not overbuilt, as reliability is not such an important fac-

tor. The cost savings in the MBS system, using more consumer-grade components and no backup anything (receivers, demods, etc.) is about one-third what a secure system should be.

I should add that we use an autodialer on a coupler phone, programmed with network couplers, to further support the system. Obviously, using the phone as a backup for short periods of time is better than nothing . . . but not much; of-

ten, too, networks fail to provide reliable phone backup. Further, in the case of extended programming (i.e., "Larry King"), the cost of the phone line significantly influences the profitability of the show.

The third advantage is the ability to piggyback, in particular, sporting events (in our case, the University of Wisconsin teams occasionally have local TV coverage). TV stations often use only one
(continued on page 31)



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Morris Blum
President and General Manager,
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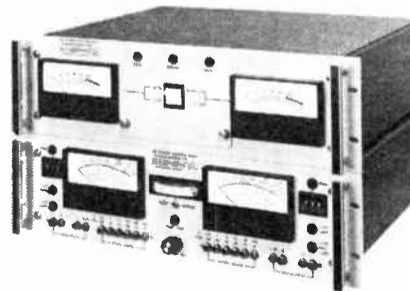
work the way it should. Literally trouble-free. Plus, it's got the numbers to back it up: over 65 systems operating in the U.S. and worldwide.

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"Stop by and I'll personally give you the deluxe station tour.

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DELTA ELECTRONICS



Frederick Baumgartner is assistant CE at KWGN-TV and a former CE of WIBA, Madison WI. He can be reached at 303-740-2222.

New Products

Digital Audio Storage

Mitsubishi International, with its DAS-2, has developed a method of digitally encoding and storing audio using 330 megabyte fixed disk drives.

The DAS-2 uses a small, detached control panel, detached RGB monitor, and a floppy disk system using 5¼" IBM PC/DOS/MSDOS format. An RS-232 interface is included with the system.

Key features of the DAS-2 include: multi-processing capability; dummy-insertion function for easier editing; stereo and mono system availability; the new Differential Pulse Code Modulation-Adaptive Quantification-Automatic Stabilization recording method; automatic file maintenance; convenient selection of editing speeds; two recording method choices; adjustable running time and storage of long or short programs.

For further information, contact Mitsubishi at 415-651-9955 or write Mitsubishi International, 46305 Landing Parkway, Fremont CA 94538.

Symetrix Voice Processor

The new Symetrix 528 includes all control functions needed for mic signal processing: mic preamp; compressor/limiter; downward expander; parametric equalizer and de-esser. Phantom power is available for condenser mics.

Levels are kept in check by the compressor/limiter, which allows normal

speech levels while responding quickly to transients; the downward expander prevents pumping, reduces noise from cart machine solenoids and paper rattling, and maintains the best possible SNR. The compressor/limiter and downward expander are interactive, enhancing dynamic processing.

The parametric equalizer smooths out acoustic anomalies and notches out hum and interference. Three overlapping sections cover the entire audio spectrum from 16 Hz to 22 kHz, providing 12 dB boost or 30 dB cut, with bandwidth adjustable from 0.05 octave to 3.3 octaves.

The patching and switching system allows the unit to be used to equalize the audio signal or the internal control signal. EQ in the control circuit makes the interactive dynamics processor more frequency dependent, making the compressor/limiter more sensitive to problem frequencies.

For more information on the Symetrix 528, contact Roy Blankenship at 206-282-2555 or write 4211 24th Ave. West, Seattle WA 98199.

FM Atlas and Directory

The 10th edition of the *FM Atlas and Station Directory*, thoroughly revised, is now available, according to publisher Bruce Elving.

Two years in the making, the 10th edition is designed to make it easier for FM



Sound Technology Stereo Analyzer

Sound Technology has introduced the 1530A MTS Stereo Analyzer/Monitor, designed to optimize troubleshooting, verification and alignment of the stereo AM, FM or MTS transmission signal path.

The 1530A accepts discrete left and right channel signals which have been demodulated from the aural carrier. The 1530A measures two-channel level, swept frequency response and narrow-band channel separation, phase error, and composite and spectral noise. In addition, the 1530A performs wave and

radio-equipped travelers or DXers to identify or home-in on signals.

The book features 77 pages of FM maps showing exact locations, call letters and frequencies, along with directories arranged by frequency and geography. Technical and programming data on some 5,000 FM radio stations in the US, Canada and Mexico are included.

SCAs, their uses, and low-power FM translators are given, with frequency and

IMD analyses.

Alphanumeric and graphic test results are displayed on the 1530A's integral CRT. The unit also contains an optional two-channel oscillator for transmitter site work, such as aligning the stereo generator, aural exciter, diplexer and transmitter.

The oscillator option also contains a precise low-distortion sideband generator (10,396 Hz) for use in Bessel null alignments.

The 1530A can also be used with any external audio generator for remote testing applications.

Deliveries are four weeks after receipt of order. The base price of the 1530A is \$5,850, with options ranging from \$130 to \$1,595.

For more information, contact Kent McGuire at Sound Technology: 408-378-6540.

call letters of the full-service station re-broadcast shown.

Editorial content includes stories on FM piracy, improving reception and FM DXing.

The 164-page directory has been in existence since 1971. It can be ordered from Bruce Elving, Box 24, Adolph MN 55701-0024, for \$8.95, with \$.55 postage. Two or more copies are \$7, plus \$.55 shipping.

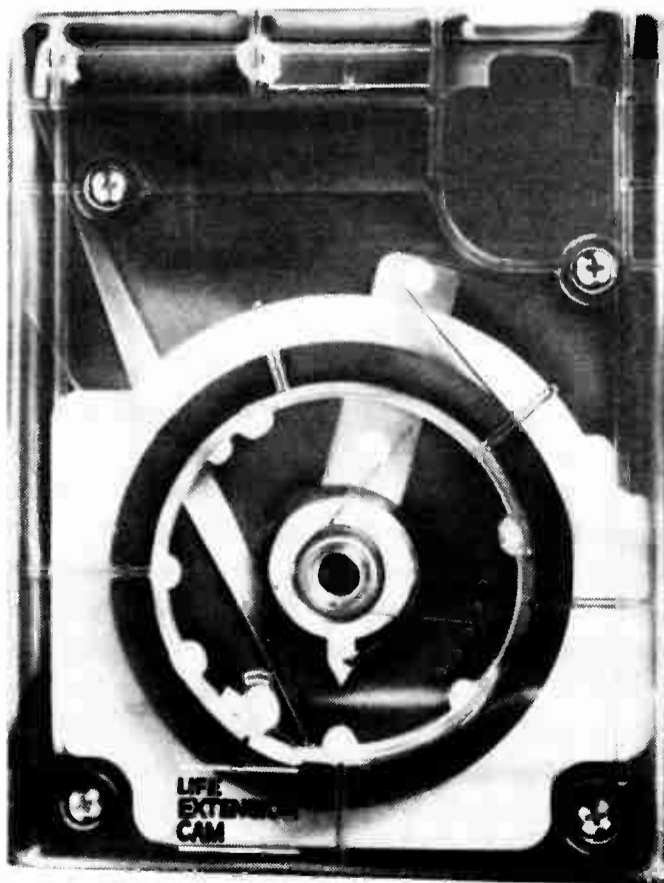
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Agile Radio Downlink Justified

(continued from page 29)

of the two subcarriers available via satellite. Often they will sublease the additional subcarrier at rates very competitive with phone lines.

Obviously, the satellite audio channel outperforms even a local 15 kHz loop (yes, it can sound better coming from across the continent than from downtown).

The fourth advantage to an agile system is "space awareness." Programmers can sample services at will. News can check out events elsewhere. Sports can pick up games that relate to local standings and get highlights. Teleconferencing programs and technical sessions carried via satellite are accessible.

The long and short of it is that an agile downlink has some significant advantages. Typically, the cost of the agile system is 25% to 50% above a fixed system yet, at the very least, it can do twice what a fixed system can do.

Of course, if your needs begin and end at one (or less) downlinked source, it doesn't make much sense to employ an agile system. If the future (3 to 5 years) is void of any potential needs, then you should rule out the agile downlink.

Case history

To give you some idea as to why we decided on an agile dish, let me briefly go through the history of WIBA. At the time we decided to go with an agile system, we had a Scientific Atlanta digital downlink for CBS, and leased two 15 kHz phone lines to deliver the two MBS services we needed.

The CBS system was in the \$12K cost range (installed). The phone lines ran \$3,600 per year. At this point (Fall '84) the Milwaukee Brewers' flagship station, WTMJ, Milwaukee, decided to go to SCPC distribution. A reliable fixed system for this would run about \$8K.

If we could combine the needs, MBS and the Brewers, into one downlink, the economics could easily justify the \$12K we would spend on the agile system.

Later we added the "Ed Busch Show" (talk show) on weekends. At this point, the agile system was on air about eight hours each day and spent a lot of time wheeling between different birds and transponders, etc.

Agile system overworked

At the end of the first year, the agile system was declared paid for, and overused. It had too much utility and thus we became too dependent on it.

We had foreseen this possibility and had prepared to add a MBS downlink to reduce the agile system's workload. Our only mistake was in not knowing how soon it would become advantageous.

For the MBS downlink, we traded for a dish, LNA and miscellaneous hardware. With the purchase of a used down-converter, and one used and one new demod, the system cost was less than \$5K.

As long as this combination works, we save the load on the agile system, but we recognize that it is not the battleship grade we would want if it was our only means of downlinking MBS.

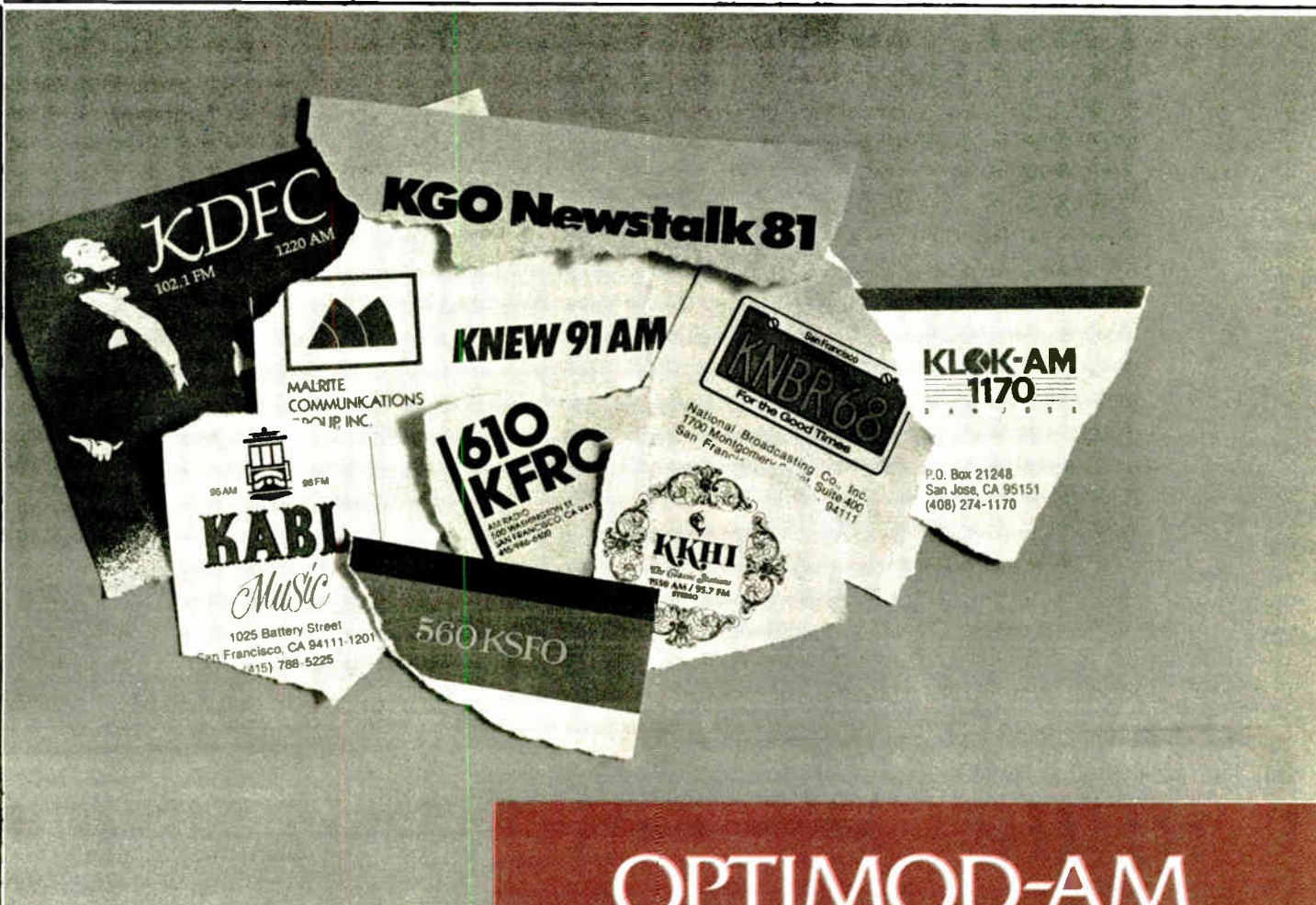
The MBS downlink becomes not a necessity of life but an affordable convenience (it also is somewhat agile, so it can back up the 'big' dish with labor intensive care; I'll talk about that in Part II).

I want to finish this part with an important note. No one at WIBA had

ever seen or heard of an agile radio downlink (though there are now several). No one sold a package system or recommended its installation. Several people said it couldn't be done.

Analyzing all the facts, we decided to fly counter to the advice and plan for the long term. Jim Worthington (now GM

at WNIC, Detroit), Tom Barney (now PD at WGAR, Cleveland) and Leonard Charles (now CE at WIBA) had the objectivity and support to explore new ground. In this case, they planted trees instead of shrubs. All the technical ability, creativity and willingness means nothing without managerial support.



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Circle Reader Service 24 on page 32

Referrals Good PR

(continued from page 15)
ing their earning potentials.

"What I would really like to see," said Emrick, "is someone from station 'A', which is interfering with reception of station 'B', get together with someone from that station and see what they can do to resolve the problem together."

The FCC stands ready with educational help as well. The publication—"How To Identify and Resolve Radio TV Interference Problems"—prepared by their staff, stands as an excellent primer in the field and is available from their offices. It is also available from the Superintendent of Documents, US Government Printing Office, Washington DC 20402, Stock Number 004-000-00345-4.

Home visit guidelines

Visiting the home of a complainant will necessarily require you to use skills you normally do not use as a technician. Courtesy is vital, as is patience. Remember that these people are likely to be upset; they are having trouble receiving something they want, and will view you as their problem, not as a solution. It is up to you to explain that you are not an adversary.

It's best to go with another technician

or, better still, your station or general manager. Often the GM can take some of the heat while you can do some troubleshooting. Set a time for the meeting and keep it. Never say you will drop by when you have time to look at the problem; that is a sure way to lose any credibility you may have started out with.

When you want to try different solutions, be sure to ask permission. The equipment belongs to the listener. Use good judgment in what tricks you try; if you take the back off of that TV, you may have bought it. You may want to try only very simple solutions on your first visit, leaving more involved corrections for another session. This will allow you to discuss liability with station management.

You must be sure to keep very accurate records of each complaint case. After each conversation and each visit, write down everything you think is important. You can do this in the form of a diary. You will be amazed how many details you would have forgotten over time. Save each case in a separate file.

Never be afraid to call on another engineer for suggestions to a problem. This is neither a battle of egos nor one of washing your dirty linen in public. The point is cooperating to better serve your listeners.

The complaint referral program has been so successful in Virginia that the FCC office is currently working with the North Carolina Association of Broadcasters to establish a similar program there.

Examine Output Net

(continued from page 28)

necessary. If the antenna tuning unit was set for a -90° phase shift, adding -24° would result in a new phase shift of -114° DG, and the following impedances would be seen by the final (PA) stage of the transmitter:

Frequency Z (ohms) Z (normalized)
990 kHz 2225 +j 1200 0.89 +j 0.48
1000 kHz 2500 +j 0 1.0 +j 0
1010 kHz 2250 -j 950 0.90 -j 0.38

This would provide a reasonably symmetrical load to the transmitter, resulting in better balanced sideband power for increased high frequency response, lower distortion and better far depth signal strength.

An additional series L/C network could be added to the input of the antenna tuning unit to more closely balance the reactive components. However, it would be questionable whether the additional L/C network would be warranted.

Note that sideband symmetry at the PA output circuit, in which resistances are lower than the carrier frequency resistance, tends to reduce distortion products; where resistances are greater than carrier frequency resistance, high frequency

response tends to be preemphasized.

Thus it becomes quite clear that the transmitter must be properly maintained and tuned for best results, and that the transmitter must see a solid symmetrical load in order to achieve full brilliance and crispness with low distortion.

However, when the transmitter sees an asymmetrical load causing the transmitter to deliver more power into one sideband than the other, only muddy, dull and distorted sound can be expected.

Why optimize the load from the PA final circuitry, since it is the antenna tuning unit which is being adjusted? If the antenna system was perfectly matched to the antenna tuning unit and the latter presented a perfect termination load to the transmission line (at all frequencies), there would be no reason to optimize the load from the PA final circuitry.

However, in the real world, imperfections exist. Optimizing the load at the transmitter compensates accordingly, allowing an excellent compromise in performance to the entire system.

In today's marketplace, listeners demand quality. Your transmitter and antenna system can deliver that quality!

Field Reports Good

(continued from page 16)

"Encoding can be done as time permits," he noted. "It does not have to be a massive changeover operation, because encoded and nonencoded carts can be intermixed through the system with no problems."

WBNS is one of the stations which performed field tests on the Phase Fixer prior to market introduction, and has been using the system for about 18 months. McGrew said it has made a significant improvement to the station, where studios are set up for stereo, including carted music on the AM side.

Since WBNS is still broadcasting in mono, the left and right channels are

combined at the output of the Phase Fixer, where piloted segments will not suffer interchannel delay error and cancellation of high frequency programming.

Music for the FM side is from reel-to-reel syndicated tapes, which may be encoded in the future for flutter correction and protection. McGrew reported that the station has begun encoding FM carts in preparation for another Phase Fixer system in the FM station air chain.

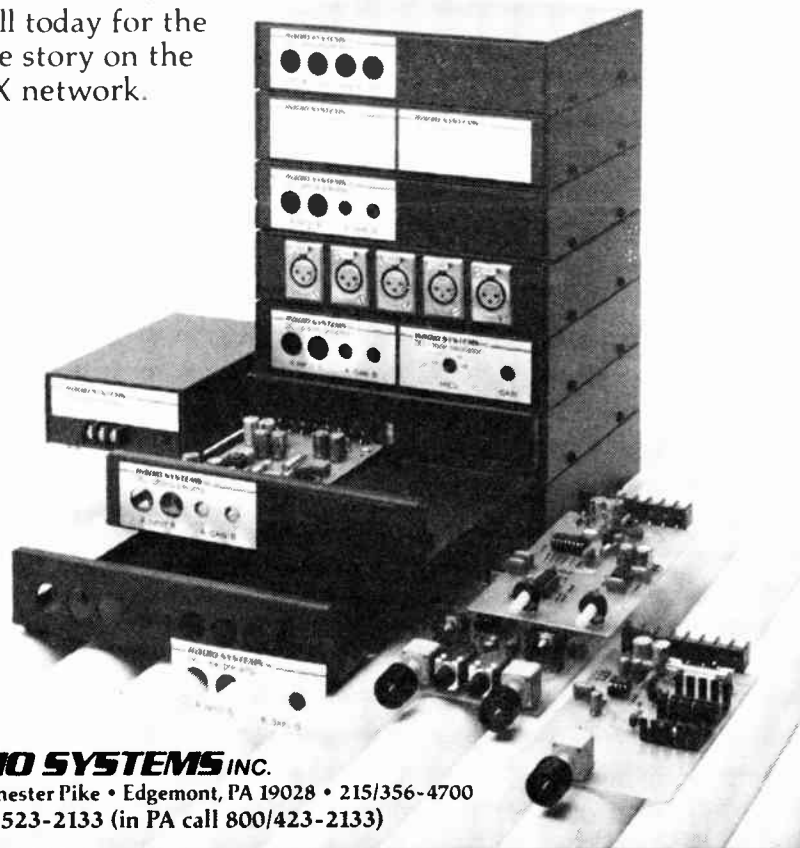
For broadcasters who do not fit into the five categories above, McGrew urges that a lot of consideration be given to adding Phase Fixer correction/protection to their air chains.

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The DC-5MA is five mic pre-amps, each with a XLR input connector, internal level trim, and balanced line level outputs.

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Circle Reader Service 48 on page 32

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 - 2 Commercial FM station
 - 3 Educational FM station
 - 4 Combination AM/FM station
 - 5 Network/group owner
 - 6 Recording studio
 - 7 TV station or teleprod facility
 - 8 Consultant/ind engineer
 - 9 Mfg. distributor or dealer
 - 10 Other

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- A. Ownership
 - B. General management
 - C. Engineering
 - D. Programming/production
 - E. News operations
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AMPLIFIERS

Want to Sell

Sigma ADA-210 dist amp, 2 stereo 1x10s or single 1x20, ins & outs, bal or unbal or any combo, new, \$300. J Bruzese, Pampa Sds, 31925 Van Dyke, Warren MI 48093. 313-264-8888.

University 100T solid-state 100 W PA line amp, gd cond, \$95. W Laughlin, KDCV, 2636 N 56, Lincoln NE 68504. 402-466-8670.

McIntosh & Crown amps, \$300 ea or \$500/both. W Burchett, Bur-K Inc, 842 Bellefonte Princess Rd, Ashland KY 41101. 606-324-8812.

RTS 405 phono preamp, \$245. J Probst, Production Svcs, 1235 Wildwood Ste 151, Sunnyvale CA 94089. 408-733-2695.

GKC 100, (2) two yrs old, excel cond, \$79 ea or \$139/both. C Butler, 8709 Pinon Dr, Jacksonville FL 32221. 904-786-6363.

Langevin AM101D 50 W power amp, tube type, bridge input 1-25K ohms, workhorse unit, BO; Langevin AM128X, 20 W tube type power amp, works good, BO. D Hastings, WKYB, POB 1000, Hemingway SC 29554. 803-558-2558.

Adcom 555 stereo pwr amp, rack mnt, mnt cond, \$495. W Laughlin, KDCV, 2636 N 56th, Lincoln NE 68504. 402-466-8670.

BE Spotmaster TMS-200 TT preamp, \$150. J McDermott, KCVO, POB 190, Camderton MO 65020. 314-346-2763.

JREI 1122 (3) phono preamps, gd cond, \$250 ea. S Schneider, WBMX, 408 S Oak Park, Oak Park IL 60302. 312-524-3240.

McLardy & Gates program amps, preamps & EQ's, BO. E Burger, 3403 Woodley Rd NW, Washington DC 20016. 202-966-3025.

Tube type 30 W stereo amp, orig used in Schafer automation system, \$50. M Persons, KKIN, POB 930, Aitkin MN 56431. 218-829-1326.

McIntosh MC2300, 300 W/chan amp \$1000. J Etrick, 1157 Terrace Rd, Colorado Springs CO 80904. 303-635-5342.

Mari PHG-20H program/line amps (2). P Wicker, WOBK, POB 400, Wanchese NC 27981. 919-473-3434.

Air Reflex UST 5B1 single system portable amp, \$250 plus frt. J Baltar, Maine Reel Comm, 67 Green St, Augusta ME 04330. 207-623-1941.

Want to Buy

McIntosh MC-50 amp, clean, J Robillard, KLVU, 1803 N First East St, Haynesville LA 71038. 318-624-0105.

McIntosh, Marantz, Dynaco Quad, Audio Research, etc. amps; WE, Tannoy, Altec, EV, JBL, Harmsfield, Olympus, Harness, Laguna speakers; Thorens, Fairchild turntables; WE tubes & microphones. Lapine, 3920 August Dr, Lake Worth FL 33461. 305-588-8195.

ANTENNAS & TOWERS

Want to Sell

Andrew PLB-65D antennas (2) w/radomes & mounts; (2) 250' EW63 waveguide w/connectors & hangers, \$9000. C Bryson, Comserv, 93 Robinhood Dr, Velienville PA 16063. 412-776-3793.

Cotec 1 bay w/de-icer, tuned to 93.7, never used, Gil Garcia, KTON, POB 240, Belton TX 76513. 512-398-3079.

Andrew 1-5/8 line, never used, 375' on roll, \$3000. Gil Garcia, KTON, POB 240, Belton TX 76513. 512-398-3079.

Phelps Dodge, 3-1/8" coaxial switches (4), new, \$100 ea. G Torres, GT Int'l, 48 W 46th St, NY NY 10036. 212-730-7114.

Delta DIB1 bridge & matching Potomac SD31 detector & gen w/carrying case, cables, new cond, \$3000 comp. J Cunningham, YSDA Radio, Rt 2 Box 1138, Stonewall OK 74871. 405-265-4496.

RCA BFH-7A 7 bay on 106.5, no deciers, \$1500. E Muscovitch, WHLM, 107 W Main, Bloomsburg PA 17815. 717-784-4900.

RCA coax switch, motor driven, 1-5/8" ports, \$950. E Muscovitch, WHLM, 107 W Main, Bloomsburg PA 17815. 717-784-4900.

Crouse-Hinds 46996 motor flasher unit, new; Crouse-Hinds FCB-12 tower beacons for 2-620 W lamps; ancient RCA FM isocoupler; Harris FMS-5, 5-bay CP FM antenna. P Wells, KLZZ, 8665 Gibbs #201, San Diego CA 92123. 619-565-6006.

FMD-4 ERI FM 4 bay directional ant on 100.3 MHz, BO. T BonDurant, WOJY, POB 2808, High Point NC 27261. 919-869-0101.

FH2-50, 3/8", 150' phase stabilized heliax, new, \$100. C Anderson, 1519 Euclid Ave, Bowling Green KY 42101. 502-781-2067.

Coax cable, RG17AU, one roll 490', \$200; one roll 111', \$50. P Schneider, KPMJ, 1280 S Oxnard Blvd, Oxnard CA 93033. 805-486-2337.

RCA BFA 6A, FM antenna w/deicers, pole mnt w/hardware, 90.1, free just pick it up! B Caithamer, WMBI, 820 N Lasalle, Chicago IL 60610. 312-329-4304.

Harris (ERI) FM4-11AC 11 bay FM w/shorting stub, excel cond, ready to ship, 107.7 MHz, 4 yrs old, \$19,000. R Roiseland, KSKX, 5315 W 7th, Topeka KS 66604. 913-272-2122.

RCA CP antenna, 9 poles, 9' long w/4 radials on each pole except 2, 94.7 MHz, inc 200' Andrew 2" dia coax, BO as is, Lynn Smith, KIXY, City Hall Plaza, San Angillo TX 76903. 915-653-3387.

Scala FMVW 4 bay, circular w/58" tower, \$1300. S Lawson, KAK, POB 91, Villa Grande CA 95486. 707-865-1516.

Hard xmission line, 400' of 3", in 20 20' sections, gd cond. G Harper, WSTV, 614-283-4747.

Want to Buy

FM antenna, 3-6 bay, on or near 96.9 MHz. R Calhoun, Calhoun Assoc, 2412 Larsen Rd, Yakima WA 98908. 509-783-6605.

FM antenna, 4-6 bay, CP. M McKenna, McKenna Comm, POB 90277, Long Beach CA 90809. 213-597-1961.

Self-supporting tower, 250-300', prefer at least 2' top member, should support multiple side arms, zone B. H Brumwell, Comm Eng Co., 1000 27th Ave SW, Cedar Rapids IA 52404. 319-364-0271.

Andrew Coax reducers, 3-1/8" down to 1-5/8", No. 186; 1-5/8" down to type N, No. 2261A or other 3-1/8" reducer considered to buy or trade. B McBride, KMAZ, POB 10, Beatrice NE 68310. 402-228-5923.

Phelps Dodge ECFM2 at freq 98.3 w/radomes, J Howell, Howells Audio, 521 Park St, Kingman AZ 86401. 602-753-3054.

Towers, gd cond, minimum 800', recog manf, on ground or standing, pay cash. L Magnuson, KSCJ, POB 1379, Sioux City IA 51102. 712-239-2100.

FM antenna, 1, 2 or 3 bay FM, at 105.1 MHz. D Barton, KMTI, POB 1590, Manti UT 84642. 801-835-7301.

AUDIO PRODUCTION (OTHER)

Want to Sell

Radio equip: items to numerous to list for sale, inc amps, speakers, EQ's, encoder-decoder's, noise meter, audio gen, etc, write for details & prices. G Barnett, KWXV, Broadcast Centre, Palm Springs CA 92263.

Eventide H910 Harmonizer, excel cond, \$1000. J Roman, KQIP, 1011 Texas Commerce Bank Bldg, Odessa TX 79761. 915-337-6262.

Harris MSP-100 audio processor, \$3000; DBX-142 NR unit, \$350. Insurance Salvage Recovery, 800-334-5375 or in Indiana 800-922-4791, Donna Wyss.

Elcom 300 gd cond, \$300; Lauderdale Electr Labs SF-101, \$95; Ramko Research ACL-25/E, \$250; TFF 760 generator fine, decoder needs work, \$300; Lang Electr PEQ-2A, \$200 ea; Gates Dynamote 70 remote mixing board, \$175. Steve Portier, WNOE, 529 B'enville St, New Orleans LA 70130. 504-529-1212.

Burwen 1201A dynamic noise filter, new in unopened box, \$200. W Laughlin, KDCV, 2636 N 56, Lincoln NE 68504. 402-466-8670.

Valley People audio processing rack, excel cond, inc powered rack, 2 Gain Brain II compressors, Kepex II expanders, perf for prod, sold as unit only, \$1350. B Walker, Hoyt & Walker, 3422 Old Cantrell Rd, Little Rock AR 72202. 501-661-1765.

Tellabs stereo talco EQ unit, w/program amps & repeat coils, working when removed from service, BO. M Meyer, KLQP, POB 70, Madison MN 56256. 612-598-7301.

Ampro Monomax matrix encode-decode units, BO. R Hill, WTPA, 107 E Main St, Mechanicsburg PA 17055. 717-697-1141.

Studer 2/2 (2) VUK R-R, M Hicks, KLTQ, 329 E 200 South, Salt Lake City UT 84111. 801-533-9305.

Burwen 1201A dynamic noise filter, new, never used, \$200. W Laughlin, KDCV, 2636 N 56th, Lincoln NE 68504. 402-466-8670.

dbx 157 8 chan NR, \$700. D Kocher, 1901 Hanover, Allentown PA 18103.

Carvin 2029 EQ (2), 1/3 octave EQ's, 1 mo old, \$275 ea or both \$500. R Dieterich, WLJ, 1051 Brinton, Pittsburgh PA 15221. 412-244-7600.

Eventide H949 Harmonizer, like new, \$2750. K Stephens, KTUX, 4615 Monkhouse, Shreveport LA 71109. 318-635-9999.

Shure SE 30s, 1 gd cond, 1 for parts, BO. G Hyatt, 13318 Schwenger Pl, Herndon VA 22070. 703-471-5250.

Want to Buy

Harris SSA-3 silence sensor, D Williams, KTNV, Cedar & S Main, Libby MT 59923. 406-293-6234.

Audio delay system for AM mono station. T DeCapua, WGFT, 131 W Boardman, Youngstown OH 44503. 216-744-5115.

AUTOMATION EQUIP.

Want to Sell

ATC FA-5 25 Hz filter assy, T Devine, WMGE, Box 8 Burgin Rd, Danville KY 40422. 606-236-2711.

Schafer 903 automation systems, remanufactured, warranty, installation, and training. Broadcast Automation, 4125 Keller Springs, #122, Dallas TX 75244. 214-380-6800.

Harris SC-90 automation system, installed in racks, call for details & price. K Freeman, WBBQ, 1305 Georgia Ave, N Augusta SC 29841. 803-279-6610.

Harris 995-7867-001 R-R source interface (2) for System 90 or 9000, \$150 ea. C Bryson, Comserv, 93 Robinhood Dr, Velienville PA 16063. 412-776-3793.

IGM 500, 3 reels, 2-48 tray mono Instacart's, 3 racks, pres in operation. P Kessler, KZKX, 212 1st St S, Seward NE 68434. 402-643-4571.

Automated Dect Control 2504 tone sensor, stored demo, never used, \$200. R Gasman, Gasman Audio, 779 Worcester St, Wellesley MA 02181. 617-CELTICS.

Satellite automation system, Sono-Mag MSP-1 programmer, (3) 452 stereo Carousels, (2) 722 dual stereo PBs, in rack, 18 mos old, like new. R Broussard, KFMV, POB III, Franklin LA 70538. 318-828-5372.

Schafer 7000 automation system, 3 Audiofiles, 4 Otari R-R's, 2 Carousels, 18 mos old, assume \$650/mo payment. D Mance, WONY, 129 Main St, Dansville NY 14437. 716-335-2273.

SMC ESP-1 controller, PDC5 clock, DS20 switcher, RAC30 remote control, Extel AHP11R printer, 4 SMC 350RS Carousels, 3 Audicord A31SR cart machines, 3 Otari ARS1000 DC & more, call for details. W Howe, WONY, 122 S Cayuga, Ithaca NY 14850. 607-277-1528.

IGM 48 tray stereo Instacart, works good, \$5000. M Meyer, KLQP, POB 70, Madison MN 56256. 612-598-7301.

SMC Carostat, 24 tray instant access cart machine w/SMC interface, vgc, \$2000. M Persons, KKIN, POB 930, Aitken MN 56431. 218-829-1326.

SMC DP-2 8K memory, super clock, time announce, (4) Otari R-R's w/autowind, (3) stereo Insta-Carts, Extel logger printer, T1700 data terminal, CRT, remote control, spare PC boards, in service, \$20,000. R Belenot, KGIL, 14800 Lassen St, Mission Hills CA 91345. 818-894-9191.

Broadcast Products 2 trk R-R PB elec, E/C, rack mount, \$150. H Jernegan, WHRO, 5200 Hampton Blvd, Norfolk VA 23508. 804-489-9476.

SMC TS-25 dual tone sensor, E/C, rack mount, \$150. H Jernegan, WHRO, 5200 Hampton Blvd, Norfolk VA 23508. 804-489-9476.

SMC LA-246S AGC amp, rack mount, E/C, \$150. H Jernegan, WHRO, 5200 Hampton Blvd, Norfolk VA 23508. 804-489-9476.

IGM 770 12K, 16 source stereo w/full backup CPU & audio, 2 CRT's & printer, BO. J Ashton, WIBX, POB 950, Utica NY 13503. 315-738-9313.

Harris 9001 automation system inc (5) Otari ARS1000DC, (2) 42 tray IGM Go-Carts, (1) 78 tray IGM Go-Cart, (5) Harris single play stereo decks, (2) stereo cart recorders & misc spare parts, extra CPU, extra RAM, excel cond, \$25,000. R Baxter, WMAY, POB 460, Springfield IL 62705. 217-629-7077.

Network delay cart machine, must be compatible w/SMC automation. J Clark, WWJZ, Box 1120, Hermitage PA 16148. 412-981-4586.

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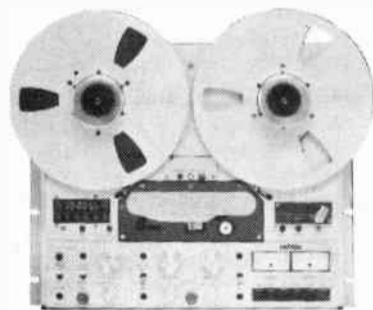
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CAMERAS (VIDEO)

Want to Sell

IVC BYU-110 3 tube color, pwr supply, 10:1 lens, battery charger, 1 battery, 14-10 pin VCR cable, tripod base, chest rest, carrying case, LN, \$3000. J Bruzese, Pampa Sts, 31925 Van Dyke, Warren MI 48093. 313-264-8888.

B&H 2970 studio color camera, gd shape, cables inc, BO. M Fanto, WEBQ, Westmore Plaza, Marion IL 62959. 618-993-8030.

RCA TK76, 86, 760, 780, spare parts & assemblies, circuit boards, triax & camera cable, BO. T Smith, CCI Prod, 192 Lancaster Ave, Frazier PA 19355. 215-289-1725.

Mitsubi FP22 (3) comp systems w/studio viewfinder, hand controllers, Fujinon 12:1 lenses, camera cable, CCU's & cases, new tubes, excel cond. T Smith, CCI Prod, 192 Lancaster Ave, Frazier PA 19355. 215-289-1725.

Philips LDH-20, studio config w/ATE T-10 tripod, head & dolley, hand controls, camera cable & CCU, 12:1 Canon lens, plumbs, BO. T Smith, CCI Prod, 192 Lancaster Ave, Frazier PA 19355. 215-289-1725.

CART MACHINES

Want to Sell

Cart 2000, mono R/P cart machines. J Phillips, WDCW, 414 Washington Ave, Defiance OH 43512. 419-782-8591.

IGM 48S stereo Instacart, clean, low miles, \$6000. T McGinley, First Media, POB 10239, Wash DC 20018. 301-441-3500.

Audicord 526, gd cond, \$1000. J Howell, Howells Audio, 521 Park St, Kingman AZ 86401. 602-753-3054.

Tapecaster (2) X700RPs, \$650 ea or \$1200 for pair & (1) X700RPM, \$495, like new. R Sumner, Cavu Comm, 3351 Contessa Ct, Annandale VA 22003. 703-560-0233.

Telex/Magnecord stereo cart recorder w/sec/ter tones, vg working cond, \$900. M Persons, KKIN, POB 930, Aitken MN 56431. 218-829-1326.

Harris Criterion 80 stereo PB w/2 cue tones, mono record w/single cue w/remote control & manual, E/C rack mounts, \$450. H Jernegan, WHRO, 5200 Hampton Blvd, Norfolk VA 23508. 804-489-9476.

A20 RP, mono cart R/P, gd cond, \$475. J Hall, WCHV, 1140 Rose Hill Dr, Charlottesville VA 22901. 804-977-5566.

Mertronic heads for Harris & Tapecaster cart machines, all appear to be new in boxes & packaging, includes (15) 2052 & (5) 2050 plus others, 20 plus pieces worth over \$1800 for only \$500. P Kahnze, WARY, POB 258, Valhalla NY 10595. 914-285-6752.

Tapecaster 700P (2) gd cond, \$250 ea; ITC RP cart stereo, 3 tones, az adj, vgc, \$2000; ITC WP (play only) stereo, 3 tones, vgc, \$1100. S Schneider, WBMX, 408 S Oak Park, Oak Park IL 60302. 312-524-3240.

ITC SP stereo PB w/all tones, \$900. B Hawkins, WENS, 1099 N Meridian #1197, Indianapolis IN 46204. 317-266-9700.

ITC Delta III & IV mono, very little use, BO over \$3500. T Parker, KXEW, 889 W El Puente Ln, Tucson AZ 85713. 602-623-6429.

Telex/Magnecord stereo cart recorder w/sec & ter tones, very gd working cond, \$900. M Persons, KKIN, POB 930, Aitken MN 56431. 218-829-1326.

ITC 3D mono play only, \$2000. T BonDurant, WOJY, POB 2808, High Point NC 27261. 919-869-0101.

UMC 12-123-022 stereo cart recorder w/mono heads, P Wells, KLZZ, 8665 Gibbs #201, San Diego CA 92123. 619-565-6006.

BE TW120 cart winder, w/o timer in mint cond, \$175. B Hawkins, WENS, 1099 N Meridian #1197, Indianapolis IN 46204. 317-266-9700.

Rapid Q mono recorder, \$350; ITC mono play only, \$450; Gates Criterion 80 (5) mono PB, \$300 ea; Gates Gateway 2, mono mixer, works well, BO. K Magrill, KSLM, POB 631, Salem OR 97308. 503-364-8433.

Want to Buy

ITC SP, WP, RP or 3D cart machines, any cond. D Smith, WFCB, 45 W Main, Chillicothe OH 45601. 614-773-3000.

BE 3000 & 2100 cart machines wanted. Exporter needs 90 used machines, working cond, not more than 6 yrs old, reasonable price avail. Send particulars to: RW, POB 1214, Falls Church VA 22041. Attn: Box 1-1.

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Want to Sell

Ampex 300 mono decks, \$100/both. R Robinson, Trod Nessel Recdg, 10 George St, Wallingford CT 06492. 203-265-0010.

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Uher 4000 Report-L, 2 trk, leather case/carrying strap, battery case, Netz-Ladegerat battery charger/mains unit, Sennheiser mic, like new, BO. Allen Bassing, 7303 Holly Ave, Takoma Park MD 20912. 301-587-9020.

Wellensak 2780 AN high speed cassette duplicator, slave unit (3 slaves) for use w/the 2770 AN, \$700. D Flynn, Continental Recdgs, 210 South St, Boston MA 02111. 617-426-3131.

Wellensak 2770 AN high speed cassette duplicator, 1 master & 2 slaves, dupes at 30 ips, \$750. D Flynn, Continental Recdgs, 210 South St, Boston MA 02111. 617-426-3131.

Ampex 440 FT, mono, 7.5-15 ips in Ruslang wooden console, \$1250. D Flynn, Continental Recdgs, 210 South St, Boston MA 02111. 617-426-3131.

Harmon Kardon CD-491 cass recs (4), 1 yr old, w/Dolby BC & HX Pro, exhaust fans installed, BO. P Appleson, Appleson Stds, 1000 NW 159th Dr, Miami FL 33169. 305-625-4435.

Revex A77 1/2 trk 7.5/15 ips, \$450. J Probst, 1235 Wildwood #151, Sunnyvale CA 94089.

Scully 280 B trk, \$3500; Scully 280-B 2 trk \$2250. W Burchett, Bur-K Inc, 842 Bellefonte Princess Rd, Ashland KY 41101. 606-324-8812.

Tascam 80-S, rack mnt, w/DX8, cords, Teac patch bay rack mnt, 2 reels, new tape, owner's manuals, vgc, \$2400. B Busetti, 114 N Robinson, Florence CO 81226.

Telex 300 high speed cass-cass duplicator, mono, 1 master w/15 slaves, needs some work, all cabinetry & rewind modules inc, \$2000. B Bradley, Sound Hound, 45 W 45th St, NY NY 10036. 212-575-8664.

Telex Magnecord 1022 1/2 trk stereo, \$300. S Campbell, Keynote Prod, 105 Coolview Dr, Seneca SC 29678. 803-882-2762.

Wellensak 1500, excel cond, \$150. L Syner, Box 182, Floral Park NY 11001. 718-347-2940.

Teac TD700 3 speed, rack mount R-R w/10-1/2" reels, excel cond, \$800. D Hastings, WKYB, POB 1000, Hemingway SC 29554. 803-558-2558.

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Scully 280 stereo w/manual, \$750 ea; Telex 3000 mono w/electr & manual, \$275 ea; Teac RA41 electr only, stereo w/manual, \$150 ea. B Gould, WHAV, Haverhill MA 01831. 617-374-4733.

Revex A77 1/2 trk w/wooden case, vgc, you ship, \$450; Sony TC-630, 1/4 trk R-R w/20 Wchan amp & brand new heads, vgc, you ship, \$350. B Michaels, KORK, POB 2201, Abaleen TX 79604. 915-673-2545.

Revex A-77 recorders (2), \$750 ea; Ampex 351 w/mdl 375 Inovonics electr (3), \$595 ea; Inovonics units alone, \$395 ea. S Moseley, KOJY, 597 N Alta, Dinuba CA 93618. 209-486-1130.

Revex PR99 R/P erase heads removed from new machine, 1/4 trk, (3), \$195 all. L Snyder, Box 182, Floral Park NY 11001. 718-347-2940.

Technics RS1520 (3) 2 trk stereo, front panel bias, EQ w/rack mount, \$1200 ea. P Appleson, Appleson Stds, 1000 NW 159th Dr, Miami FL 33169. 305-625-4435.

Ampex AG440 2 trk, hyst synch motor, 4020260 electr, heads worn but OK, \$600 neg. M Miller, WGBH, 125 Western Ave, Boston MA 02134. 617-492-2777 X2322/2233.

Ampex 440-2 1/2 trk stereo (2), 7.5-15 ips, in Ruslang wooden consoles, re-lapped heads, one for \$1900, other \$1750. D Flynn, Continental Recdgs, 210 South St, Boston MA 02111. 617-426-3131.

Ampex PR10, gd cond, \$100. L Houck, Rollin Recdg, 210 Altgelt, San Antonio TX 78201. 512-736-5483.

Ampex AG4408 4 trk hyst synch motor ch 1 & 2 electr in port case, ch 3 & 4 in rollaround, elect are 4020260's, vgc cond, \$2000. neg. M Miller, WGBH, 125 Western Ave, Boston MA 02134. 617-492-2777 X2322/2233.

Ampex AG445C 2 trk, PB electr 4020150-060, missing 4 control relays & tension arm guide, w/head gate ass'y, \$350 neg. M Miller, WGBH, 125 Western Ave, Boston MA 02134. 617-492-2777 X2322/2233.

Scully 280-S 8 trk comp w/cabinet, gd cond, \$3000; Scully 280-B, 2 trk, less cabinet, gd working cond, \$1000. I Kaufman, Natl Recdg, 460 W 42nd St, NY NY 10036. 212-279-2000.

Ampex 300-4 4 trk w/sel-sync, comp w/cabinet, gd working cond, \$400. I Kaufman, Natl Recdg, 460 W 42nd St, NY NY 10036. 212-279-2000.

Studer A810 2 trk portable w/wood side panels & remote control, ops & srvs manual, mint cond, \$4200. R Cannata, Cantrax Recds, 2119 Fiddler Ave, Long Beach CA 90815. 213-498-6492.

Ampex 351-U 1 trk, missing head gate, otherwise 100 percent functional, \$200 neg. M Miller, WGBH, 125 Western Ave, Boston MA 02134. 617-492-2777 X2322/2233.

Tascam 58 prof 8 multi-track, 1/2", excel cond, \$3950. S Cilurzo, KGMG, POB K, Oceanside CA 92054. 619-729-1000.

Nontronic 9202 (36) Scully PB heads, used; record 8401; 9128 erase (new), BO. S Russell, Russell Music, 60410 Kett Dr, Decatur MI 49045. 616-782-9258.

Nontronic 8208 (17) PB heads, 2 trk stereo, Crown, Magnecord, Presto, used, BO. S Russell, Russell Music, 60410 Kett Dr, Decatur MI 49045. 616-782-9258.

Nontronic 8406 (13) PB heads, mono 1 trk for Crown, Magnecord or Presto, used, BO. S Russell, Russell Music, 60410 Kett Dr, Decatur MI 49045. 616-782-9258.

Metrotech Series 400 logger, 4 chan w/timecode & vox, BO. M Glaser, C&G Ent, 2 Floyd Ln, Massapequa NY 11762. 516-489-1071.

Telex Copier I & II cassette duplicator, 3 master units, 3 slave units, 3 copiers/unit, 1 master & 1 slave unit, \$1300 master & slave, all 6 units \$3300. J Arcotta, Sound Innovations, 3161 Westwood Ct, Boulder CO 80302. 303-444-1777.

Ampex 440-B, 2 trk w/roll around, may need minor work, gd appearance, \$1800 ea. S Schneider, WBMX, 408 S Oak Park, Oak Park IL 60302. 312-524-3240.

Tascam 34, 4 trk, mint cond w/manual & metal take-up reel, \$1095. B Osborne, A-V Assoc, 4760 E 65th St, Indianapolis IN 46220. 317-253-8562.

Ampex 350 deck w/mono heads & Inovonics 375 solid state electr; ITC 750 stereo recorder; Ampex 700 reel deck, stereo w/mono heads. P Wells, KLZZ, 8665 Gibbs 201, San Diego CA 92123. 619-565-6006.

Teac 80-S w/rack mounts, DX-8 w/patch cords, YTT 1144 alignment tape, Teac 64 point patch bay, rack mount, 2 reels new tape, 6 reels used tape, w/manual, \$2500. W Busetti, 1124 W 2nd, Florence CO 81226. 303-784-3540.

MCI JH 110A, stereo reproduce only, \$1000. R Dieterich, WLTJ, 1051 Brinton, Pittsburgh PA 15221. 412-244-7600.

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Ampex 351 tube electr, (6), \$35 ea/BO. D Weinstein, Cinema Snd, 311 W 75th, NY NY 10023. 212-799-4800.

Ampex 351 transport, runs but needs some work, wall motors & 2 trk stereo headstack, \$250. D Weinstein, Cinema Snd, 311 W 75th, NY NY 10023. 212-799-4800.

Inovonics 375 tape elec, stereo pair, \$700/pr & 376 stereo PB unit, \$300. D Weinstein, Cinema Snd, 311 W 75th, NY NY 10023. 212-799-4800.

Scully 280B 1/2", 4 ch, 15/30 ips, w/vari-pitch, also has 2 tr stack, excel cond, other equip avail, \$1500. J VonVeck, Aras Recdg, 2321 N Utah, Arlington VA 22207. 703-524-5067.

Otari DP 4050 DCF R-R to cass & cass to cass, high speed duplicator, 5 copies from master, mint cond, \$2795. R Sumner, Cavu Comm, 3351 Contessa Ct, Annandale VA 22003. 703-560-0233.

Ampex ATR 700, 3-3/4", 7-1/2 ips, 2 yrs old, less than 200 hrs, BO. S Moore, City Hope Radio Bdct, POB 1841, NY NY 10163. 718-783-0111.

Otari MX5050 8 trk, mint cond, \$3000; Otari MX5050B Q11, 4 trk, mint cond, \$1500. M Hilbert, Unique Design, 2920 Industrial Dr, Fimksburg MD 21048. 301-833-0027.

Ampex AG-350 transport w/brand new rebuilt half trk stereo head assembly, spare motor, pinch roller, 2 chan of Inovonics 375 elec, all very gd cond, needs interconnect cable for Inovonics, original manuals, \$850 firm ppd. G Finerman, Advanced Media, 17 Hillcrest Rd, Suffern NY 10901. 914-368-1143.

Ampex 350 stereo PB only (2), inc 3 Schafer amps & 2 TTD-3 cue time module, all units work, \$1000. M Persons, KKIN, POB 930, Aitken MN 56431. 218-829-1326.

Ampex 350 w/mono & stereo head stacks & extra motors & parts, mounted in dolly w/overbridge, \$700. G Hyatt, 13318 Schwenger Pl, Herndon VA 22070. 703-471-5250.

Ampex ATR-7000 stereo (2), E/C rack mount w/manuals, \$1500 ea. H Jernegan, WHRO, 5200 Hampton Blvd, Norfolk VA 23508. 804-489-9476.

Ampex 351 mono decks (3), each w/BPI 2 trk PB elec, E/C w/manuals, \$350 ea. H Jernegan, WHRO, 5200 Hampton Blvd, Norfolk VA 23508. 804-489-9476.

Ampex AG-355 service manual, BO. W Laughlin, KDCV, 2636 N 56th, Lincoln NE 68504. 402-466-8670.

MCI JH-110A R/P decks, (2), \$3000 ea. T BonDurant, WOJY, POB 2808, High Point NC 27261. 919-869-0101.

Stallweck SP7, 7-1/2 ips, 2 trk elect w/mono heads, mint cond, \$1400/BO. B Lilling, The Voice House, 1813 9th #4, Santa Monica CA 90404. 213-450-8329.

3M M79 24 trk w/Audio Kinetics Intelloator, gd cond. A Varner, Penny Lane Stds, 1350 Ave of the Americas, NY NY 10019. 212-687-4800.

Nakamichi 600II w/rack mount plate, very clean, \$250/BO. J VonVeck, Aras Recdg, 2321 N Utah, Arlington VA 22207. 703-524-5067.

Ampex 440C 2 trk stereo (3), excel cond, \$1700. D Smith, WFCB, 45 W Main, Chillicothe OH 45601. 614-773-3000.

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Ampex 440CF mono, excel cond, \$1300. D Smith, WFCB, 45 W Main, Chillicothe OH 45601. 614-773-3000.

Ampex ATR 700 2 trk stereo, \$1000. D Smith, WFCB, 45 W Main, Chillicothe OH 45601. 614-773-3000.

Ampex 351 w/Inovonics 375 electr, \$700. D Smith, WFCB, 45 W Main, Chillicothe OH 45601. 614-773-3000.

Tonmeister TRE-3M, WHPA, POB 464, Hollidaysburg PA 16648. 814-695-4441.

Crown Imperial, tube type, fair cond, WHPA, POB 464, Hollidaysburg PA 16648. 814-695-4441.

Ampex solid-state elect for AG-500 or PR-10, R-R transports, \$200. L Ayer, KRPL, POB 8849, Moscow ID 83843. 208-882-2551.

Scully roll J Ross, WTVN, 6263 Emberwood, Dublin OH 43017. 614-766-4292.

Revex A77 2 trk stereo, 3.75-7.5; (30) 14" 2 trk stereo, 7.5 ips, IGM gd music tape, never played. F Anderson, 3801 5th Ave S, Great Falls MT 55405. 406-452-2810.

Otari MX7308 1" 8 trk, very low hrs, excel cond, w/remote control, \$5800. L Wagner, ARN Prod, POB 1788, Orlando FL 32802. 305-299-1299.

Otari MX5050 HSHT 1/4" 2 trk, gd cond w/remote control, \$1100; Otari MX5050 4SL 1/4" 1/4 trk stereo, gd cond, 2 trk PB head, \$800. L Wagner, ARN Prod, POB 1788, Orlando FL 32802. 305-299-1299.

Pioneer RT1050H 2 trk R-R, 15 & 7.5 ips, will take 10-1/2" reels, excel cond, \$500. J Block, Prod Block Stds, 906 E Fifth, Austin TX 78702. 512-472-8975.

Tascam 38 1/2 R-R 8 trk, excel cond, \$1850 w/remote & edit button. J Block, Prod Block Stds, 906 E Fifth, Austin TX 78702. 512-472-8975.

Teac 40-4 w/DX-4 dbx built in, rack mounted, very low hrs, exc cond, \$1200/BO; Sony TD5, portable stereo cassette recorder w/Weather case, \$325. R McMillen, RM Audio Prod, 13515 SW 72nd, Tigard OR 97223. 503-684-1973.

Fostex A8 8 trk R-R w/remote, \$800; Fostex 350 8 trk mixer w/3030 meter bridge, \$650. A Simon, 305 Spring St, NY NY 10013. 212-924-2276.

Garner Ind 2056 R-R stereo duplicator, 5 to 10-1/2" reels, 1 master, 5 slaves, \$4500. R McGrath, Spanner Dup Svcs, 320 William Circle, Alliance NE 69301. 308-762-7640.

MCI JH1108 1/2", 4 trk in console w/remote, \$5500; MCI JH1100 1/2" 4 trk w/o console, w/remote control & autolocation, \$5500. M Harrelson, Boutwell Studios, 720 23rd St S, Birmingham AL 35233. 205-251-8889.

Revex A77, \$400; Audio Control C22 octave EQ, \$150; UREI 1176LN peak limiter, 6 mos old, \$400. D James, Wireless Co, POB 3325, Danville VA 24541. 804-836-0970.

Ampex 300-4 4 trk w/sel-sync in gd working cond, you pick up, \$450; Scully 280-8 8 trk in gd cond, you pick up, \$3500. I Kaufman, Natl Recd, 460 W 42nd, NY NY 10036. 212-279-2000.

Ampex MM1000 16 trk recorder, 7.5-15 ips, newly relapped heads w/full remote control, new 8 trk guides & head stack, very clean, all lights work, will deliver, \$5995. J Stitzinger, Calvary Baptist Church, 1380 Valley Forge Rd, Lansdale PA 19446. 215-368-9922.

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Ampex AG 440 1/2" 4 trk head stacks, head block & parts. R Riccio, ETS Record, Box 932, Honolulu HI 96808. 808-533-6095.

Ampex MX10 or MX35, P Chance, Imperial Analog, 1809 Capers, Nashville TN 37212. 615-322-7601.

Revex A77, D Van Zandt, WGNV, POB 88, Millador WI 54454. 715-457-2988.

Ampex 351-2 pref w/portable case, P Chance, Imperial Analog, 1809 Capers, Nashville TN 37212. 615-322-7601.

FT recd hd for Ampex AG350. L Houck, Rollin Recdg, 210 Altgelt, San Antonio TX 78201. 512-736-5483.

CONSOLES

Want to Sell

Collins 10 ch mono rotary, workable but as is, BO plus frt; Raytheon 7 chan also avail, used, as is, BO. B Coleman Jr, Coleman Bdct, 114 Circle Dr, Rocky Mt NC 27804. 919-443-7870.

Autogram, BE, UREI studio consoles, new. Let BAI bid on your needs. Broadcast Automation, 4125 Keller Springs, #122, Dallas TX 75244. 214-380-6800.

Gates Studioette solid state 4 chan, J Phillips, WDCW, 414 Washington Ave, Defiance OH 43512. 419-782-8591.

Teac AX20 mixdown panels (2), \$20 ea. W Laughlin, KDCV, 2636 N 56, Lincoln NE 68504. 402-466-8670.

Arrakis SC 2000 12 chan, 4 yrs old, \$950. C Gray, Kiny & Assoc, 1107 W 8th St, Juneau AK 99801. 907-586-6037.

Gatesway dual chan 10 pot TV board, old but clean & in gd cond, inst book, pwr supply & amps included, \$350, you ship. H Espravnik, WHHV, Box 648, Hillsville VA 24343. 703-728-9114.

Console, 16 in 16 out, all transistorized, 5 EQ sliders, \$2500. W Burchett, Bur-K Inc, 842 Bellefonte Princess Rd, Ashland KY 41101. 606-324-8812.

Yamaha 1516 mixer, \$5000. J Probst, 1235 Wildwood #151, Sunnyvale CA 94089.

Studiomaster 16x16x8x2, mic/line ins, 3 band EQ (semi-parametric), internal routing, Anvil case, Koss headphones, like new cond, \$2200. B Busetti, 114 N Robinson, Florence CO 81226.

Yamaha 6 chan mono, \$350. J Stanley, WSCG, 609A Palmer, Corinth NY 12822. 518-654-9058.

Shure M267 & M268, 1 yrs old, excel cond, \$289 & \$179 or both for \$439. C Butler, 8709 Pinon Dr, Jacksonville FL 32221. 904-786-6363.

Tascam M-520, 20x8 mixing console w/stand, pwr supply, walnut side panels, excel cond, \$4300. S Gilurzo, KGMG, POB K, Oceanside CA 92054. 619-729-1000.

UREI Mod One, fair cond, working, w/manual, \$500. S Schneider, WBMX, 408 S Oak Park, Oak Park IL 60302. 312-524-3240.

Shure M67 (2) metered, gd cond, \$150 ea. J VonVelck, Aras Recdg, 2321 N Utah, Arlington VA 22207. 703-524-5067.

McMartin B80253 8 chan stereo, \$800; Collins 9 chan mono, \$300. B Van Prooyen, Van Prooyen Bdcg, 628 Mulford Dr SE, Grand Rapids MI 49507. 616-452-0133.

Collins 212F-2 console, like new, some preamps never unpacked, \$850. P Schneider, KPMJ, 1280 S Oxnard Blvd, Oxnard CA 93034. 805-486-2337.

Ramko DC38-BS 8 chan stereo, \$2900. D Smith, WFCB, 45 W Main, Chillicothe OH 45601. 614-773-3000.

Gates Executive 10 chan stereo, gd cond, G Williams, WASK, POB 7880, Lafayette IN 47903. 317-447-2186.

Opamp Labs 2008-4E, 20 in 10 out, very clean sound, \$6500. L Wagner, ARN Prod, POB 1788, Orlando FL 32802. 305-299-1299.

Gates SA-40, spare tubes & manual, BO. L Ayer, KRPL, POB 8849, Moscow ID 83843. 208-882-2551.

RCA BC-4A tube type mono, 4 chan, gd cond; RCA BC-6A, tube type mono, 8 chan, poor cond. WHPA, POB 464, Hollidaysburg PA 16648. 814-695-4441.

Shure M68 (2) mixers, new, \$100. J Ross, WTVN, 6263 Emberwood, Dublin OH 43017. 614-766-4292.

Bogen MXM mixer, fair cond; Bogen LOM mixer, fair cond. WHPA, POB 464, Hollidaysburg PA 16648. 814-695-4441.

Quantum QMBP stereo prod console, \$595; Tangent 802 prod console, \$400/BO. M Harrelson, Botwell Studios, 720 23rd St S, Birmingham AL 35233. 205-251-8889.

BE BM100A 8 mixer mono, dual chan, vgc w/manual, \$1500. R Laine, United Cable of CO, 4757 S Salida Ct, Aurora CO 80015. 303-690-9533.

Want to Buy

Inst book &/or schematic for RCA BC15BS 5 chan stereo SN 6130-004. C Smith, KREK, POB 1280, Bristow OK 74010. 918-367-5501.

Langwin AM-516-B tube type preamps, P McManus, McManus Interp, 4011 Orchard Ave, San Diego CA 92107. 619-223-1730.

DISCO & SOUND EQUIP.

Want to Sell

AKG BX10 stereo reverb, just rebuilt by AKG, \$950. R Tiegen, Plum Studios, 2 Washington St, Haverhill MA 01830. 617-372-4236.

EMT 140-T plate reverb, have stereo conversion kit, as is, \$1750. D Flynn, Continental Recdgs, 210 South St, Boston MA 02111. 617-426-3131.

Orban 1118, new, \$495; Aphex aural exciter type C, brand new w/full warantee, \$300. G Chapekis, Mirror Image, 8505 E Temple #447, Denver CO 80233. 303-694-6642.

Tapco 4400 spring tank reverb system, stereo unit w/graphic EQ for each chord of reverb, compressed input to compress points, \$275. B Walker, Hoyt & Walker, 3422 Old Cantrell Rd, Little Rock AR 72202. 501-661-1765.

ARK BX-5 reverb, \$400; Lexicon 93 Prime Time, \$500; UREI 1176LN limiters (2), \$275 ea; dbx 150 type 1 NR, \$175. J Probst, 1235 Wildwood #151, Sunnyvale CA 94089.

K&H UE-100 universal EQ, tube/mono, w/manual, \$100. D Weinstein, Cinema Snd, 311 W 75th, NY NY 10023. 212-799-4800.

Recd studio package inc Ampex MM1200 16 trk, 32x16 mixing console, digital reverb system, mics & other outboard gear, all equip in excel cond, real estate also avail, terms sale/lease. R Medlen, Creative Sound Studio, 602 Cree Dr, San Jose CA 95123. 408-225-6302.

E-V MC8A 8" speaker, new in box, never used, \$25. W Laughlin, KDCV, 2636 N 56th, Lincoln NE 68504. 402-466-8670.

Studio, 8 trk, mostly new equip, BO. W Preist, Classic Sound & Recd, 1515 County Rd 1, Dunedin FL 33528. 813-736-3131.

Urso Major Space Station digital reverb & echo, \$1000; Delta Lab DL2 acoustic computer, \$850. D Kocher, 1901 Hanover, Allentown PA 18103.

Opamp Labs 1155 (2) reverb units, \$100 ea. L Wagner, ARN Prod, POB 1788, Orlando FL 32802. 305-299-1299.

Comp Recording Studio: consoles, recorders, speakers, mics, EQ's, limiters, mic stands, B3 organ, low noise fluorescent fixtures, etc. L March, Intl Recdg, 2516 W Armitage, Chicago IL 60647. 312-227-2000.

JBL L100 monitors, great cond, carton & manuals, \$325/pr. R Cannata, Cantrax Recdrs, 2119 Fidler Ave, Long Bch CA 90815. 213-498-6492.

Tanroy LSU/HF/12/8 monitor gold dual concentric monitor spkrs, in cabinets, \$250/pr. D Weinstein, Cinema Snd, 311 W 75th, NY NY 10023. 212-799-4800.

APP-Holman HP, stereo preamp w/latest mod, perf cond, \$350; Russound QT-1 mini plug patch bay w/12 patch cords, switches up to 4 tape decks, 47 jacks, \$150. J Sunier, Audiophile Auditions, Box 1621, Ross CA 94957. 415-457-2741.

dbx 162 compressor limiter, stereo balanced in & out, excel cond, \$550. L Wagner, ARN Prod, POB 1788, Orlando FL 32802. 305-299-1299.

LIMITERS

Want to Sell

Inovonics 220, audio level optimizers (2), \$250 ea. Steve Portier, WNOE, 529 Bienville St, New Orleans LA 70130. 504-529-1212.

Orban 9100A1, mint cond, used less than 1 yr, w/manual, M Pittman, WAMN, POB 631, Anapolis MD 21404. 301-269-0700.

CRL audio processing equipment, great prices on the full line. FM4G in stock for immediate delivery. Broadcast Automation, 4125 Keller Springs, #122, Dallas TX 75244. 214-380-6800.

Orban 81001 processor, excel, \$3500. T Gaiser, KQXR, POB 2700, Bakersfield CA 93303. 805-328-1410.

CBS Volumax 400, excel clean cond, \$175; CBS FM stereo Volumax 411, excel clean cond, will also make fine phone patch amp/limiters, \$325. R Moen, Radio Service Co, 2905 S 160th Pl, Omaha NE 68130. 402-334-8767 after 6PM.

Urei 1178 stereo, mint, w/srvs manual, \$500. M Paradiso, Ultimate Image, 7200 Dunfield, LA CA 90045. 213-410-1009.

Inovonics 215 audio processor, includes gated AGC, compressor & FM peak controller modules, (2) both in excel cond. W Brown, WGAJ, Dearfield Academy, Dearfield MA 01342. 413-772-0241.

UREI BL40 Modulimiter, RMS, peak limiting for AM. J Phillips, WDCW, 414 Washington Ave, Defiance OH 43512. 419-782-8591.

Collins 260-1 limiter; Gates 994-6543-001 limiter; Gates Sta-Level, BO plus ship, M Rockwell, WNBI, POB 309, Park Falls WI 54552. 715-762-3221.

Delta AMC-1 AM mod controllers (2), one good, one for parts, sell as a pair, \$400; Harris ME-1 mod enhancer, gd cond, \$65. R Dieterich, WLTT, 1051 Brinton Rd, Pittsburgh PA 15221. 412-244-7600.

CRL AM4 mono inc: APP400, SEP400B, PMC300A, used only 8 mos, sell as system only, BO. E Cohen, WLFT, 310 Auditorium, MSU, E Lansing MI 48824. 517-353-4414.

UREI 1176LN peak limiter, never used, BO. J Ford, Musaire, 432 E Sahara, Las Vegas NV 89104. 702-735-9393.

Optimed 8000A w/manual, factory checkout in 4/86, spec sheet inc, \$2200 firm. B Dickerson, WPXE, POB 520, Starke FL 32091. 904-964-5001.

Marti CLA-40M AM mono audio processor, \$300. M Persons, KKIN, POB 930, Aitkin MN 56431. 218-829-1326.

Dorough DAP 310, AM mono, \$900. M Persons, KKIN, POB 930, Aitkin MN 56431. 218-829-1326.

Fairchild 663 compressor modules (2), need work but very gd mech cond, both units for \$75 ppp. G Finerman, Advanced Media, 17 Hillcrest Rd, Suffern NY 10901. 914-368-1143.

Aphex aural exciter II-B, audio processor, excel cond, \$2000. S Gilurzo, KGMG, POB K, Oceanside CA 92054. 619-729-1000.

Harris MSP 90 stereo AGC, \$1000. R Dieterich, WLTT, 1051 Brinton, Pittsburgh PA 15221. 412-244-7600.

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CBS 410 Volumax (2), \$150/both or trade. R Sanson, WGUS, POB 1475, Augusta GA 30913. 803-279-1380.

Orban 8100A/ST, FM studio chassis, limiting prior to STL microwave, new, \$600/BO. T Schultz, Video Masters, POB 1963, Kansas City MO 64141. 816-474-8530.

CBS 400 Volumax, as is, sell or trade, \$75. R Sanson, WGUS, POB 1475, Augusta GA 30913. 803-279-1380.

CBS Audimax 3, gd cond, \$145. J Hall, WCHV, 1140 Rose Hill Dr, Charlottesville VA 22901. 804-977-5566.

CRL AM4 mono system, complete, BO. K Jenkins, KAMA, 4150 Pinnacle #120, El Paso TX 79902. 915-544-7600.

Aphex Compellor, less than 1 yr old, \$800. T Parker, KXEW, 889 W El Puenete Ln, Tucson AZ 85713. 602-623-6429.

Volumax 400 & 411; Dorrugh DAP-310 FM audio processor; Inovonics 215 processor; Orban 245 E stereo synthesizer. P Wells, KLZZ, 8665 Gibbs #201, San Diego CA 92123. 619-565-6006.

Moseley TFL-200B limiters (2), excel cond, \$850 ea; CRL SEP-400A, excel cond (2), \$550 ea; CRL CC-300A comp limiter, gd cond, \$400. S Schneider, WBMX, 408 S Oak Park, Oak Park IL 60302. 312-524-3240.

Orban Optimod 8000A, gd cond, \$1750 or trade for prod equip. R Sanson, WGUS, POB 1475, Augusta GA 30913. 803-279-1380.

dbx 162 rack mounted stereo comp/limiter, \$400. B Hawkins, WENS, 1099 N Meridian #1197, Indianapolis IN 46204. 317-266-9700.

Orban 8000A Optimod in excel cond, \$2000 or trade for stereo console. Larry O'Neal, KIXK, POB 1624, El Dorado AR 71731. 501-862-9696.

Optimod 8100/A compressor/limiter/stereo gen, excel cond, \$3700/firm. S Cilurzo, KGMG, POB K, Oceanside CA 92054. 619-729-1000.

Marti CLA-40H compressor/limiters (2), P Wicker, WOBR, POB 400, Wanchese NC 27981. 919-473-3434.

Collins 260-1 limiter, P Wicker, WOBR, POB 400, Wanchese NC 27981. 919-473-3434.

Gates Solid Statesman, FM limiters, \$500. K Magrill, KSLM, POB 631, Salem OR 97308. 503-364-8433.

Gates solid-state FM audio limiters, matched-pair (2), \$400 ea. L Ayer, KRPL, POB 8849, Moscow ID 83843. 208-882-2551.

Optimod 9000A/1 AM, excel cond, \$1995. R Benson, KHOM, POB 728 Station 2, Houma LA 70360. 504-876-5466.

UREI BL40 recently recond, \$250 or trade. B Ladd, WNRR, 108-1/2 E Main, Bellevue OH 44811. 419-483-2511.

Pacific Recorders Multi-Max & Multi-limiter triband AM system, \$1000. K Magrill, KSLM, POB 631, Salem OR 97308. 503-364-8433.

CCA AGC amp, AGC-10 tube type, fair cond, WHPA, POB 464, Hollidaysburg PA 16648. 814-695-4441.

UREI LA4's, dual, blackface w/rack & manual, just aligned, \$600. B Hawkins, WEMS, 1099 N Meridian St, Indianapolis IN 46204. 317-266-9700.

UREI LA3A, LA2A, excel cond, work like new, BO. R Kaufman, Ricky The K Prod, POB 29804, Atlanta GA 30359. 404-636-9911.

Want to Buy

Orban 8100A or 8000 FM Optimod, J Paffenbarger, WUOM, 5000 LSA Bldg, Ann Arbor MI 48109. 313-763-1551.

Orban 8000A, D Van Zandt, WGNV, POB 88, Millador WI 54454. 715-457-2988.

Orban 8000A, perf cond, J Howell, Howells Audio, 521 Park, Kingman AZ 86401. 602-753-3054.

Inevonics 201, D Nebenzal, Tamara Prod, 8143 Morse Ave, N Hollywood CA 91605. 818-780-3099.

MICROPHONES

Want to Sell

Altec 21B tube omni condenser mic, R Robinson, Trod Nossel Recdg, 10 George St, Wallingford CT 06492. 203-265-0010.

AKG mic access, inc (4) CK-1 capsules, \$70. CK-5 capsule, \$170, & (3) A-51 elements, BO. D Flynn, Continental Recdgs, 210 South St, Boston MA 02111. 617-426-3131.

EV Cardline 642 shotgun mic, 50, 150, 250 ohms imp, bass flat, gd cond, \$100 firm. B Dickerson, WPXE, POB 520, Starke FL 32091. 904-964-5001.

Sennheiser MKH 816 P48 (6) shotgun mics, \$450 ea. John Probst, Production Svcs, 1235 Wildwood Ste 151, Sunnyvale CA 94089. 408-733-2695.

EV RE34 line level mics, new in boxes (2), \$249 ea of \$479/both. C Butler, 8709 Pinon Dr, Jacksonville FL 32221. 904-786-6363.

RCA 448X in fine cond, \$350; RCA 77DX mic, excel cond, \$325. L Syner, Box 182, Floral Park NY 11001. 718-347-2940.

Sony C-500 condenser mic, gd cond, w/o pwr supply, \$450/BO. M Fiedler, Mahoney Fiedler Prod, POB 24476, Minneapolis MN 55424. 612-822-0013.

Turner 2302 dynamic, new \$30; Turner 450D paging mic, new \$10; Ampex AG-350 service manual, BO; EV MC8A, new in box, \$25. W Laughlin, KDCV, 2636 N 56, Lincoln NE 68504. 402-466-8670.

Baby Boom mike stands (7), \$35 ea. W Burchett, Bur-K Inc, 842 Bellefonte Princess Rd, Ashland KY 41101. 606-324-8812.

Neumann U-64 (4), \$1600. W Burchett, Bur-K Inc, 842 Bellefonte Princess Rd, Ashland KY 41101. 606-324-8812.

Sennheiser 816P48 mikes (6), \$400 ea. J Probst, 1235 Wildwood #151, Sunnyvale CA 94089.

Neumann U-64 w/power supply (2), \$600 ea. A Varner, Penny Lane Stds, 1350 Ave of the Americas, NY NY 10019. 212-687-4800.

Neumann U-67, factory recond w/hw capsule, \$1200. J Hoffman, Daybreak Ent, 12318 Hardesty Rd, Ft Wayne IN 46825. 219-627-5990.

EV D056 (2) omni directional mic, \$70 ea. A Simon, 305 Spring St, NY NY 10013. 212-924-2276.

EV RE15, \$90; Sony C500, \$600; AKG N66 pwr supply, \$150. D Kocher, 1901 Hanover, Allentown PA 18103. 215-776-1455.

EV CS15 condenser, cardioid, \$150; Beyer 101NC omni dynamic, small dent in shell, freq response still exc, \$50; Audio-Technica ATM63 supercardioid dynamic, \$75. 813 condenser, \$75. 813R phantom powered condenser w/stands, higher SPL, \$100. R McMillen, RM Audio Prod, 13515 SW 72nd, Tigard OR 97223. 503-684-1973.

Want to Buy

EV RE20, A Kosack, C&G Assoc, 516-489-1071.

RCA 448X on 77DX, P Chance, Imperial Analog, 1809 Capers, Nashville TN 37212. 615-322-7601.

RCA 77DX, must be in excel cond, need two. M Brenner, Cal State Long Bch Music Dept, 1250 Bellflower, Long Bch CA 90840. 213-498-4796.

MISCELLANEOUS

Want to Sell

Onan 15 KVA 15 kW gen, 10-1/2 hrs total use time, FOB Mpls, BO over \$3500 before 8/30. D Johnstone, WCCO, 625 2nd Ave S, Mpls MN 55402. 612-721-2416.

Tascam DX40 DBX NR units (2), \$225 ea. Florian Pamer, 340 22nd St, Brooklyn NY 11215. 718-788-3514 aft 6.

Vikron 5742, mono play heads for cart/R-R use (5), \$60 ea, all for \$250. D Peluso, DGP Consultants, 2900 E Charleston St, Las Vegas NV 89104. 702-384-0081.

Sparta tech manuals, new audio manuals, \$10 ea; xmt manuals, \$25 ea; specify mdl of product wanted. D Peluso, DGP Consultants, 2900 E Charleston St 197, Las Vegas NV 89104. 702-384-0081.

AP wirecopy paper, 30 cases, BO or trade. B Musso, WGCC, POB 746, Chester SC 29706. 803-581-1490.

Indiana AM/FM station for sale, call for details. A Stanley, WNDI, POB 545, Sullivan IN 47882. 812-268-6322.

Epson JX-80 printer, color dot matrix, hardly used, BO. R Hill, WTPA, 107 E Main St, Mechanicsburg PA 17055. 717-697-1141.

Symetrix 104 telephone interface system, 2 mos old, like new, \$1000. K Harnack, WPAD, 1700 N 8th St, Paducah KY 42001. 502-442-8231.

Weston illuminated VU meters, \$25 ea. D Weinstein, Cinema Snd, 311 W 75th, NY NY 10023. 212-799-4800.

Phase Master T-10000, rotary phase converter, used 2 mon, ran 25 kW FM xmtrs until install 3 phase power, avail now, \$3950. K Dolly, WQCB, POB 273, Brewer ME 04412. 207-989-5631.

Telephones, (4) rotary dial, individual hold, 5 lines, E.C, \$35 ea. H Jernegan, WHRO, 5200 Hampton Blvd, Norfolk VA 23508. 804-489-9476.

Ampex & Simpson VU meters, illuminated (4), \$20 ea/BO. D Weinstein, Cinema Snd, 311 W 75th, NY NY 10023. 212-799-4800.

Chassis Tracs, limited number, \$5/set. R Meyers, Sound Masters, 4700 SW 75th Ave, Miami FL 33155. 305-372-5594.

Equip racks, (3) short 19", 37" high, gd cond, WHPA, POB 464, Hollidaysburg PA 16648. 814-695-4441.

Centner 48 DR & RS-PN, new patch bay, \$150. A Soroka, WJRO, POB 159, Glen Burnie MD 21061. 301-761-1590.

AM 1 kW daytimer 1580 kHz; FM 3 kW 105.5 MHz, comp automated, equip excel, Sunbelt, ideal for owner/operator, only station in market, \$250K, call or write. JP Robillard, 1803 N First East St, Haynesville LA 71038. 318-624-0105.

RCA Extel 32 printer, R Spain, KCWY, 304 N Center, Casper WY 82601. 307-234-1111.

Bird 8891, 5 kW coax load resistor w/blower, \$750. R Renner, WCLT, POB 880, Newark OH 43055. 614-345-4004.

Rack cabinets, 6' by 15" deep & 4' by 24" deep. P Wicker, WOBR, POB 400, Wanchese NC 27981. 919-473-3434.

T-12A vacuum crystals, 1250 kHz (2); T-12A vacuum crystal, 1380 kHz, WHPA, POB 464, Hollidaysburg PA 16648. 814-695-4441.

Teledyne Telan-2 series, thermal gen, complete w/meters, propane fueled w/regulators, 24 VDC 70 W, new, BO. D Barton, KMTI, POB 1590, Manti UT 84642. 801-835-7301.

Plate transformer FM, high voltage, 3 phase 220/4000 V, never used, \$500. D Smith, WFCB, 45 W Main, Chillicothe OH 45601. 614-773-3000.

Want to Buy

Bdct school needs used equip of all kinds, quality not priority. S Meyer, Meyer School of Bdctg, POB 2126, Minot ND 58702. 701-852-0427.

MONITORS

Want to Sell

TFT 753, \$900; Belar AMM-1, \$400 ea. Steve Porter, WNOE, 529 Bienville St, New Orleans LA 70130. 504-529-1212.

Gates GTM-88F FM freq mon; Metron 506B-1 AM mod mon, BO plus ship. M Rockwell, WNB, POB 309, Park Falls WI 54552. 715-762-3221.

McMartin TBM-4500A gd cond, \$1000; McMartin TBM-2000 SCA mon, 67 kHz, fact cond, \$1200. S Schneider, WBMX, 408 S Oak Park, Oak Park IL 60302. 312-524-3240.

RCA(Belar) BW 75 & BW 85, FM & stereo mod monitors, tuned to 92.9 as set only, \$1600. R Dietterich, WLTJ, 1051 Brinton, Pittsburgh PA 15221. 412-244-7600.

TFT 753 AM mono mod monitor, excel cond, \$900. M Persons, KKIN, POB 930, Aitkin MN 56431. 218-829-1326.

Collins 900F1 SCA monitor, gd shape, \$200. J Schloss, KICD, 2600 Hiway Blvd, Spencer IA 51301. 712-262-1240.

Collins 900C-3 FM mod mon; Metron 506B-1 AM mod mon, P Wicker, WOBR, POB 400, Wanchese NC 27981. 919-473-3434.

Want to Buy

Tower type accepted directional antenna monitors, 3 or more. D Davis, KMIN, POB 980, Grants MN 87020. 505-287-2989.

RCA BW 73-A mod monitor sub-carrier filter or monitor for parts, J Schloss, KICD, 2600 Hiway Blvd, Spencer IA 51301. 712-262-1240.

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Employment

To place ads in this section, use the Action-Gram form. To respond to box numbers, write Radio World, Box 1214, Falls Church VA 22041, Attn: ____.

POSITIONS WANTED

Eng will consider air shift, 2 yrs formal training, w/7 yrs exper, certified w/CC general, 25K min, all markets, currently employed. Write: RW, POB 1214, Falls Church VA 22041. Attn: Box 8-2.

Assist. Radio CE, 2 yrs exper., general class license, audio, radio freq & digital electronics knowledge. KGBT/KELT, Box 711, Harlingen, TX 78550. EOE.

CE, prod pro, air personality looking for combo position, 14 yrs exper on air & as hands on CE, presently Chief in top 50

market. Gary, 3916 Slagle Dr, Charlotte NC 28215. 704-563-8676.

Radio CE, FT, 10 yrs exper, 50 kW crit array, now ChOp, CIE grad, Grantham ASET. For resume write: RW, POB 1214, Falls Church VA 22041. Attn: Box 8-1.

Former CE of LA based satellite network, 12 yrs exper, programming, ops, recording studio design, construction, seeking CE and/or ops mgr to eventually GM. Marty Walker, 909 Palm Ave #103, W Hollywood CA 90069. 213-659-0874.

Talented DJ, 10 yrs exper, Piedmont NC pref. R Wishon, Box 545, Yadkinville NC 27055. 919-679-2379.

Currently OM at Western NY station, looking for FM position, 10 yrs exper in all phases, community minded. PW, Box 43, Dunkirk NY 14048.

Bdct Tech seeks FT/PT work in studio, can announce, 10 yrs FM/TV exper. Hank, 408-246-5563.

Radio CE, former CE Boston, Houston, Miami, Ham genrl, non-drinker, now! ASEE, M Gottsman, 3377 Solano #312, Napa CA 94558. 415-550-8506.

Prof actor w/equip looking for people to form film co. call or write: H Deans, 170 Grand St, White Plains NY 10601. 914-949-5920 or 203-866-5050 X3243.

Tech oriented person seeks bdct related job as xmitter maint tech, elect exper. Write: M Rakoff, 114-41 Queens Blvd Ste 14B, Forest Hills NY 11375.

CE/Ops Dir, 10 yrs exper, great prod if needed, prefer Colorado-Rockies, AM/FM/TV, GB, 1312 Left Hand Dr, Longmont CO 80501. 303-72-3916.

Bright, ambitious, 32 yr old, seeks station for eng work to break into bdctg, general/ham, CET plus more! Mitchell Rakoff, 114-41 Queens Blvd, Forest Hills NY 11375. 718-591-0002.

HELP WANTED

Tech Supr, New York station has opening for highly qualified person w/maint exper in all phases of broadcasting. Contact Kenneth Stout, WPAT AM/FM, 1396 Broad St, Clifton NJ 07013. 201-345-9300.

Can't Find It? Call 1-800-426-8434 For Immediate Action! Want To Sell It?



Broadcast Equipment Exchange

MOVIE PRODUCTION EQUIP.

Want to Sell

Cinema Products 16mm camera, 2 magazines & case w/Angenieux zoom lens 12:120, batteries & access, excel cond. \$1475/BO. M Fiedler, Mahoney Fiedler Prod. POB 24476, Minneapolis MN 55424. 612-822-0013.

Bolex 816 16mm movie camera, zoom lens, sync motor for snd recdg, battery pack & attachment for 400' magazine. BO. H Beans, Beans Prod, 170 Grand, White Plains NY 10607. 914-949-5920.

RCA FR-35 35mm projector, new cond w/manuals. T Smith, CCI Prod, 192 Lancaster Ave, Frazer PA 19355. 215-289-1725.

Bolex H16, 16mm w/zoom lens, sync sound motor, battery pack, pistol grip, 400' magazine on camera, \$1650. H Deans, Deans Prod, 170 Grand St, White Plains NY 10601. 914-949-5920.

RECEIVER & TRANCEIVERS

Want to Sell

Yaesu FRG 7 comm rec, excel cond, \$185. M Goodman, Interport Group, 6621 Gettisbury Dr, Madison WI 53705. 608-833-6948.

GE MSTR VHF base station w/Regency TR200 VHF mobile 2-way on 161.64 MHz, \$200 ea/\$1500 for both. F Morton, KMGZ, POB 7953, Lawton OK 73504. 405-536-9530.

Drake R7 comm rec w/all 5 bandwidth filters & noise blanker, excel cond, \$745. M Goodman, Interport Group, 6621 Gettisbury Dr, Madison WI 53705. 608-833-6948.

Motorola UHF ENG system w/HT's, mobiles, voting system & more, wide audio bandwidth, \$35000. P Wells, KLZZ, 8665 Gibbs #201, San Diego CA 92123. 619-565-6006.

Bogen TP160 solid state AM/FM mono receiver, may need some work, \$75. M Persons, KKIN, POB 930, Atkin MN 56431. 218-829-1326.

RCA Pac Tech Series, 2 W transceivers, port, exc cond (8), \$250 ea; Johnson 547 UHF port, 4 W w/rapid chargers, \$175 ea; RCA 700 series UHF base station 25 W, \$450; Standard 703 UHF repeater w/60 W amp, \$850. R McGrath, Spanner Dup Svcs, 320 William Circle, Alliance NE 69301. 308-762-7640.

REMOTE & MICROWAVE EQUIP.

Want to Sell

Telex CS91, new in boxes (2), \$89 ea of \$169/both. C Butler, 8709 Pinon Dr, Jacksonville FL 32221. 904-786-6363.

S-A 2.8 meter sat receive antenna series 9000, ABC radio network 32 pulse receiver, both items 59 percent of cost. J Cantrill, WLLR, 1910 E Kimberly Rd, Davenport IA 52807. 319-355-5331.

Micro Controls RCR-9/RCT-9 xmtx RC unit, use w/teco line only, 9 chan, not been used since recon, \$1100. M Meyer, KLQP, POB 70, Madison MN 56256. 612-598-7301.

RCA PBR-15s, like Moseley TRC-15AW but only have xmtx end (2), 1 works, 1 for parts, repairable, sell as pair, \$200. R Dietrich, WLTT, 1051 Brinton Rd, Pittsburgh PA 15221. 412-244-7600.

Moseley SC68, SC68 185 kHz subcarrier gen & demod, brand new, BO. J Ford, Musaire, 432 E Sahara, Las Vegas NV 89104. 702-735-9393.

S-A dual 7.5 kHz audio demod card, like new, for radio network pickup, \$450. R Moen, Radio Service Co, 2905 S 160th Pl, Omaha NE 68130. 402-334-8767 after 6PM.

QEI 7775 automated xmtx system, \$2000 or trade for quality R.R. D Doughty, WTLB, Utica NY 13503. 315-797-1330.

Microwave Assoc MAG-6, comp xmtx & receive stations in racks, 1 video & 2 audio chan, 6987.5 MHz, new cond, BO. T Smith, CCI Prod, 192 Lancaster Ave, Frazer PA 19355. 215-289-1729.

Marti RMC-20, vgc, w/2 chan ext relay panels total 10 ch, \$1000. J Meyers KVPR, 754 D St, Fresno CA 93721. 209-486-7710.

Marti M308T, VHF RPU transmitter w/tube type receiver on 161.64 MHz, avail 7/30/86, \$1200/BO. F Morton, KMGZ, POB 7953, Lawton OK 73504. 405-536-9530.

Microwave Assoc MAG6 complete transmit & receive stations in rack's 6987.5 MHz, new cond. T Smith, CCI Prod, 192 Lancaster, Frazer PA 19355. 215-289-1725.

Micro-Controls RCR-9 & RCT-9 analog remote control system, currently on phone line, but adaptable to STL/SCA, \$1500 & will pay ship, avail 6/86. R Miller, WRV1, 278 E Jackson, Virden IL 62690. 217-965-3388.

Want to Buy

M/A-Com satrcvr & Wegener 1600 series demod for SMN Star format. L Dupree, KSYL, Box 7057, Alexandria LA 71301. 318-445-1234.

STL antennas, 950 MHz. D Davis, KMIN, POB 980, Grants NM 87020. 505-287-2989.

Moseley TRC15A, need xmtx end, will buy system for backup. D Barton, KMT1, POB 1590, Manti UT 84642. 801-835-7301.

STEREO GENERATORS

Want to Sell

CCA SG-10 stereo gen, gd cond, \$200; Moseley SCG-4T SCA gen, 67 kHz, vgc, \$400. S Schneider, WBMX, 408 S Oak Park, Oak Park IL 60302. 312-524-3240.

Mod Sciences Sidekick, excel cond w/manuals, 67 kHz changable to 92 kHz, \$2000 firm. C Peterson, Show Sound, 4601 W Kennedy Ste 301, Tampa FL 32609. 813-884-1461.

SWITCHERS (VIDEO)

Want to Sell

JVC KM2000 switcher, like new, \$2295. D Brennan, Custom Video, POB 26126, Birmingham AL 35226. 205-823-0088.

TAPES, CARTS REELS

Want to Sell

Various AA-4's & Fidelipacs in varying conditions. P Wells, KLZZ, 8665 Gibbs #201, San Diego CA 92123. 619-565-6006.

Tape, 2500' on metal reels, 1/2" for \$15 ea & 1" for \$30 ea. D Flynn, Continental Recdgs, 210 South St, Boston MA 02111. 617-426-3131.

Fidelipac carts, (1296), all vgc, asst lengths, 75' ea or all for \$650. R Moen, Radio Service Co, 2905 S 160th Pl, Omaha NE 68130. 402-334-8767 after 6PM.

Ampex 406, 1" audio tape, never used, (9) total reels, \$35 ea/\$300 for all. M Friend, J-Mark Prod, 8706 Doss Rd, Moseley VA 23120. 804-739-3178.

Ampex 671, three groups to choose from: 7"x2400' hand picked bulk taped down ends, 70 per ctn 60' ea or \$42 per ctn plus UPS; or hand picked taped down ends in printed box, 50 per ctn, 80' ea, \$40 per ctn plus UPS; or as is bulk, 60 per ctn, 35' ea, \$21 per ctn plus UPS. Call Burlington Audio Tapes, 106 Mott St, Oceanside, NY 11572. 1-800-331-3191 or in NYS 516-678-4414.

Ampex 194 video tape, helical scan, various lengths, mostly new in box, BO. M Friend, J-Mark Prod, 8706 Doss Rd, Moseley VA 23120. 804-739-3178.

Fidelipac 300, various lengths (1188), \$600. T BonDurant, WOJY, POB 2808, High Point NC 27261. 919-869-0101.

Complete LP Lib of approx 4000 albums, top 40, MOR/AC/NW, many greatest hits & dbl sets in bdct cond, \$6500/BO. R Lewis, Innovation Org, POB 50098, Henderson NV 89106. 702-458-0965.

Metal reels, 10.5" NAB 1/4", gd cond, \$1.50 ea. G Falk, Falk Recdg, 7914 Fegenbush Lan, Louisville KY 40228. 502-239-1010.

Want to Buy

Top 40 record library, rock or country hits, 1955-pres, albums and/or 45 rpm. B Coleman Jr, Coleman Bdct, 114 Circle Dr, Rocky Mt NC 27804. 919-443-7870.

Pre-recorded 1/4T, 1/2T & quad tapes wanted. R Gasman, Gasman Audio, 779 Worcester St, Wellesley MA 02181. 617-CELTICS.

TAX DEDUCTION EQUIP.

Church Outreach ministry needs all types of audio & video equip, need 8 chan or more audio console, cart machines, mcs, etc. K Crothers, 1st Christian Church, 220 Melbourne Dr, Maryville TN 37801. 615-983-6905.

Tower, sustaining 100', 3 CB base & mobile units, desk stand mikes, coax cable & related equip. WARM/CB Townwatch, POB 11822, Phila PA 19128.

Bdct equip, any type for non-profit college, audio or video, pref working or in need minor repair, will use for ed prog. B Ally, BMC/TV, Bryn Mawr College, Bryn Mawr PA 19010. 215-645-6215.

Donations of video, radio prod, xmission equip, tax receipt given. B DeFecce, Norwalk Public Schools, Inst Media, 105 Main, Norwalk CT 06852. 203-847-0481 X221.

R-R's, mono, & record only cart machines, operational or repairable for donation/tax deduct. D Sabini, Indiana State Univ, Dreiser Hall, Terre Haute IN 47809. 812-237-3248.

FM xmtx 5 kW for donation, must be reliable. J McDermott, KCVO, POB 190, Camderton MO 65020. 314-346-2763.

Donation of all types of FM radio equip to start non-profit Christian station. D Snyder, Adonai Comm, POB 426, Coudersport PA 16915. 814-274-8085.

Non-profit station needs 6076 & high voltage rectifier 857B, 6894, 6895 or 673 & parts for RCA 50 kW BTA xmtx, also 833 tube. S Weber, KGRV, POB 1598, Winston OR 97496. 503-679-8185.

Harris Criterion Compacts, religious station has donated Harris Criterion Compact 3 cart deck, need the record amp. T Cochran, Alaska Radio Mission, Box 988, Nome AK 99762. 907-443-5221.

Seven sec delay carts & 7 sec delay cart machine, donation would be appreciated. S Davidoff, WAIF, 2525 Victory Pkwy, Cincinnati OH 45206. 513-961-8960.

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Free listings in Broadcast equipment exchange are offered to all United States Broadcasters AM/FM/TV and all Pro-Sound end users. Broadcast Supply West will accept up to three listings by telephone. For more than three listings BSW will send you an ad order sheet for your convenience. BSW will list each ad for a period of three full months.



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EMPLOYMENT SECTION:

Help Wanted
Any company or station can run "Help Wanted" ads at the flat rate of \$18 per listing per month (25 words max). Payment must accompany insert; there will be no invoicing. Blind box numbers will be provided at an extra charge of \$2. Responses will be forwarded to listee, unopened, upon receipt. Call 800-336-3045 for display rates.

Positions Wanted
Any individual can run a "Position Wanted" ad, FREE of charge (25 words max), and it will appear in the following 3 issues of Radio World. Contact information will be provided, but if a box number is required, there is a \$2 fee which must be paid with the listing (there will be NO invoicing). Responses will be forwarded to the listee, unopened.

Check as appropriate: Help Wanted With Box Number
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Text (25 words maximum): _____

Name _____ Title _____

Company/Station _____

Address _____

City _____ State _____ Zip _____

Telephone _____

BROADCAST EQUIPMENT EXCHANGE
PO BOX 1214
FALLS CHURCH VA 22041

Rw

Broadcast Equipment Exchange

TAX DEDUCTIBLE . . .

Self-supporting tower, stereo gen. & solid state stereo board sought by non-comm FM college station, leave message or write: R Shegrier, KNBU FM, Baker Univ, 7th & Dearborn, Baldwin City KS 66006. 913-594-6451.

TEST EQUIPMENT

Want to Sell

Lectrochab 1555 NTSC vectorscope, like new, \$950. B Williams, 5810 N Western Ave, Chicago IL 60659. 312-944-6248.

Yaesu YC-355d nixie tube, 35 MHz/30-200 MHz, \$150; HP 331A, \$600; HP 652A, \$600. Steve Portier, WNOE, 529 Bienville St, New Orleans LA 70130. 504-529-1212.

Heathkit IM-5258 harmonic dist analyzer, gd clean working order, \$75; Gorman-Redlich CEB, like new, \$250. R Moen, Radio Service Co, 2905 S 160th Pl, Omaha NE 68130. 402-334-8767 after 6PM.

Jasoni TAS-1000P, audio tape analyzer for R-R, cart & cassette alignment, calibration, etc., \$290; ATS Corp ATS-75C-MI, stereo test set for AM/FM stereo audio proofs, self contained passive unit, \$150; Gold Line ASA-10, for analyzing room freq, response, built in mic, can be used direct, \$175. D Peluso, DGP Consultants, 2900 E Charleston St 197, Las Vegas NV 89104. 702-384-0081.

FR-1200 comm mon/RF spectrum analyzer w/all options, 250 kHz to 1 GHz, excel cond, \$6500 firm. S Cilurzo, KGMG, POB K, Oceanside CA 92054. 619-729-1000.

Barber & Williamson 200 audio osc, \$150. M Persons, KKIN, POB 930, Aitkin MN 56431. 218-829-1326.

Hickok 800 tube & transistor tester, \$150. M Persons, KKIN, POB 930, Aitkin MN 56431. 218-829-1326.

Tek 7L18 spectrum analyzer, 1.5 to 18 GHz, 60.5 GHz w/ext wave guide mixer, digital storage, perf for sat system measurement, fits Tek 7000 mainframe, excel cond, \$10,000. J Somich, KSCI, 1954 Cotner Ave, LA CA 90025. 213-479-8081.

Homs-Clark FIM-135 field strength meter, solid state, excel cond, \$550. C Anderson, 1519 Euclid Ave, Bowling Green KY 42101. 502-781-2067.

Tek 520A vectorscope, perf cond. T Smith, CCI Prod, 192 Lancaster Ave, Frazer PA 19355. 215-289-1725.

Elec Devel Corp 4100 sine wave amplitude & freq standard, excel cond, 2 yrs old, \$2000/BO. S Jordan, WUSQ, Rt 50 West, Winchester VA 22601. 703-662-5101.

Tek 526 vectorscope, gd cond, \$400; Tek 181S1 time mark gen, fair cond, \$75; HP 8558B & 853A spectrum analyzer, excel cond, \$10,000. W Grossman, 1555 Astor St, Chicago IL 60610. 312-944-6248.

Fluke 8020, digital handheld multimeter, very gd shape, \$150. R McMillen, RM Audio, 13515 SW 72, Tigard OR 97223. 503-684-1973.

Tek 1420, RM-529, 528, 520A, 1440, 1460, 146, 147, all units in gd cond; GVG 900 main frame, sync gen, proc amp & color lock module, gd cond. T Smith, CCI Prod, 192 Lancaster, Frazer PA 19355. 215-289-1725.

Sound Tech 1510A, tape & audio test system, inc reel & cart test tapes, excel cond, \$7500/BO. S Urbani, KKUS, 396 Buckley Rd, San Luis Obispo CA 93401. 805-541-8798.

SSI-Wavetek mdl 2000 synthesized signal gen, 400 kHz to 999 MHz, excel attenuator & low RF leakage, \$2750. W Arnett, WBAT, 120 N Miller, Marion IN 46952. 317-664-2411 eves.

HP 1415A time domain reflectometer w/140B scope, new cond, \$1100. R Evans, 216 N Green Bay Rd, Thiensville WI 53812. 414-242-6000.

Want to Buy

Tek 545 srs manual, need complete. Allen Audio, POB 1979, Decatur GA 30031. 404-325-7847.

B&W 4-10 service manual, have unit, need manual or help in finding one. M Klappenbach, KVWC, POB 1419, Vernon TX 76384. 818-552-6221.

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Electro-Metrics, any recent mdl or Eaton interference analyzer/field intensity meter covering 10 kHz to 1 GHz range. M Goodman, Interport Group, 6621 Gettysburg Dr, Madison WI 53705. 608-833-6948.

Manual & schematics for GR 1613A capacitance bridge or military version, TTU-24E, T Adams, WI Public Radio, 3319 W Beltline Hwy, Madison WI 53713. 608-246-2052.

CMC 616 freq counter, any cond, for replacement parts & boards. T Adams, WI Public Radio, 3319 W Beltline Hwy, Madison WI 53713. 608-246-2052.

TRANSMITTERS

Want to Sell

BE 5 kW FM xmtr, unused, will sell at loss, \$24,000/BO. Gil Garcia, KTON, POB 240, Belton TX 76513. 512-398-3079.

FM 25kW xmtr w/spares, excel cond, tuned & tested on your freq, late 70's model w/mod mon included, guaranteed; also used 1 kW AM xmtr. Goodrich Enter, 11435 Manderson St, Omaha NE 68164. 402-493-1886.

AM xmtr parts. J Cunningham, YSDA Radio, Rt 2 Box 1138, Stonewall OK 74871. 405-265-4496.

Versa Count V-322 FM stereo exciter & LA-150 xmtr, 150 W, 4 yrs old, excel cond, \$3500. W Brown, WGAI, Dearfield Academy, Dearfield MA 01342. 413-772-0241.

Gates 1E-1, \$900; RCA BTA-1R, \$2500. Steve Portier, WNOE, 529 Bienville St, New Orleans LA 70130. 504-529-1212.

BE exciter, used 7 mos, \$4500. Gil Garcia, KTON, POB 240, Belton TX 76513. 512-398-3079.

Collins 820-D-2 AM xmtr, 1 kW & pwr increase, dial location change, w/compatible tower, excel cond, avail immed, BO. C Thornton, WAGE, POB 1290, Leesburg VA 22075. 703-777-1200.

Collins 83001A 1 kW stereo xmtr. BO. B Wilkinson, Colorado Recdg, 1665 Bluebell Ave, Boulder CO 80302 303-442-1198.

Collins 820-D-2 AM, 1kW, compatible tower also for sale, excel cond, avail immed, BO. C Thornton, WAGE, Box 1290, Leesburg VA 22075. 703-777-1200.

Gates DC-5E, 5 kW AM, on 1260, new P Dahl pwr xformers, vgc, some spare parts, \$2950 neg. J Hall, WCHV, 1140 Rose Hill Dr, Charlottesville VA 22901. 804-977-5566.

Bird 8922 dummy load, 5 kW, \$1700. E Muscovitch, WHLM, 107 W Main, Bloomsburg PA 17815. 717-784-4900.

Collins 22.5 kW xmtr, 945' of 3-1/8" coax w/connectors, 12 bay antenna & 1000' tower, BO for lot. L Dupree, KWID, 1115 Texas Ave, Alexandria LA. 318-445-1234.

QEI 675, 20 W exciter, mint, \$2000. S Lawson, KAK, POB 91, Villa Grande CA 95486. 707-865-1516.

RCA BTF20E1 20 kW FM xmtr w/BTE15A exciter, BB1B stereo gen, BTK18 SCA gen, no finger stock in PA socket recently & some spares, \$10,000. G Morrill, WITL, 3200 Pinetree Rd, Lansing MI 48910. 517-393-1010.

RCA BTAS0F1, 50 kW AM, gd cond w/spares, BO. B Sowell, WMAZ, POB 5008, Macon GA 31213. 912-741-9494.

RCA BTA 5F, 5 kW xmtr, 620 freq, \$5000. B Hale, WINF, POD K, Leesburg FL 32749. 904-787-1410.

RCA BTE-15A FM exciter, 107.7 MHz, w/SCA module & wide band input module, manual, gd cond, in operation, \$1000. R Roiseland, KSKX, 5315 W 7th, Topeka KS 66602. 913-272-2122.

RCA BTA-1R 1000 W on 1320 kHz, BO. T BonDurant, WOJY, POB 2808, High Point NC 27261. 919-869-0101.

Gates DC-1F, AM 1 kW xmtr in aux use, BO. R Benson, KHOM, POB 728 Station 2, Houma LA 70360. 504-876-5466.

Collins 8200-2 AM, tuned to 1290, power set to 1K/500 W, inc spare parts, \$8000 plus ship. P Draisay, WAGE, Box 1290, Leesburg VA 22075. 703-777-1200.

Collins 830-1, 10 kW power amp, \$5000. R Renner, WCLT, POB 880, Newark OH 43055. 614-345-4004.

QEI Mdl 77751 ATS interface panel, never used, \$150. J Robillard, KLVU, 1803 N First East St, Haynesville LA 71038. 318-624-0105.

LPB carrier current, inc (3) 2-20 systems w/TX-20 xmtr & T-8 interface; (2) T-1A-X pwr splitters; (1) T-1A-X pwr splitter; (9) T-8 interfaces; (4) RC-5A 5 W xmtrs; RF patch cables for all but RC-5A units, various manuals & install instructions. J Kobrock, WEOS, Geneva NY 14456. 315-789-8970.

Harris FM-10K, like new, 3 yrs old, in operation, w/exciter, \$25,000. J Zimmer, Zimmer Bdctg, POB 1610, Cape Girardeau MO 63701. 314-651-3003.

Gates FMSB 5 kW FM xmtr on 92.9, final cabinet needs minor work w/manual & spare final, \$500 & buyer ships. B Croghan, KWFM, 2100 N Silverbell Rd, Tuscon AZ 85745. 602-623-7556.

Want to Buy

FM xmtr, older type OK. R Calhoun, Calhoun Assoc, 2412 Larsen Rd, Yakima WA 98908. 509-783-6605.

Gates FM1, D Van Zandt, WGNV, POB 88, Millador WI 54454. 715-457-2988.

TTC XL1FM2 FM translator. P Nordgren, WXPB, 303 W Prospect, Rhinelandt WI 54501. 715-367-6000.

FM xmtrs, 5-20 kW. M McKenna, McKenna Comm, POB 90277, Long Beach CA 90809. 213-597-1961.

Main cavity blower motor for Collins 830E-1A, 5 kW FM xmtr. R Mains, WMPX, 1510 Bayliss St, Midland MI 48640. 517-631-1490.

FM xmtr, 20 kW, mid 70's or newer in gd cond, single phase if possible. G Durham, WYGO, 400 E Center, Corbin KY 40701. 606-528-6618.

BTA-1R-1 or IR-2 xmtr, call or write: R Eugene, 610 W 141st #5A, NY NY 10031. 212-926-2511 or 212-862-1298.

Rust FMT15A-HV FM xmtr instruction manual, \$50 reward. D Swanson, KTFC, RR 2, Sioux City IA 57106. 712-252-4621.

FM xmtr, 20 kW, w/o exciter, for full donation or part donation or part cash, non-comm licensed to public school district. J Mangan, KVTI, 4500 Steilacoon Blvd SW, Tacoma WA 98499. 206-756-5889.

TUBES

Want to Sell

RCA, Amperex, Raytheon, etc audio tubes, miniature type, audio/RF, some medium size 6L6 etc. send for list or types wanted, \$2-5 depending on type. D Peluso, DGP Consultants, 2900 E Charleston St 197, Las Vegas NV 89104. 702-384-0081.

EIMAC 4CX250B, unused, makes power, 10 yrs old, \$60; EIMAC 5CX1500A, unused, makes power, 10 yrs old, \$600. L Snyder, Box 182, Floral Park NY 11001. 718-347-2940.

Tubes, high power transmitter, new & used, all guaranteed & verified. BO. T Smith, CCI Prod, 192 Lancaster Ave, Frazer PA 19355. 215-289-1725.

Varian, Machelett, RCA xmtr pwr tubes, various types, all guaranteed & verified. T Smith, CCI Prod, 192 Lancaster, Frazer PA 19355. 215-289-1725.

Want to Buy

Tube, 4CX5000, gd working cond. Allen Audio, POB 1979, Decatur GA 30031. 404-325-7847.

RCA TU11B, need (2) 6181 tubes & (2) 6161 tubes for 1 kW UHF xmtr. L Nixon, WTKV, 601 N Lee, Valdosta GA. 912-247-3333.

TURNTABLES

Want to Sell

Russco Studio Pro B, (2), \$95 ea. Steve Portier, WNOE, 529 Bienville St, New Orleans LA 70130. 504-529-1212.

Technics SP10MKII (2) new, orig box, \$600 ea. B Henry, KLLK, 12 W Valley St, Willits CA 95490. 707-459-1250.

Russco & QRK TTs in Ruslang cabinet (2), \$300. D Flynn, Continental Recdgs, 210 South St, Boston MA 02111. 617-426-3131.

QRK 12-C, excel cond w/arms & cartridges, \$175 ea. R Moen, Radio Service Co, 2905 S 160th Pl, Omaha NE 68130. 402-334-8767 after 6PM.

Shure M44-7 (3), brand new; Shure SG39EJ (6), brand new. B Major, KJNO, 3161 Channel Dr #2, Juneau AK 99801. 907-586-3630.

BE Spotmaster Studio Pro TT w/Micro-Trak tonearm, low hrs, \$200. L Wagner, ARN Prod, POB 1788, Orlando FL 32802. 305-299-1299.

Want to Buy

Technics SL1800, B Nary, Doc Rock Prod, 3700 Durham Rd, Guilford CT 06437. 203-457-1032.

Sony TTS 3000 2 speed belt drive, pay any price, collect calls accepted. M Glaser, C&G Ent, 2 Floyd Ln, Massapequa NY 11762. 516-489-1071.

VIDEO PRODUCTION EQUIP.

Want to Sell

Sony CVM1900 19" combo receiver/monitor, \$575. J Probst, Production Services, 1235 Wildwood Ste 151, Sunnyvale CA 94089. 408-733-2695.

Fearless MI 26040 Panoram Tel dolley w/turret, max hght 6', \$5000/BO. D Agey, Transmedia Inc, 2054 Kingston Ave, Norfolk VA 23503. 804-587-4112.

Misc amps, couplers, modulators, filters, etc, all used, in gd cond, call or write for list. A Braun, Aluan Eng, 2305 Florencita, Montrose CA 91020. 818-957-0618.

Clear-Com RS-100A belt packs, \$100 ea; KB-111A sprk strn w/box, \$150 ea; AC-10K adaptor, \$200; 2 chan CS-200 main stn, \$250; 8 chan main stn, \$500; Audio Follow mixers, 8 stereo inputs, A/B bus out, parametric EQ, mint (2), \$750 ea; Quick Set Hercules pedestal w/cradle head, rebuilt, mint, \$500. M Paradiso, Ultimate Image, 7200 Dunfield, LA CA 90045. 213-410-1009.

Alden 9271 DA/AEC facimile recorder for NWS map repro via sat or landline, 4 yrs old, 24 hr clock stand, 30 rolls paper, spare blade, \$4000. KLMS, 1540 S 70th Ste 200, Lincoln NE 68506. 402-489-6500.

VDS/Comparvid System, teletext, char gen, includes all equip for full screen data & stock disp from sat, inc keyboard. F Campenni, Madison Cable Network, POB 8056, Madison WI 53708. 608-252-6000.

Harris 516 digital TBC, 16 lines, excel cond, \$2595; Dynascience hor/vert image enhancer, gd cond, \$495. D Brennan, Custom Video Labs, POB 26126, Birmingham AL 35226. 205-823-0088.

Harris 516, TBC, gd cond, 16 line digital, \$2795. D Brennan, Custom Video, POB 26126, Birmingham AL 35226. 205-823-0088.

Want to Buy

Video equip w/payment ltx trade dollars. J Harsh, Country Club II, I 70 & Hwy 83, Okley KS 67748. 913-672-3428.

VIDEO TAPE RECORDERS

Want to Sell

Sony VO1800 3/4" player/rec, 2 chan audio, RF out works fine \$375. R Peterson, Pacific Comm, POB 7668, Olympia WA 98507. 206-754-7081.

JVC 60600 3/4" w/manual, vgc, \$800. R Robinson, Trod Nossel Recdg, 10 George St, Wallingford CT 06492. 203-265-0010.

Sony SLO320 ind Beta I player/rec, auto repeat, works fine, \$275. R Peterson, Pacific Comm, POB 7668, Olympia WA 98507. 206-754-7081.

Sony V05600 U-matic, front load, w/high speed search, gd cond, \$1300 plus frt. W Wong, Acme Video, 1343 N Highland, Hollywood CA 90028. 213-871-9008.

RCA TR600A, 2" VTR w/heads, like new, mint cond, (3) under 140 hrs, must sell this month, \$8000 ea or all for \$22,500, call & make offer. S Dock, Rocky Mtn Film & Tape, 145 Madison St, Denver CO 80206. 303-399-6444.

Video editing equip, 3/4", (2) Sony VO2860A, one for parts; Sony VP2260; RM430 editor; (2) Panasonic CT1010M color monitors; 50-100 misc 3/4" video tapes, \$3000. Rich, Pacific Comm, POB 7668, Olympia WA 98507. 206-754-7081.

Panasonic NV9240 3/4" recorder, \$4000; Panasonic NV8500, 1/2" editor, \$1600; Panasonic A500 controller, \$700. M Remes, Penquin Video, POB 632, Fayetteville AR 72702. 501-442-8153.

JVC 6060U w/service manual, \$1000. R Robinson, TNA Studios, 10 George St, Wallingford CT 06492. 203-269-4465.

Sony BVM-1100 dynamic motion controller, VO-4800, VO5850, VO-5800, RM-440, Sony 1" alignment tape; EECO VCP-950 & VCP-750, time code gen & readers, new cond. T Smith, CCI Prod, 192 Lancaster, Frazer PA 19355. 215-289-1725.

Zenith VR9800 & VRT9850 2 piece Beta VCR system, recorder, tuner/timer, wireless remote, editing, hrs-mins-secs & more, w/3 batts. VCR case & AC supply charger, \$550 plus ship. P Combs, Only Son Prod, 2316 Forrest Home, Dayton OH 45404. 513-236-2340.

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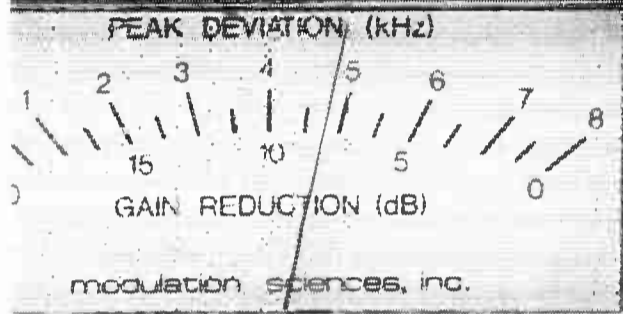
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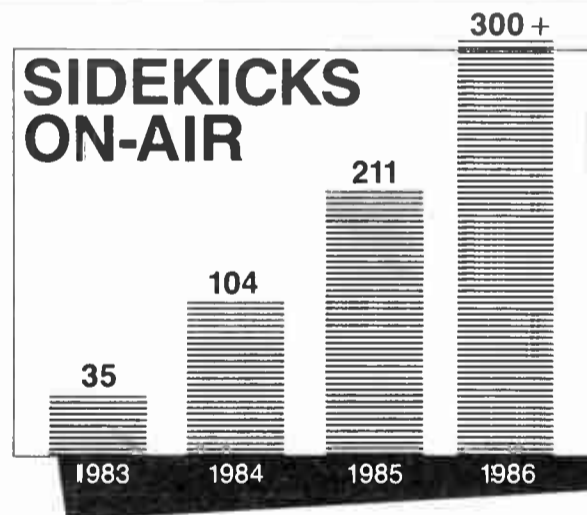
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