

RF Lighting: Views Vary

by Alex Zavistovich

Washington DC ... The NAB has "applauded" a FCC effort to limit AM interference from RF lighting devices, but urged the use of certain standards only as an "interim" measure, pending further study of the issue.

The NAB's comments were filed in response to a Commission proposal to adopt RF lighting device radiation limits at frequencies below 30 MHz.

On the other side of the issue, North American Phillips Corporation, manufacturer of the SL-18 RF lamp, expressed concern that the "excessively stringent" emission standards proposed by the FCC may limit innovations in RF lighting.

The FCC's proposal, unveiled in May, would limit radiation emanating from RF lighting devices to 15 $\mu\text{V}/\text{m}$ at 30 meters for frequencies from 1.705 MHz to 30 MHz. Other limits include 2.4/F $\mu\text{V}/\text{m}$ (where F is frequency in MHz) at 300 meters for the 9 to 450 kHz range and 24/F $\mu\text{V}/\text{m}$ for the 450 kHz to 1.705 MHz range.

According to the proposal, consumer RF lighting devices would fall under Commission certification requirements; nonconsumer devices would be required to meet verification criteria.

"If it ain't broke ..."

Phillips urged the FCC to consider "less restrictive standards" and suggested that "an emerging consensus on voluntary industry standards ... will provide all the protection necessary against objectionable interference."

The National Electrical Manufacturers Association (NEMA), in its comments, maintained that there is no "substantiated need to establish federal regulations limiting radiated emissions from RF lighting devices below 490 kHz."

NEMA claimed the FCC can establish regulations only "when there is a substantiated reason to believe that licensed communications will be subject to objectionable interference."

"In the absence of a problem, no corrective action is necessary," NEMA said.

However, NAB maintained that the potential of RF lighting devices to replace conventional sources exacerbates the problem of AM interference and requires the establishment of minimum technical standards. The organization has urged the FCC to adopt an "interim" standard to limit

(continued on page 8)

FCC AM Efforts Lauded

by David Hughes

Washington DC ... In comments filed with the FCC, broadcasters generally supported the recommendations to improve AM radio contained in the Commission's "Report on the Status of the AM Broadcast Rules." However, the NAB and others have asked the FCC to tread lightly in some areas.

While it applauded much of the contents of the report, the NAB asked the FCC to take a cautious approach in several areas, including suggestions to revamp the nation's clear channel service, permit stations to buy and sell interference rights and allow the use of synchronous transmitters.

The FCC's Mass Media Bureau released the 103-page report in April in the hope of laying the groundwork for a major FCC effort to revitalize AM radio.

FCC Mass Media Bureau Chief James McKinney said the Commission would examine comments it received on the report during the summer and start issuing proposals for formal rule changes this fall, with the process continuing well into 1987.

While the NAB supported rapid action on many issues, it warned that revamping efforts in more controversial areas could stall the overall momentum of much-needed AM improvements.

For example, NAB argued against im-

mediate consideration of whether there should be a review of "the service balance among various classes of AM stations operating on domestic clear channels."

It said such an examination, which would involve reclassifying various groups of AM stations (such as merging Class II and Class III), would "cause dissension and would divert limited FCC staff resources from more 'mainstream' AM improvement activities."

The NAB recommended a similar course of inaction in the debate on preserving Class I clear channel operations. It said the controversy should be "placed on a deferred list" while the FCC "focuses its attention on areas where the potential for broadscale AM improvement is great and intramural industry dissension is minimal."

Group W and Capital Cities/ABC, each of which operate several clear channel stations, joined many firms that own other Class I clear channel operations, such as WQXR, WWWE, WLW, WGN and WCCO, in arguing outright for protection of the nation's clear channel service.

The Washington DC consulting firm of duTreil-Rackley was perhaps the most colorful in its comments on this issue—it asked the FCC to "save the whales," the beasts being the clear channel giants.

"We believe the clear channel stations

are a national resource which should be preserved. Other means should be utilized to assist the struggling Class II stations without destroying the clear channel resource," it said.

The firm added that some in the industry want to see the clear channel "whales" eliminated "to create numerous insignificant plankton to drift in the sea of competition."

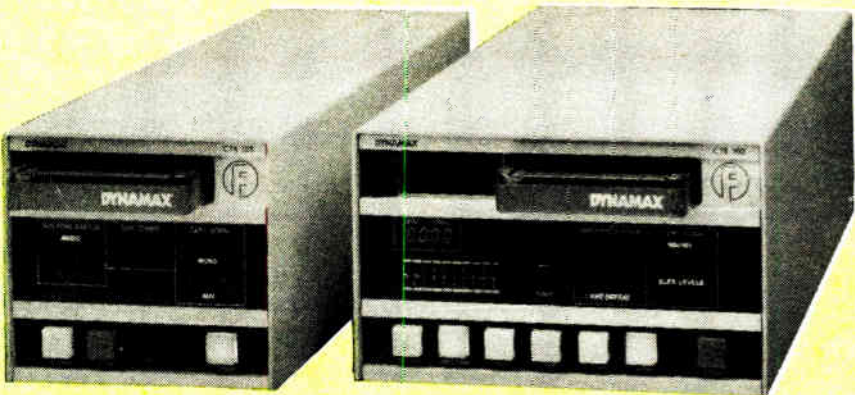
Other groups argued that cutting back the Class I clears would not guarantee that less powerful stations that would be allowed to use the frequencies would prosper.

Interference rights

The NAB joined others in cautioning the FCC to proceed slowly in its efforts to allow stations to buy and sell interference rights.

The FCC, the association said, "should decide whether or not marketplace forces, economic considerations and the use of private agreements are appropriate to govern where and when interference will occur" before changing existing interference rules.

Such a "flexible" approach, the NAB (continued on page 25)




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Regulatory News

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AM Stereo

The FCC Office of Engineering and Technology (OET) in July dismissed a complaint filed by Kahn Communications Inc. (KCI) that alleged Motorola's C-QUAM™ AM stereo system created adjacent channel interference. KCI had indicated that it would appeal the OET's ruling to the full Commission.

In other news, Texar Inc. said it would file a petition in August requesting that the FCC select an AM stereo standard. The FCC has previously relied on a marketplace approach, which has whittled the battle down to two major AM stereo systems—the Kahn-Hazeltine ISB system and Motorola's C-QUAM.

Texar says that receiver manufacturers, reporting slow sales, indicated that consumers are confused about the two systems. Most receiver manufacturers make C-QUAM-only radios.

For more information, see the related article in this edition of RW. For more information about the FCC's OET decision, contact Bruce Franca at 202-632-7060.

AM Improvement

Broadcasters filed comments with the FCC in August on the FCC's AM improvement report, which was released in April. The 106-page document covers a wide range of issues, including the purchase and sale of interference rights and revamping clear channel service. The re-

port also examines the use of synchronous transmitters, main channel data transmissions, relaxed duopoly rules and allowing AM broadcasters to utilize FM translators.

FCC Mass Media Bureau Chief James McKinney said that the Commissioners, after studying the comments, will select the most pressing issues to be considered for specific rule making proposals to be issued this fall.

One of the first rule making proposals to be released, McKinney said, will examine a wider use of synchronous transmitters, which would permit stations to extend their coverage by utilizing additional transmitters on the same frequency.

For details on the comments, see the related article in this edition of RW. FCC contacts are Wilson LaFollette, 202-632-5414, and Jonathan David, 202-632-7792.

FCC User Fees

In August, the FCC asked for comments on 11 proposed procedural changes and additions to a schedule of charges that will apply to broadcast permittees and licensees next year. The FCC said it plans to begin collecting the fees by April 1987.

New fees that affect radio broadcasters include \$2,000 for a major CP by AM stations, \$1,800 for a major CP by FM stations, \$6,000 for all FCC hearings,

\$500 for minor CPs and \$325 for AM licenses. Stations will also have to pay \$3,000 to apply for transmit/receive earth stations, \$1,350 for transmit-only earth stations and \$200 for initial authorization to operate a receive-only earth station.

According to the plan, a chargeable application or filing must be accompanied by full fee payments; partial payments or installments will not be permitted. Other proposals involve retention and refund of charges, method of payment, waivers and penalties for late or failed payment.

For more information, contact Brent Weingardt of the FCC's management planning office at 202-632-3906.

Daylight Savings Time

The NAB Daytimers Committee met in June with FCC Mass Media Bureau Chief James McKinney to discuss the loss of an hour of AM drive time next spring because of an extension of daylight savings time (DST). Earlier this summer, the federal government approved a plan to start DST on the first weekend in April instead of the last weekend in the month.

No solution for the problems posed by the lost hour has been developed; however, observers indicate that a petition for rule making may be filed on daytimers' behalf later this year.

For more information, contact the NAB Daytimers Committee at 202-429-5480, or Jonathan David at the FCC, 202-632-6955.

Mexican Agreement

At press time, FCC officials indicated that they hoped that the final accord on a plan to allow US daytimers operating on any of seven Mexican clear channels to add nighttime service would be signed by late August or September.

A preliminary US/Mexican broadcasting agreement was signed in August 1985, with plans for a final agreement to be signed by November 1985. However, a September 1985 earthquake that destroyed buildings housing Mexico's communications authority caused a delay in finalizing the agreement.

FCC show cause orders, which specify nighttime power levels, were sent in early June to stations operating on Mexican clears.

Once the agreement is signed, a large number of daytimers who are not on Mexican clears will be allowed to extend their postsunset operations past 6 PM local time.

Docket number of the original foreign clear channel order is MM 84-281. For information, contact Jonathan David at 202-632-6955.

Synchronous Transmitters

The FCC is studying whether to issue several construction permits (CPs) to allow some AM stations to begin experimental synchronous transmitter operations.

So far, only one application has been approved—for a new station, KROL, Laughlin, Nev. Other stations that have asked to operate carefully synchronized slave transmitters on their original frequency in order to extend their coverage areas include KGNW, Seattle, WA and KOB, Albuquerque, NM.

The FCC said it may address the overall synchronous transmitter issue with a rule making proposal connected with its AM improvement report, which was released in April. For more information, contact Gary Thayer at the FCC: 202-632-7010.

Technical Deregulation

The FCC has proposed deregulating the rules that apply to modifications made to transmitters. According to the plan, unveiled 19 June, broadcasters could make some minor electrical or mechanical modifications to transmitters without filing an application for a construction permit.

Modifications would be permitted in *(continued on page 4)*

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Regulatory News

Kahn Seeks FCC Test Results

by David Hughes

Washington DC . . . Kahn Communications Inc. (KCI) has allegedly filed a Freedom of Information Act (FOIA) request with the FCC's Field Operations Bureau (FOB) to obtain the results of recent field tests that were conducted as a result of the firm's complaint that Motorola's C-QUAM AM stereo system excitors create adjacent channel interference.

An FOB spokesperson and Bruce Franca, an engineer with the FCC's Office of Engineering and Technology (OET), confirmed that the August FOIA request had been filed. KCI President Leonard Kahn would not comment.

Following field tests conducted earlier this summer, the OET had dismissed KCI's complaint on 18 July and cleared the C-QUAM system. The Commission indicated that not one of 23 stations tested produced harmful adjacent channel emissions.

In a prepared statement dated 22 July, KCI faulted the FCC for not releasing data collected in the tests.

"Why, if the FCC staff had any data, generated at the FCC laboratories in accordance with normal type acceptance test procedures, supporting a finding that C-QUAM excitors comply with FCC rules, (why was) such data . . . not made public," questioned the KCI statement.

The only information the FCC has publicly released about the tests was contained in a seven paragraph letter, which revealed only broad test results, sent by OET Chief Thomas Stanley to Kahn. The Commission would not reveal details about the field tests, including infor-

mation about which C-QUAM equipment licensees were involved.

Franca has categorized the report as "an internal memo" that was "not in written form to give out."

He did indicate that the FOB did measure some Kahn AM stereo stations and some mono stations when it conducted the field tests of the C-QUAM stations. "Basically, they listened to the other stations in order to test their equipment," Franca said. "The tests, however, concentrated on Motorola."

KCI's July statement also indicated that Kahn intends to request "a full review" of the OET's "preliminary staff opinion" to the "full Commission." It added that "a number of broadcasters have already voiced distress and disagreement with this staff letter report."

In mid-August, Kahn reportedly asked the FCC to hold a hearing on the OET's decision.

Apart from releasing details about the tests, KCI had several complaints with the Commission's tests.

"Why did the FCC staff not utilize scientific laboratory tests as specified by FCC rules 2.983, 2.989, 73.44, and 73.128 to make its decision," the KCI statement questioned. Instead, KCI charged, the OET relied on "unscientific, subjective field tests."

Franca said that the decision to conduct field tests, as opposed to laboratory tests, was in direct response to KCI's complaint that on-air, "in-use" interference was being produced.

KCI also alleged that the FCC staff "alerted a number of AM stereo stations prior to 'eavesdropping' on the stations."

It claimed that "alerting" the stations resulted in "measurements (that) would be distorted and rendered useless."

Franca denied that KCI complaint. "That's not the way the FOB does business," he said.

The interference controversy surfaced 14 March when KCI filed a complaint against Motorola. The FCC, in a 10 April letter, dismissed the complaint. One day later, Kahn filed a second complaint which he said contained additional information alleging C-QUAM's failure to adhere to FCC carrier frequency requirements.

Despite the FCC decision to dismiss the complaints, KCI appears to retain an optimistic attitude.

In its statement, KCI cites several "recent dramatic events" among receiver manufacturers toward the production of "quality multi-system radios," including the introduction of a new Sanyo multi-system IC and the new Sony XR-A37 car radio. KCI also touted Sanyo's new "au-

tomatic switching" MW-250 AM stereo radio.

In another AM stereo matter, at RW's press time in mid-August, Texar Inc. officials said they had not yet filed a petition for rule making asking the FCC to abandon its marketplace approach and select an AM stereo standard.

Texar President Glen Clark would not comment on when the petition was scheduled to be filed, although he indicated it would definitely be filed.

Pointing to receiver manufacturers' reports of sluggish AM stereo receiver sales, Clark maintained that consumers are confused by the continuing battle between the Kahn-Hazeltine ISB system and Motorola's C-QUAM system. The petition, he said, will not specify which system the Commission should choose.

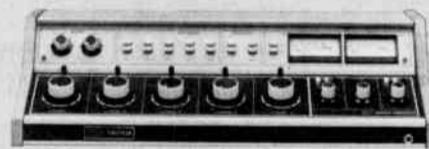
For more information about the FCC's study of the KCI allegations, contact Bruce Franca at 202-632-7060. For more information on the AM stereo standard petition, contact Glen Clark at Texar: 412-856-4276. For more information about KCI's plans, call Leonard Kahn at 516-222-2221.

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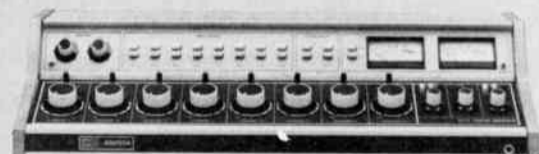
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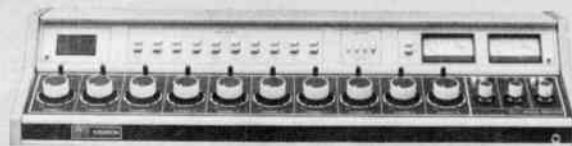
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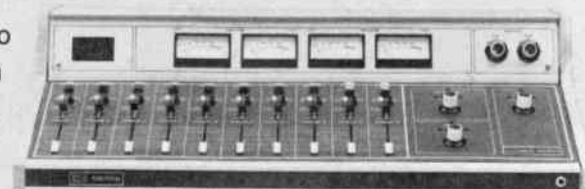
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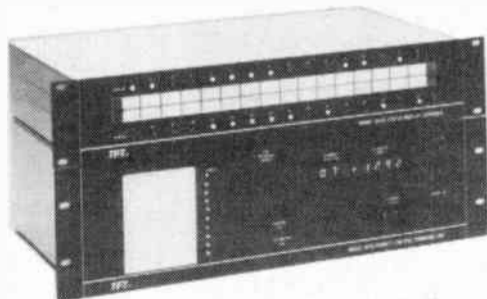
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FCC Files

(continued from page 2)

FM and AM mono transmission equipment provided the changes do not create harmful interference. The plan does not cover changes made to AM stereo generators.

At press time, comments on the plan were due in August. The FCC is expected to rule on the matter in late summer or fall. Docket number is MM 86-264.

In another issue, in April the FCC approved a plan to deregulate FM quality of service rules applying to stereo transmissions and SCAs. Docket number of that effort was MM 85-325.

For more information on either docket, contact Michael Lewis at the FCC: 202-632-9660.

RF Radiation

A public notice issued by the FCC in May requested that broadcasters submit comments on their experiences in complying with nonfederal radio frequency radiation (RFR) standards.

The notice was the FCC's response to an NAB petition urging the Commission to establish a preemptive policy statement regarding local and state RFR standards.

Broadcasters facing license renewals or facility modifications must certify with the FCC that they comply with the ANSI standard. These new rules became effective 1 January 1986.

In related developments, the EPA in June issued four alternatives for RFR exposure standards. The proposal, available for public comment, suggested options ranging from roughly 1/10th the ANSI limit to no standard at all.

The first three options limit the allowable specific absorption rate of RF radiation to 0.04 W/kg, 0.08 W/kg, or 0.4

W/kg for frequencies above 3 MHz (the third option is equal to the existing ANSI standard). A fourth possibility suggests "conducting other activities," including public awareness programs.

The FCC docket number is GEN 79-144; contact Robert Cleveland at 202-632-7040. For more information on the EPA's RFR standards, contact the EPA at 202-475-8388.

FM Translators

In recently filed comments, the NAB and National Public Radio (NPR) requested that the FCC not allow non-commercial FM translators to be programmed by satellite or land-based microwave. The FCC had released the proposed rule change in April, in response to a 1985 request from Chicago's Moody Bible Institute (MBI).

The NAB suggested the proposed modifications were contrary to FCC radio allocations policy and the public interest, and pointed out that such modifications could result in "objectionable" FM interference to TV Channel 6.

NPR said translators located great distances from their parent station could produce a "de facto network" which could operate outside FCC guidelines for full-service FM stations.

Docket number is MM 86-112. The FCC is expected to rule on the matter this fall. For more information, contact Marcia Glauberman at 202-632-6302.

FM Allocations

The FCC unveiled a plan in April to replace the current method of defining FM commercial station classes with a scheme based on the "maximum permitted distance to the expected service contour of each class." Classes are cur-

rently determined by minimum and maximum power levels and antenna height.

In the same docket, the FCC proposed allowing any class of FM station on any FM commercial channel, and added that FM station class should be determined by its city of license rather than its transmitter location.

FCC docket number is MM 86-144.

For more information, contact Michael Lewis at the FCC: 202-632-9660.

Cuban Interference

No progress has been reported with Cuba regarding talks on AM band interference. Several AM broadcasters had submitted complaints to the FCC about higher levels of interference from Cuban stations.

Any hope of future talks bogged down when the Cuban government recently said it wanted a clear channel in order to broadcast English language programming to the US in response to the Voice of America's Spanish-language "Radio Marti" service beamed to Cuba on the AM band.

Responding to the Cuban interference problem, the FCC in April recommended granting its fifth monetary award in less than a year in a program to compensate AM stations for transmission system improvements made to battle Cuban interference. However, since the US Information Agency, which distributes the money, has not yet made a request to Congress for funds, none of the stations (all located in Florida) has received compensation.

The Cuban interference contact is Louis Stephens: 202-632-7792. The compensation program contact is Dennis Williams: 202-632-6485.

RF Lighting

Comments were filed with the FCC in response to its proposed radiation limits on RF lighting devices at frequencies below 30 MHz. The FCC's proposal was

issued in an effort to address a longstanding complaint from the NAB that RF lighting devices interfere with AM radio reception.

The NAB, in its filing, said it supports interim use of a 4.5/f(MHz) $\mu\text{V}/\text{m}$ limit in the frequency band 0.45 MHz to 1.705 MHz, measured at a distance of 30 meters.

For more information, see the related article in this RW. Docket number for the proposal is GEN 83-806. Contact Liliane Volcy at 202-653-7316.

FM-TV 6 Interference

Public broadcast interest groups, including the Corporation for Public Broadcasting, have urged the FCC to adopt a policy statement restricting future TV-6 channel assignments. They maintain that an increase in Channel 6 assignments would interfere with non-commercial radio stations located between 88 and 92 MHz.

In summer 1985, the FCC adopted an industry compromise filed jointly by non-commercial educational FM and TV-6 interest groups. The FCC rule included the lifting of a December 1984 application freeze and addressed grandfathering rights and refined interference models.

The rule also granted noncommercial FM stations power level allowances for efforts to co-locate with a TV-6 or other actions to remedy interference.

Both public broadcasting and TV-6 in-

(continued on page 7)

NABET Settles

by Alex Zavistovich

Hollywood CA ... An agreement has been signed by the National Association of Broadcast Engineers and Technicians (NABET) and Capital Cities/ABC, ending more than 16 months of contract negotiations.

Negotiations between the two parties were concluded 30 July, when NABET announced that contracts concerning AM writer/producers in San Francisco and radio program coordinators in Los Angeles were ratified.

The contracts were the last of Cap Cities' proposals to be approved. The remainder of the package, which was reported to be the company's "final offer," was ratified by NABET in a vote tallied 9 July.

NABET and Cap Cities met 23 July in Hollywood to attempt to resolve the contracts. Cap Cities rejected all of the NABET negotiating committee's proposals, the union said.

In a telephone conference held 28 July, NABET decided to submit the open contracts for a re-vote, the union said.

For more information, call NABET at 818-846-0490.

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Kudos to Texar

Dear RW:

The "Open Letter to AM Broadcasters" from the Texar Corporation is the most literate, intelligent and sane communication regarding AM stereo that I have ever heard or read.

It's too bad that the facing page featured an article in which Bill Sacks trashes Delco's latest effort in AM stereo receivers. I hardly think that will enhance the relationship between broadcasters and receiver manufacturers.

It may come as a shock to some, but I really no longer care which stereo system is technically better. Not that I advocate slapping any old thing on the air, but because all this nitpicking about bandwidth and platform motion is dragging us all down.

How many engineers out there who have done any research really believe that the 38 kHz subcarrier method is the best way to transmit FM stereo? But it is standard, and that's what made that system fly in the first place.

The FCC should have, and still should, adopt a standard for AM stereo. We as broadcasters have certainly shown that we cannot, and I can tell you right now that the standard should be C-QUAM. Here's why:

Both the Kahn and Motorola systems work, and work well. They are both type accepted, Mr. Kahn's efforts notwithstanding. I have heard both, and they both sound great.

But the fact is that when I look in a

mail order or other stereo catalog, I see 80% of the available AM stereo receivers are C-QUAM only. The others are multi-mode. I submit to Leonard Kahn that his efforts are no longer to the benefit of the industry, but are only serving to accelerate the failure of our efforts to save the band.

As I am writing this letter, the staff is celebrating the latest Birch. Our AM, KOKY, is #4 in the market, AM or FM, and seriously challenging the major FMs. All this with 660 W day and 50 at night.

We are building a new array, and I was all prepared to go in and pitch AM stereo to the GM. I was even ready for the "no receivers" argument. All we needed was enough Sony portable receivers for the sales staff. If we sold a potential client on AM stereo, we win. We make the station successful, and people take notice.

Now, I find that Sony has stopped making those portables, because we as broadcasters will not stop our infighting. I am now left without a defense, and very likely without AM stereo, too.

Tom Nichols, CE
KZOU/KOKY
Little Rock, AR

No lost cause

Dear RW:

I agree with the recent comments by Mark Durenberger about the romance of long-distance AM reception of AM at night. I would also like to correct some of the statements made by Bruce Elving (RW, 1 July), who thinks AM improvement is a lost cause.

First of all, my recent work with SCAs indicates that the poorest AM reception is better than most of the SCAs around today. The coverage of the SCA is much worse than the main channel coverage, and the cross-modulation between the main and SCA channel is, in most cases, produced in the FM transmitter. There is only one station in my area which has clean SCA signals.

FM reception in the Minneapolis area may be good, but in New England, you must be willing to put up with continual fading and picket-fence effect.

In contrast, it is possible to drive all day and listen to AM without fading or interference. Perhaps Mr. Elving has not listened to some of the newer AM automobile tuners which are so sensitive that fading occurs only in tunnels.

He also mentions the smaller size of the FM antenna. Since when is a whip sticking out of the top of a radio more convenient than one inside? If the AM tuner were to make use of the whip antenna, its reception would be more than twice as good as with the one internal ferrite antenna.

On a recent trip to Chicago by car, I

This fall is a crowded one in terms of shows, and the engineering travel budget is inevitably strained in making choices between Radio '86 in New Orleans, the 32nd annual Madison Broadcast Engineering and Management Seminar (University of Wisconsin), the SBE's First National Convention in St. Louis and the AES show in Los Angeles.

The fact that the radio broadcast industry can support such a variety of shows in such numbers is an indication of a healthy industry.

What marks this fall's shows is the wide variety of topics in the sessions and presentations to be offered. NAB has made great strides in making Radio '86 valuable to engineers this year, for all the right reasons.

Since Radio '85 was strongly criticized for its lack of engineering focus by both attendees and exhibitors, NAB set out immediately after the show last year to put together a very strong lineup for engineering interests at Radio '86.

NAB has obviously taken advantage of its streamlined post-NAB/NRBA merger ability to pack the show with events, including some dramatic announcements to be made by the National Radio Systems Committee on a preemphasis/deemphasis standard, thus making it important for engineers to attend.

The Madison Clinic covers some of the same ground as does Radio '86, but does so in an atmosphere resembling an intimate workshop. The small discussions and "nuts and bolts" style sessions have been popular with engineers for 31 years, and this year's clinic continues that tradition.

The SBE's first national convention in St. Louis is expected to be well attended by radio and TV engineers. Booth space was in immediate demand, and John Battison's sessions, along with the exhibit area, should keep attendees busy.

In November, engineers can attend the information-packed show sponsored by the Audio Engineering Society. Held this year in Los Angeles, the convention promises the latest from audio specialists in the US and Japan.

Wherever engineers choose to travel this fall, they should show as much support as possible for the industry and its ability to cater to their many needs by attending as many of the different shows as they can.

—RW

made an interesting test of coverage area. Driving back toward Detroit, I compared the signals from a major FM and AM station. I reached the coverage limit of the FM station a short distance into Michigan, but was able to receive the AM station all the way to Ann Arbor, and the reception remained good. If the AM had been on a subcarrier of the FM station, I would have lost it on the outskirts of Chicago.

Recently, I added an AM stereo decoder and dual AM bandwidth to my home hi-fi receiver (Motorola AM stereo, of course). The wide bandwidth audio response is about 6 kHz, and now I even listen to music stations on AM, especially the stereo ones. This is because there is very little variety on FM and it soon gets tiresome.

Living in the northeast corner of Connecticut, I can listen to all the major New York AM stations, plus those from Hartford, Boston and Providence. The limit of the FM reception is about 60 miles from here.

At night, I can get reliable reception of Detroit, Chicago, Toronto, Montreal, Louisville, etc. I think many of these AM stations really have something going for them, especially at night when you can listen to them on a car radio over most of the eastern half of the US. Perhaps

some national advertisers would like to take advantage of this.

I don't think AM has to die out, because it has some inherent advantages which FM does not. In spite of what Mr. Elving says, DXing on FM is virtually nonexistent, and if you get tired of easy listening or rock music, it is time to try AM again.

The Motorola AM stereo system works well, and ICs to produce a high quality demodulated audio signal are currently available. Besides daytime-only AM stations which serve a local audience very well, there are AM super stations which cover as large an area as any of the TV superstations, so I think AM improvement is not a lost cause at all.

Jon P. Grosjean
Consulting Eng.
S Woodstock, CT

Learn to listen

Dear RW:

For a very long time now I have observed "comments" related to the "Old Timer" and similar columns from various readers.

Being a radio broadcaster for some 35 years, mainly engineering, it needs to be said that the many who criticize these

(continued on page 6)

Radio World

Vol 10 September 1, 1986 No 17



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

Readers' Forum, Continued . . .

(continued from page 5)

columns don't seem to fully understand, it seems to me, that the situations and very good tips that are offered should be closely reviewed and digested.

Floyd Hall, for instance, offers his many encounters in broadcasting for a very good reason—to feed the minds of us all, especially the less experienced. I, for one, certainly welcome anyone's personal solution to any problem as fuel for the mind.

I have known many engineers who give the impression that they have all the answers. You are only spoofing yourself; it's Panic City when something breaks down. Any pro will tell you that the first thing to do is relax and think! Entering a situation panic stricken will only add confusion and cloud your reasoning.

The type of column which has always been a value to all engineers is the one where engineers contribute their solutions to various problems they have encountered. Could RW have something like this? It's especially appropriate in today's "radio world," where so many new young engineers are entering broadcasting's field. The key here is to listen to those who know.

Dan G. Peluso
DGP Consultants
Las Vegas, NV

RW replies: RW and its columnists always welcome questions/solutions from readers. Columnist Floyd Hall replies: "The letter from Dan G. Peluso of DGP Consultants, Las Vegas, NV couldn't have come at a better time. I have been berated by several clients for things I should have done, but didn't, or vice versa; my wife has been cross and demanding today; one of my helpers went off on a binge the other night, and fouled up a whole day's work, and my little poodle dog has been chewing on my feet. That's why I welcomed Dan's letter!

Seriously, just for a second. I fail to see why working as a maintenance engineer in a broadcasting station is any different than digging ditches for a plumber, framing a house or pulling wires through a conduit.

The guy is paid to do a certain job. He agreed to do the work for certain monies.

Now, the electrician, the plumber's helper, the carpenter's helper or the chief mechanic himself has to produce, or the contractor gets somebody else.

This is one of the reasons I think a general manager should have a basic knowledge of the electronics of his operation.

A contractor damn well knows whether that carpenter kid is doing a good job or not!"

Upon closer examination . . .

Dear RW:

I read with what I'll politely term "interest" the guest editorial by Bruce Elving (RW, 1 July).

Goodness! With a mere stroke of the pen, Mr. Elving seems to have eliminated the entire AM band.

I feel there are several areas of the editorial that warrant closer examination.

Elving writes: "Americans will not go back to AM." Here in Seattle, those Americans have yet to leave. The two top-rated stations are AM, (and) one of those is a music-based format.

This story holds true in numerous other markets. These successful AM stations all share a common bond. They are successful on the strength of their programming, though—possibly—they owe some of their success to the vagaries of FM reception, which Mr. Elving discreetly ignored.

While it's true that AM transmissions fade under bridges and power lines, there are similar quirks in FM reception. Those VHF signals are fraught with picket fencing, multipath and shadow areas. All are around to haunt the mobile FM listener.

As the RF spectrum becomes increasingly crowded, let's also remember that AM transmissions require only a tiny fraction of the bandwidth required by commercial FM broadcasters. Perhaps

someone would also care to write a few paragraphs on the potential harm of non-ionizing radiation from VHF-FM transmissions as opposed to those emanating from AM broadcast towers.

All quibbling aside, let's look ahead. Just as FMX holds promise for a new lease on life for disgruntled FM-stereo listeners, AM-stereo listeners can also look to improvements from advancing technology.

Impulse noise reduction, dynamic bandwidth control and synchronous detectors all loom on the high-fidelity AM horizon. For the AM broadcaster there are improved transmitters, AM-stereo exciters, better antenna designs, improved bandwidth phasers and, soon to come, synchronous AM repeaters.

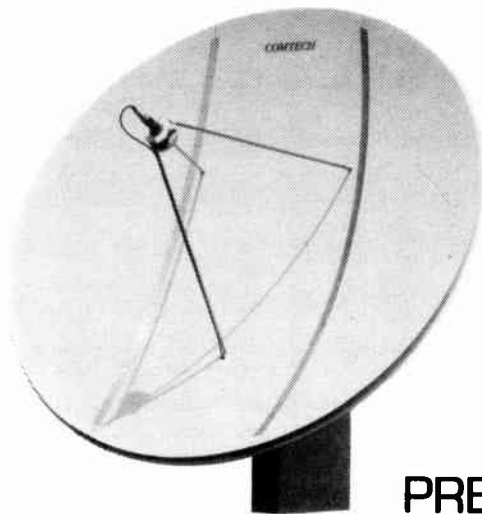
In my car I've installed an off-the-shelf AM stereo receiver. In practicality, the quality of the AM stereo stations I've monitored is on a par with local FM stations. Owing to some grotesque FM audio processing, the AM stereo stations frequently sound better than their FM brethren.

Band loyalties aside, I certainly see a time when radio listeners will choose their favorite station not by form of modulation but by quality of programming.

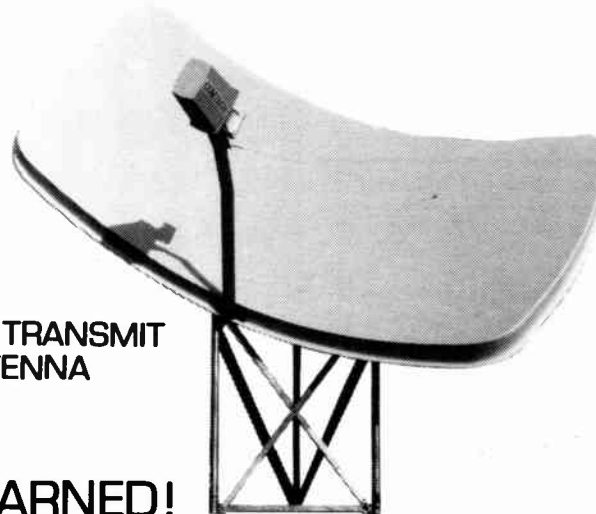
If Mr. Elving's highly touted crystal ball doesn't get a clear signal on AM's future, not to worry, sir—it's probably just a little FM multipath!

Bob Brooks
Asst. PD
KJR AM-Stereo
Seattle, WA

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NAB to Open Show Day Earlier

by David Hughes

Washington DC . . . The NAB has announced that it will open its 1987 and future spring shows on a Saturday and end them on a Tuesday, departing from the traditional Sunday-to-Wednesday show schedule.

According to the plan, which was approved by the NAB Executive Committee in July, the exhibit floor will open on Saturday, instead of Sunday, and close on Tuesday rather than Wednesday.

Like this year's spring show, the 1987 event will be held at the Dallas Convention Center. Unlike the 1986 show, however, the 1987 show will take place in late March instead of mid-April.

The NAB said the new format will allow for four full days of exhibits, instead of only three and a half. At previous shows, the floor was closed at 2 PM the last day (Wednesday).

The new procedure will also allow exhibitors to avoid paying overtime costs

for booth setup on Saturday, NAB said.

In addition, those who attend the show just for the exhibits will only miss two working days (Monday and Tuesday) instead of three (Monday, Tuesday and Wednesday).

The 1987 show, which will be held from 28 to 31 March, will close with a dinner and entertainment Tuesday evening, instead of the traditional Wednesday brunch.

The advancement of the show by one day will affect the traditional Saturday engineering sessions, according to NAB Engineer Ed Williams, organizer of the technical sessions.

While "nothing is cast in concrete yet," Williams said he is leaning toward moving the engineering sessions up to Friday, perhaps starting them that afternoon and continuing Saturday morning.

"We still do not know when the opening ceremony will take place," he said. But if that is also moved up a day from its traditional Sunday afternoon slot,

then no sessions could be slated for the same time period.

Williams added that schedule changes will also affect when the engineering workshops (usually held Tuesday night)

“

Advancement of the show by one day will affect the traditional Saturday engineering sessions.

and the FCC question-and-answer session (usually Wednesday morning) would be held.

With the show ending Tuesday evening, no official events could be scheduled Wednesday, he said. However, broadcast groups that normally hold meetings along with the show could hold them Wednesday, without having to compete with convention events, Williams added.

The NAB Engineering Conference Committee will discuss specific show details when it meets in October. "Things won't be 'finalized' for a couple of months," he said.

Williams also announced that the engi-

neering committee has officially released its "call for papers" for the 1987 show.

Broadcasters and equipment manufacturers are invited to submit a one-page abstract on talks involving broadcast equipment, systems and techniques.

Papers from associate members dealing with "notable improvements" to broadcast engineering technology, especially papers from equipment users, are also welcomed.

Deadline for submission of the abstracts is 10 October. The engineering committee will then meet to select which papers will be presented at the show.

In other convention news, the NAB Executive Committee agreed to provide more bus transportation for exhibitors at the 1987 show, along with improved security.

Exhibit space costs were hiked from \$16 to \$17 per square foot on the upper level of the Dallas Convention Center, and from \$14 to \$15 on the lower level.

For more information on the show in general, contact Bob Hallahan at 202-429-5350. For general information on submitting papers, contact NAB's Science and Technology Department at 202-429-5346. To submit an abstract, write to: Engineering Conference Committee, Science and Technology Department, NAB, 1771 N St. NW, Washington DC 20036.

FCC's Actions Outlined

(continued from page 4)

Interest groups stressed the compromise is a "short-term accommodation" to the interference problem.

FCC docket is 20735. Contact Michael Lewis at 202-632-9660.

Metric Curves

The FCC has set 1 January 1987 as the effective date for the use of new AM metric curves. While applications filed on or after the deadline must contain the new curves, the Commission said it will continue to process applications with the older English unit curves if they are filed before the deadline.

The rule specifying use of the metric curves was approved in May 1985, but the Commission delayed the effective date to allow for easier conversion to and wider availability of the new curves.

The metric curve rules are contained in docket MM 84-752. Contact Jonathan David at the FCC for more information: 202-632-6955.

Modulation Levels

On 15 July the FCC said it would delete its rule prohibiting FM stations within 200 miles of the Mexican border to operate with modulation levels of up to 110% when utilizing subcarriers.

The FCC said the changes were made so that subcarrier operations in the Mexican border area could be conducted on the same basis as it is elsewhere in the US. The restrictions had been in place to conform with international broadcasting agreements with Mexico.

For more information on the ruling, contact John Reiser at the FCC: 202-632-9660.

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RF Lighting Comments Varied

(continued from page 1)

radiated emissions of RF lighting devices.

NAB's proposed standard is $4.5 \mu\text{V}/\text{m}$, which they maintain is "approximately equivalent" to a limit of $25 \mu\text{V}/\text{m}$ at 10 m, adjusted for frequency dependence.

The association expressed some doubts, however, over the usefulness of any RF emission limit for AM protection,

claiming that current FCC AM technical standards may still permit interference by certain steady-state signals of co-channel AM station transmissions.

Before a permanent limit can be made, the NAB said, the FCC must also address whether to adjust the limit for environments with multiple RF lighting devices and whether a single standard is

suitable for the entire life of an RF device.

Although "additional studies are necessary . . . to definitively establish appropriate limits," the NAB stated, "some standard is better than having no standard at all . . ."

NAB also suggested that the FCC should do away with its "consumer/non-consumer" distinction in setting RF light-

ing standards. The organization claimed that such a distinction is ambiguous, maintaining that even an assembly line may be considered a consumer environment, if the workers choose to listen to AM or FM radio.

In limiting radiation emissions above 30 MHz, the nonconsumer environment "receives less-strict standards" than the consumer environment, NAB added.

All environments should have a single standard, the NAB said, and all devices should be made to comply with it.

Amador Corporation, which tests for magnetic interference, stated that consumer and nonconsumer products should be tested to the same standard.

The terms "consumer" and "non-consumer" fail to have meaning except to the manufacturer who wishes to design a product to meet a standard, any standard, such that the product can pass," Amador contended.

But NEMA disagreed with consolidation of the standards, claiming that such an action would "reverse the Commission's long-held recognition of the vastly different environments" in which devices such as RF lighting operate.

NEMA held that "ambient noise levels" in nonconsumer settings are "high enough to mask any measurable emanations" from RF lighting. Steel and concrete construction of commercial structures are also liable to inhibit some transmissions, "even in the absence of any electrically generated noise," NEMA contended.

Other comments

The American Radio Relay League, Inc., an association of amateur radio operators, opposed the proposal, saying it was concerned that the field strength limit for RF lighting is "too high and requires further testing before adoption."

ARRL claimed the $15 \mu\text{V}/\text{m}$ limit at 30 m for frequencies between 1.705 MHz and 30 MHz should instead have a reference distance of 10 m, which is more representative of the distance between buildings in a residential environment.

On the other hand, Linear Corporation, a manufacturer of RF equipment, opposed the proposal on the grounds that the suggested limitations "do not reflect the extreme potential for creation of harmful electrical interference to all co-located RF devices."

Anything less than the strictest limitations on unintended radiation from RF lighting devices would "result in a harmful increase in floor noise, (and) creation of (an) extreme threat of harmful interference to licensed radio services and unlicensed intentionally radiating devices," Linear said.

The NAB has moved for an extension of the reply comments deadline to 15 September. At press time, the FCC had made no ruling concerning the extension.

Docket number is GEN 83-806. For more information, call Liliane Volcy at the FCC: 202-653-7316.

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Transmission Line Examined

by Joe Bellis

Part 3

Cape Girardeau MO . . . The transmission line is simply a method of transferring or guiding electrical energy from one point to another.

For AM broadcast purposes, the transmission line is used to transfer the energy from the transmitter to the antenna or the antenna tuning unit (ATU). Obviously, if the antenna array is directional, the energy is transferred from the transmitter to the phaser and then to the various elements of the array in a manner that establishes a proper phase relationship between these elements.

It is not the intent of this article to illustrate basic transmission line theory since such information is readily available. However, a simplified review is in order.

Every transmission line has an input (signal source) end and a load end (termination load). The line is usually described in terms of its characteristic impedance (surge impedance).

The value of the characteristic impedance depends entirely upon the physical construction of the transmission line and has little, if any, relation to the line length, resistances of the conductors or the frequency of operation of the line. The characteristic impedance is simply the value of the impedance measured at the input end of the line when the load end is terminated in a pure resistance of like value. This statement is important to remember because of the effect in operational impedances.

When the load impedances are not equal to the characteristic impedance of the line, it is possible for the transmis-

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.

sion line to exhibit a different impedance at the input end. These impedance transformations, when properly understood, can be very useful; if ignored, the overall effect can be catastrophic.

This is true regardless of the length of the line, as long as the line losses are neglected. Therefore, any transmission line of any length, when properly terminated in its characteristic impedance, will exhibit that impedance at its input end, and all the energy supplied to the input end will be absorbed by the load termination.

This is true only when the load impedance is seen to be of a purely resistive nature.

VSWR

In broadcasting, purely resistive loads are seldom seen. When the load impedance is not a pure resistance equal to the characteristic impedance of the line, only a portion of the transmitted energy is absorbed by the load. The forward or incident energy that is not absorbed by the load is reflected back to the transmitting end.

The actual energy distribution along the transmission line is the sum of the incident (forward) energy and the reflected energy.

Although the incident energy is moving toward the load end and the reflected energy is moving toward the transmitting end, the sum of the two does not move at all, and is called the standing wave. The magnitude of the standing wave is commonly measured as the voltage standing wave ratio (VSWR), and is the ratio of the maximum voltage to the minimum voltage. It is also equal to the ratio of the terminating resistance to the characteristic impedance of the line, or vice versa.

Obviously, forward and reflected currents and powers can also be used to compute the standing wave ratio. Formulas for calculating the standing wave ratio are usually arranged so that the ratio will always be a number greater than

one.

The reflected energy will always be equal to or less than the forward energy. It can never be greater than the forward energy.

Therefore, whenever a transmission line is terminated in any load except an equivalent resistance equal to the characteristic impedance of the line, there will be a reflection or standing wave on the line.

When the transmission line is terminated in a purely reactive load, all the incident energy (in a loss-less line) will be reflected back to the source. Reactances store energy but do not dissipate it (in theory, neglecting the actual resistances of the reactive components). This allows a definitive phase shift to occur.

When the reacting load is equal in value to the value of the characteristic impedance of the line, the resulting phase shift will be $\pm 45^\circ$. The degree of incurred phase shift along the transmission line will be governed by the magnitude of the load reactances and the length of the line to the point of measurement.

In broadcasting, virtually every transmission sees a load that is not a pure resistance equal to the characteristic impedance. Therefore, all the incident energy will not be absorbed by the load and standing waves will always be present.

Since impedance is the ratio of voltage to current, the actual impedance measured will vary along the length of the line.

Driving point impedance

The measured impedance at the sending end is appropriately termed the "driving point impedance," and is directly related to the terminating load and the line length. The driving point impedance becomes very important to a well-designed "broadbanded" system, as it is the load the transmitter sees.

RF energy travels at approximately the speed of light in free space. However, along the transmission line, the RF energy must charge the distributed capacitance of the line and induce an electrical field along the inductance of the line, thereby reducing the rate at which the energy travels. The rate at which the RF energy travels is termed the "velocity of propagation."

Manufacturers specify the velocity of propagation as the velocity factor, which is the ratio of the velocity in the line to the velocity in free space, and is expressed as percentages or decimal equivalents. The electrical length of the transmission line is the physical length times the velocity factor, and is commonly expressed in wavelengths or degrees.

(continued on page 10)

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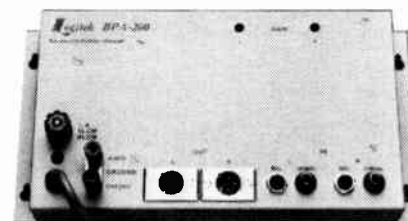
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Xmsn Line Dynamics Outlined

(continued from page 9)

The period of time the RF energy travels along the transmission line is normally expressed in terms of phase shift. The amount of phase shift introduced to the RF energy is a direct function of the velocity of propagation and the physical point of reference (measurement) to the

end of the line. Phase shift (expressed in degrees) is commonly used to determine the current at any point along the line and is determined by the number of electrical wavelength and/or fractions thereof (each wavelength introduces a total 360° phase shift).

In order to allow a more intuitive

grasp of the effects of various lengths of transmission lines to the overall system, a brief overview is in order.

The eight-wavelength open-ended line behaves as a capacitive termination resulting in a 45° phase shift. In other words, the driving point impedance will be a capacitive reactance equal to the

characteristic impedance of the line. The shorted eight-wavelength line will exhibit a 45° phase shift of opposite sign, and the driving point impedance will be an inductive reactance equal to the characteristic impedance of the line.

The quarter-wavelength line will invert the impedance in which it is terminated. Therefore, a shorted quarter-wavelength line will result in a very high driving-point impedance. The open-ended quarter wavelength line will result in a very low driving point impedance. Quarter wavelength lines behave like resonant circuits, according to their terminations.

The half wavelength line will always have a driving point impedance equal to the terminating impedance.

The phase shift exhibited by the transmission line depends upon the electrical length of the line. Heat and cold cause the transmission line to expand (lengthen) and contract (shorten), resulting in minor phase shift changes. These minor phase shift changes are not normally a consideration in most installations, except for directional arrays and sampling lines.

Manufacturers provide "phase stabilized" transmission lines in order to minimize the phase shift variations caused by temperature variations. Phase stabilized lines provide a repetitive phase/temperature characteristic for reliable tracking in multiple element antenna arrays and sampling line systems.

Line losses

In practice, transmission lines exhibit losses resulting from the series resistance of the conductors and the leakage losses between the conductors. Line losses are dependent upon the length of the line and the frequency of operation and are expressed as attenuation in decibels per 100' or meters.

When the line losses are subtracted from the driving point energy, the effi-

(continued on page 22)

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Circle Reader Service 21 on Page 23

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Bootstrapping Yourself in Radio

by John "Q" Shepler

Rockford IL ... I get a surprising number of letters on subjects you might not expect. The opening line usually goes something like this:

"Dear John, I just started as chief engineer at XXXX radio. I'm new in the business and eager to learn. Where do I start?"

Just as surprising, I get an equal number of calls from panic-stricken managers who just heard their engineer of 10 years announce he was going to greener pastures and/or back to school. "Hey, John, know anybody in this area ... ?"

From what I can tell, there is a bright employment picture for the right kind of new people in the business. There is also a steady supply of excited new faces eager to find out if radio is as much fun as it looks. If you're one of the newly enchanted, then read on. This column's for you.

Welcome to the business.

Radio is a lot like life. You come into it with wide eyes, a little scared because you don't know what to expect or what others will expect of you. Your first steps are a little shaky. You make mistakes and you feel awful.

Then you start to get the hang of it. The rest of the staff comes to depend on you. Without you, the show doesn't go on.

The euphoria that comes with getting the transmitter back on the air at one minute 'til sign-on makes you forget about having been dragged out of bed at 2 AM. The excitement of the air personalities is contagious. This is not a job—it's show biz, and you love it.

Maybe you're reading this while taking a short break in the production studio with your feet propped up on the

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

console. That's the same console that was pronounced dead by the continuity director 3 hours ago. Despite the dozen circuit cards strewn across the floor, despite the missing ICs and resistors now woven into the carpeting, despite the multimeter with both test probes sheared off, don't despair.

Q-Tips

In the end, you'll resuscitate the console and exit the studio a hero. You'll have to. Nobody else can.

Some years from now—maybe 3, maybe 10—you'll be very good at what you're doing. You'll wonder what it was that seemed so hard. Transmitters come back to life almost effortlessly. The wiring rat's nest in the equipment racks is now neatly bundled.

The tape equipment is in razor-sharp alignment. The staff has long since forgotten what "out-of-service" stickers look like. The equipment is almost never out of service. A smooth operation is no longer a miracle, it's expected. Heroism is giving way to routine.

This point, however distant it seems now, will be a crossroad in your career. You'll know you're there because you will see yourself becoming dissatisfied. You will no longer look forward to going into the station. Equipment breakdowns and interruptions will become problems, not challenges.

A lot of people call this career burnout. It's really more of a brownout. It's another challenge, only this time the challenge is personal, not technical.

The challenge is to recover the sense of challenge. Some never make it through this one. They linger on, becoming sour on life. They complain about the working conditions, the pay, the lack of recognition, the odd hours, and on and on and on.

Don't let it happen to you. If the flame

ever starts to die, at age 30 or age 60, recognize the need to expand your horizons and move on.

Maybe you'll move into television, or industry, a larger radio station or a smaller radio station, or even your own station. You could choose to become a traveling consultant or get into field service; you could design and manufacture your own equipment, spin records at weddings, sell products, or a maybe just move permanently to the beach. Do what makes you excited but, above all, stay excited.

If it sounds strange to hear about the excitement of radio in one breath and career burnout in the next, my purpose is only to help you deal with problems you'll certainly encounter.

The technical problems will seem pretty tough, but will be the easiest to find solutions for. In these columns, I'll pass along lots of technical pointers. The other Radio World columnists will also be a tremendous help.

There are many other sources of technical help available. We'll get into some

of those in later columns.

Now, however, I want to pass along some personal advice I've found useful: stay away from the burnouts, the complainers, the negativists, and all those who should have found bigger dreams long ago. Keep your enthusiasm and stick with others who share that enthusiasm. Your eventual success will be far greater than you ever expected, and you'll have a lot of fun doing it.

Who's making it

The people who seem to be doing the best in this business are the youngsters and the oldsters.

The traditional broadcast engineer, a 40-year-old family man with an old mortgage and a new car, is no longer the common stereotype. The salary structure of the '80s unfortunately can't maintain the Great American Dream of the '50s and '60s.

Many of the guys who still fit this profile are being siphoned off into industry, **(continued on page 12)**

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Circle Reader Service 23 on Page 23



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Advice to Neophytes

(continued from page 11)

lured by stable employment and regular hours. Other radio engineers are staying in the business, but moving into sales or management positions.

The engineering vacuum is being filled by a variety of newcomers. What they have in common is a desire to work in a business that offers challenge, fun and a reasonable income for simple needs.

It's a great business for young singles. I got started working part-time during high school and helped pay for college by working vacations and summers as an engineer and announcer.

Without formal training available, how do you learn about radio? A ham radio ticket is probably the best way to get hands-on experience with transmitters. Another good path is military training.

Audio can be learned by starting up a rock band on a shoestring and kludging together the equipment you can't afford. Working at Radio Shack is another way to get started.

Some just hang around a station 'til someone finds something for them to do.

One healthy trend is that more of the young singles are women. Nearly half of the new voices on the air are female; eventually the engineering ranks will also be evenly populated. In a business that now requires more brains than brawn, that shouldn't be surprising.

Young singles do well in radio because they fit in. Most stations are programming some form of contemporary music which is, by nature, young.

The economics of radio are acceptable to those with uncomplicated lifestyles and few commitments. Many stations are run by crews in their teens and twenties. What they lack in experience they make up for in enthusiasm.

It's ironic, but the same conditions that make radio jobs attractive to young singles also create opportunities for seniors.

The oldsters may be victims of industrial cost cutting which forced unwanted early retirement. Maybe they've just tired of the daily grind and no longer need the big salaries to support growing families. Maybe health limitations dictate a part-time-only job.

Regardless of the reasons, an over-50

engineer offering maturity and technical expertise makes a nice complement to the young go-getter who moves like lightning but isn't sure where to strike.

If you're like most engineers, you got your job through desperation—the station's. Half of the equipment is broken and the other half is seriously headed in that direction.

Depending on how you look at it, this situation is: a sinking ship that should take someone else to the bottom with it; or a golden opportunity to be a hero for somebody who wouldn't normally get a chance.

You could be that hero, but you'll have to get moving before disaster really does set in. What you need to accomplish immediately is to: keep the station on the air; keep it legal; and convince everyone that you are fixing things faster than they are breaking.

This may sound absurd, but the one most important key to success is convincing your management and coworkers that things are getting better, not worse—even if it's a fib. If they feel that the problems are being handled, and especially if their special concerns have top priority, they will hang with you. They might even help. At the very least, a friendly atmosphere will buy you time to really find out what is wrong and fix it.

Here is another list of starting suggestions, which I'll expand on in future columns:

1. Get a notebook. Interview everybody who uses the equipment and find out what they want fixed. Pick the top

10 trouble spots and attack them first.

2. Get a copy of the FCC rules and regs. A new copy. Find out where you are illegal and do something about it.

3. Find all of the equipment manuals and put them in one spot, one that you can get to easily. Read them in place of bedtime stories.

4. Take a parts inventory. Find out where you are lean. Question: If it blows, are you down for a week? Get a spare.

5. Line up all the test equipment on the workbench. If you don't have a bench, make one first. If there isn't any test equipment, make the bench anyway. Then go get some test equipment, starting with a good multimeter.

6. Make up instruction lists for the jocks. If they can't get the aux transmitter on without waking you up, the instructions aren't good enough.

7. Quick, where does that wire come from? Don't know? Better make wiring diagrams for the whole plant. Put stick-on numbers and/or tags on those wires so you can find them in a hurry.

8. Buy an air compressor or run a hose to the nearest filling station. Use it to blow out (i.e., remove dirt from) transmitters, cart machines and amplifiers. Clean equipment is happy equipment.

9. Search out and neutralize all safety hazards, such as bypassed interlocks, pennies in fuse boxes, or exposed power connections. You're more valuable alive.

10. Never miss an opportunity to tell the air personalities how great they sound. They'll go away for hours.

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The OIB-3 Operating Impedance Bridge provides extended resistance and reactance ranges, measuring up to 1000 ± j900 ohms. The bridge has a built-in carrying case and RF amplifier for improved nulling.

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- Through Power Rating: 5 kW Modulated 10 kW Carrier only
- Direct Reading in R: -1000 to +1000 ohms
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- Accuracy: R and X, 2%, ± 1 ohm

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'J-Plug' Provides Accuracy

by Frank S. Colligan

Washington DC ... The details of a new "J-Plug" design for use in directional antenna phasing equipment is shown in Figure 1. It should be used at the tower feedpoints to ensure high accuracy of Delta OIB impedance bridge readings.

This bridge has grown to be universally used throughout the industry and is capable of very high accuracy if carefully used. It does have a substantial insertion effect when connected into the circuitry of AM directional antenna arrays. The effect is that of inserting a small Pi section into the circuit, and consists of 1 μ H of series inductance.

The shunt arms consist of capacitors of 18 pF each. Inserting this into antenna feedpoints can greatly upset the parameters of ratios and phases throughout the system.

This will result in false results in reading the R and X dials of the bridge.

In the case of driving point resistances that are very low or very high, the effect can throw the whole system substantially out of kilter.

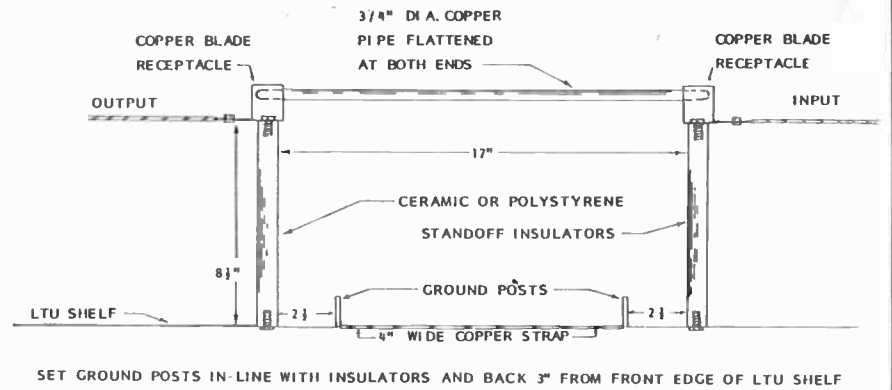
The new J-Plug shown in Figure 1 greatly eliminates the insertion effects. Built as shown, the OIB will fit in between the two standoff insulators. As one faces the bridge, once in place, power flows from left to right. The J-Plug assembly must be wired so that power

input is on the right and output is on the left.

Simply enough, the bus bar between the two standoff insulators substitute for the bridge's insertion effect. In removing the bus bar and inserting the bridge, the insertion-removal effects are equal and therefore balance out.

The prime location for this new type of J-Plug is at the antenna feed point next to the base current ammeter. When removing the bus bar and inserting the bridge, it is still good practice to check the antenna monitor for that particular tower to see that the ratio and phase are still the same as desired.

Figure 1. High Accuracy Compensation "J" Plug



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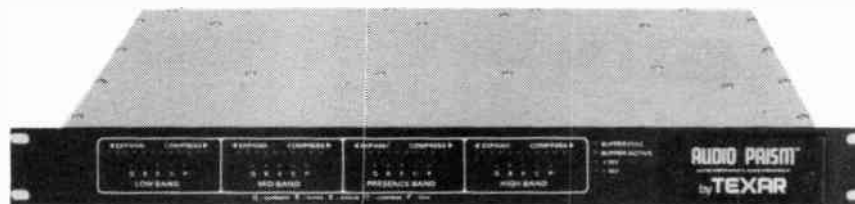
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* Summer '85, Fall '85, Winter '86 and Spring '86 Arbitron Ratings, New York MSA, Total Persons 12+ Share, Mon-Sun, 6A-12M. (Used with permission.)

Frank S. Colligan is a telecommunications consultant based in Washington, DC. He can be reached at 301-229-5577.

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Radio '86 Preview

Expect Diversity at Radio '86

by Alex Zavistovich

New Orleans LA . . . A diverse group of broadcast equipment and related service companies will display their products at the NAB Radio '86 Convention, to be held 10-13 September at the New Orleans Convention Center.

The product display is "mixed," and will include transmitters, cartridge decks, consoles, and ancillary radio equipment, according to NAB Senior VP/Radio David Parnigoni.

Parnigoni said there seems to be increased interest in the convention this year—the exhibit has drawn 109 firms,

up from 91 last year. At press time, he said the NAB was still receiving exhibit inquiries.

The NAB has allocated 19,700 square feet of exhibit space at the convention center for the event, Parnigoni added.

To ensure that exhibitors' needs are addressed, representatives from last

year's exhibit are on this year's steering committee, he said. Booths at the convention center's meeting room and the Marriott Hotel will provide convention attendees information about the displays.

Following is an overview of some of the products scheduled to be exhibited.

Harris Broadcasting will exhibit its 35 kW Powerstar FM transmitter, a 3.5 kW FM transmitter, the Sentinel 16 remote control unit, and the SX1A 1 kW transmitter.

Continental Electronics' Exhibits Manager Steve Claterbaugh said his company's display will feature its 814B 4.3 kW FM transmitter, equipped with the model 802A 50 W output exciter.

Philips will show four varieties of solid-state FM transmitters— 15 W, 100 W, 300 W and 500 W. The transmitters are available in either stereo or mono, with or without frequency-compensated attenuators (FCAs).

International Tapetronics Corporation (ITC)/3M plans to display its entire line of merchandise, including the 99B, Delta and Omega analog cartridge machines, and the Scotchcart II broadcast cartridge, according to ITC's Market Administrator Bill Parfitt.

Steve Ford, Director of Advertising for Broadcast Electronics, said his organization will present its line of consoles and transmitters, as well as the DV-2 "Digtalk" digital solid-state record/playback unit. Ford added that BE's display will also feature the 5400 and 5300 B 3-deck cartridge machines, the 3000- and 2100-series cart decks, and the PC-1 telephone cart interface.

According to Marketing Associate Amy Welton, Fidelipac will exhibit the ESD-10 eraser/splice detector and CTR-30 3-deck recorder/producer with built-in recorder electronics. Also on hand will be the Dynamax CTR 100 cartridge machine.

Cablewave's Bill Meola said the company will display its automatic and semi-automatic pressurization equipment and coaxial cable. An introduction for Cablewave is its new size 1 1/4" 50 ohm cable, Meola said.

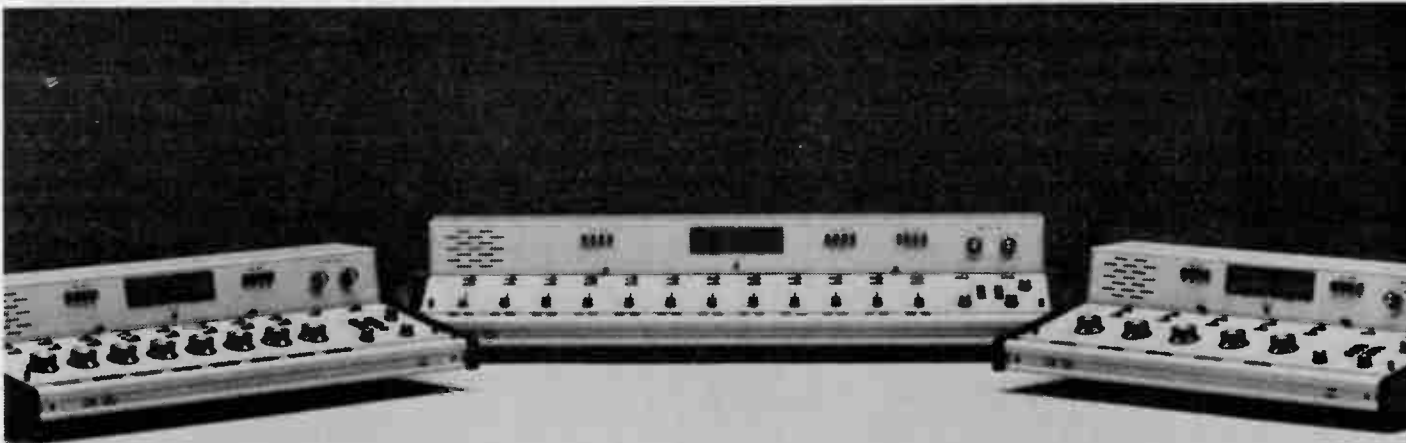
Broadcast Audio Corporation will show its complete Series 4 line of consoles, with mixers ranging from 6 to 16 channels, according to CEO David Evans. In addition to a selection of pre-amplifiers and its monitoring and distribution amplifiers, Evans said the company will also show the System 20 console for large market stations.

Evans added that Broadcast Audio will also be exhibiting an innovation for the company: the System 6, the smallest version of the Series 4, which uses the same plug-in system as larger consoles to ensure compatibility.

Howe Audio plans to bring its series 2100 and 2300 Phase Chasers and three audio consoles, said Factory Sales Executive Terry Sweeney. Sweeney said the equipment will include the 7512 A, the series 8000 (rotary) and series 9000 (linear) boards.

Data Communications Corporation will display its BIAS PC radio sales, traffic and billing system. According to

(continued on page 17)



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Radio '86 Preview

Engineering Gets Top Billing

by Michael C. Rau

Washington DC . . . Many of you are wondering which of this year's many fall engineering conferences or conventions you should attend.

The answer to this question depends on your individual professional needs and the technical needs of your radio station.

This article will describe the engineering side of the NAB Radio '86 Convention, September 10-13 in New Orleans, so you may consider whether attending Radio '86 is worth your time, effort and

Michael C. Rau is a staff engineer for the National Association of Broadcasters. He can be reached at 202-429-5346.

expense. I think it is worth all of these things.

First, Radio '86 is for *radio*, not television. There will be no technical sessions on TV, and exhibitors will not be showing any television equipment. The focus is on radio. With the recent NRBA-NAB unification, which has generated a kind of excitement in the radio industry, Radio '86 will be the perfect occasion to celebrate this significant event.

Further, your manager or PD may also be present. Radio '86 has a sizeable engineering program, but it also has sessions for management, programming and sales. If you would like to "shop" the exhibit hall with your manager, for example, you can show him or her the specific piece of equipment you have in mind for purchase. It's one thing to show

a manager a picture in a newspaper; it's another to demonstrate the real thing.

Having management present at Radio '86 should be helpful. For all the industry talk about "improving the manager-engineer relationship," in New Orleans, it seems to me, there will be an opportunity to do just that.

Technical studies debuted

NAB has decided to use the fall Radio '86 Convention for the debut of two very important technical studies, both relating to AM broadcasting.

The first is a technical report on AM overmodulation, to be presented by Harrison Klein, PE, of Hammett and Edison Consulting Engineers.

Though every engineer knows or should know what AM overmodulation is and what it does, until now there has been no comprehensive technical document on AM overmodulation, or any methodical way to tell if an AM station is overmodulating, even if the modulation monitor shows all is well.

Directional antennas, mistuned transmitters and the positioning of the modulation monitor all play major roles in determining the dynamic spectral content of the AM broadcast.

Initial testing at the NAB laboratory has shown that a *very* small degree of overmodulation causes a large amount of interference to adjacent channels. "Splatter" is a bigger problem than we thought. The Hammett and Edison study will define AM overmodulation, and describe its causes and cures.

We are also planning to debut the draft standard on AM preemphasis and

deemphasis being worked on by the National Radio Systems Committee (NRSC).

The NRSC is a joint committee of radio broadcasters and radio receiver manufacturers. This group has been working for about a year now on the tough questions of whether, and to what extent, AM preemphasis and deemphasis should be voluntarily standardized.

It appears at the present time that this effort will be successful—and you can participate in the NRSC deliberations. There will be a NRSC meeting at Radio '86 and you can comment on the standard or discuss it with attending receiver manufacturers and broadcasters.

Double your engineering pleasure

Compared to the 1985 Radio Convention, we have doubled the number of engineering sessions at Radio '86.

Radio '86 will have two in-depth sessions on AM improvement. We'll have a report on the NAB new technology AM antenna project; a report on the IEEE's efforts to examine the question of electrical interference and RF lighting devices and a full-blown policy panel with Jim McKinney, FCC Mass Media bureau chief, and Al Sikes, President Reagan's assistant secretary for Communications and Information, who is extremely interested in AM improvement. McKinney will also moderate a FCC/Industry "Town Meeting" to discuss your concerns about FCC regulatory policies and rules.

But policy is *not* the focus of Radio '86 (continued on page 20)

Radio '86 Exhibitor List *

26 System Corp.	CBSI/Custom Business Systems	IGM Communications, Inc.	Normex Ltd.
Accuweather	Century 21 Programming	International Tapetronics/3M	Philips Television Systems
Ad Team of Florida, Inc.	Clayton Webster Corporation	J&H Music Programming	Programming Plus
Advanced Broadcast Management	Columbine Systems, Inc.	Jefferson Pilot Data Systems	Radio Advertising Bureau
Alden Electronics	Comark Communications, Inc.	Johnson Electronics, Inc.	Radio Computing Services
All Star Radio	Communication Graphics, Inc.	Kalamusic	Register Data Systems
Allied Tower Company, Inc.	Conaway/Creative, Inc.	Kavouras, Inc.	Riviera Broadcast Leasing
Alpha Electronics, Inc.	Concept Productions	LeBlanc & Dick	RockCom, Inc.
American Image Productions	Concert Music Broadcasters Assn	Communications	RSN Promotions, Inc.
American Impressions Group	Data Communications Corp.	Leonard Sloan & Associates	Sacred Heart Program, Inc.
Arbitron Ratings Company	Datacount, Inc.	LPB, Inc.	Shively Labs
Associated Press	Datavision	Media General Broadcast Serv.	Sound Ideas
ATI-Audio Technologies, Inc.	Delta Electronics, Inc.	Metro Traffic Control	Sperry Corporation
Audichron Company	Dielectric Communications	Micro-Trak	Spotwise Productions
Audiotronics, Inc.	Drake-Chenault Enterprises	Mo Money Associates, Inc.	Strata Marketing, Inc.
Avcom of Virginia, Inc.	Eventide Inc.	Motorola Inc. AM STEREO	Sunspot
Broadcast Audio Corporation	Fidelipac Corp.	Music Director Programming Ser	Super Spots
Broadcast Electronics, Inc.	Film House	N.O.A.A.	Systemation Corp.
Broadcast Music, Inc.	FirstCom Broadcast Services	National Public Radio	Take a Trip America
Broadcast Prom. & Mkt. Exec.	Freeland Products, Inc.	NAUTEL	Tapecaster
Broadcast Supply West	Harris Corp. Broadcast Group	NBS, INC./WRSA	Tapscan, Inc.
Cablewave Systems Div	Harrison Systems	NEC America, Inc. Brd. Eq. Div	Tennaplex Systems Ltd.
Celwave	Howe Audio Productions, Inc.	Network Production Music	United Press International
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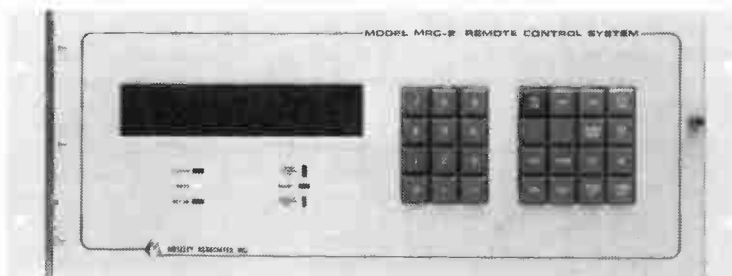
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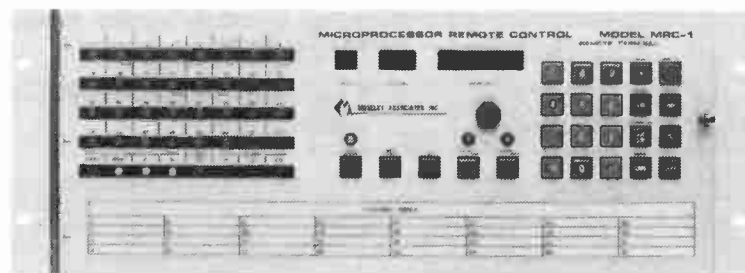
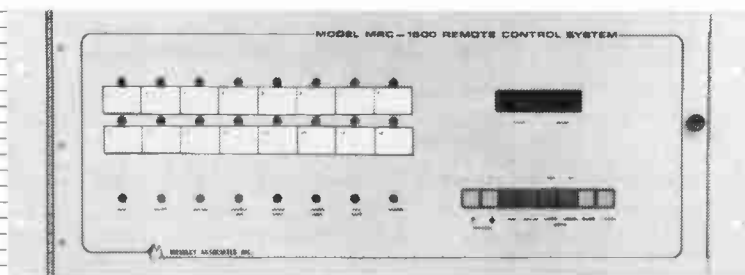
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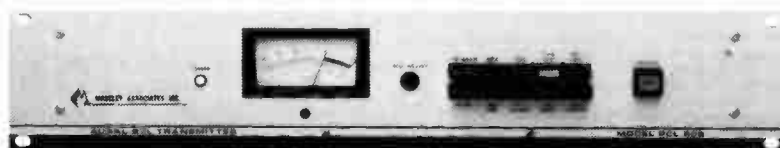
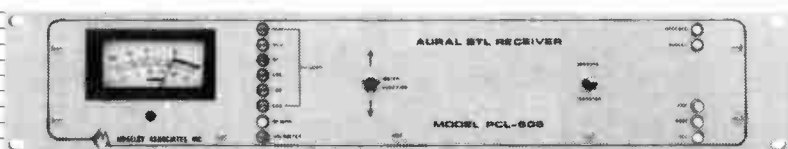
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Madison Sessions Top-Notch

by Alex Zavistovich

Madison WI . . . SCA transmissions, microwave safety standards and compact disc technology will be among the topics addressed in technical sessions at the 32nd annual Broadcasting Engineering and Management Seminar, to be held 15-18 September at the Holiday Inn in Madison, Wisconsin.

The seminar, organized by the University of Wisconsin and sponsored in part by Radio World, is designed to "offer up-to-date management philosophies and significant technical information to broadcast engineers," according to Don Borchert, organizer of the event.

The program's technical sessions run from 16-18 September, with discussions on such diverse topics as high power transmitters, antenna system design,

studio acoustics and RF safety codes.

Burton Gran, VP of Holaday Industries, will moderate a session titled, "RF and Microwave Standards." Gran said he will use a slide presentation to augment the session, which will address both emission standards for equipment and exposure standards (specific absorption rates) for individuals working with RF devices.

"The Madison clinic has more of a 'hands-on' emphasis," according to Harry Priester, a member of the seminar's program committee. He said the most popular session for engineers is the Broadcast Engineering Forum, "a nuts and bolts session" which provides practical engineering information in a relaxed, open-forum environment.

Mark Durenberger, formerly director of Technical Development for Hubbard

Broadcasting and now an independent contract engineer, agreed that the forum is "one of the sessions which makes the Madison seminar unique."

Past forums, he said, have covered everything from contract engineering insurance to problems of tower icing.

Durenberger will moderate the "Great Idea Exchange," the seminar's concluding session. He is asking attendees to submit a "great idea" in either schematic or other form for presentation. The ideas will be judged by a six-member panel; winners will receive a "worthwhile" prize donated by an equipment manufacturer.

Other sessions include the impact of international agreements on US

broadcasters and a mock inspection by the FCC.

The Broadcast Engineering and Management seminar will also include an exhibit area featuring more than 40 of the leading suppliers and manufacturers of broadcast equipment, including Broadcast Audio Corporation, Harris Broadcast Group, Sony and Panasonic.

The exhibit is larger this year than it has been in the past, said Priester. "There has definitely been a crunch for exhibitor space," he added.

The first day's sessions are devoted entirely to management topics. Techniques discussed during the day will be applied in a "Problem Solving Through Engineering Management Case Studies and Role Playing" session.

For further information, contact Don Borchert at 608-263-2157.

Engineering Emphasized

(continued from page 14)

DCC, the system has been completely rebuilt on the IBM PC AT, with more standard database software.

Dataworld will exhibit databases including population and terrain analysis, NCE-FM/TV-6, FM interference and FM upgrades.

Product Sales Manager John Pearce said Jefferson Pilot Data Systems will introduce two new systems this year: CORE, a call-out research system, and the JDS-1000 sales, traffic, and billing system, compatible with the IBM PC 36.

The group will have a PC 36 on hand to demonstrate the systems.

CBSI will demonstrate "The System," a computer-based system for radio traffic, accounting, payroll and other management functions. The System can be used with the Wang 220 mini-computer; Wang PC; IBM-XT or AT, and most of the IBM compatibles, according to CBSI's John Kenagy.

Sperry Corporation will display its IBM-PC compatible "Sperry Broadcaster" software for radio traffic and accounting.

Bring 'Great Ideas' to Share

A novel and productive new aspect of the Madison Broadcasters Clinic is the "Great Idea Giveaway."

Attendees are being asked to submit their favorite home brew circuits and engineering tricks which make their daily broadcast lives easier and more efficient. At the conference, a "jury" will select the most meaningful and useful ideas, which will then be shared with the rest of the attendees.

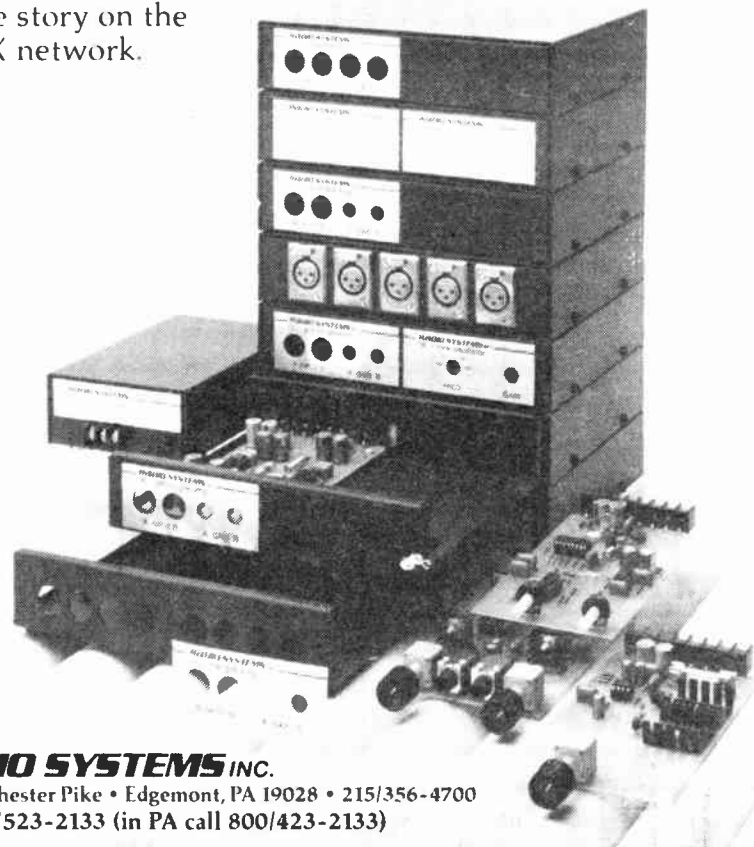
The winners will also receive meaningful prizes from supporting exhibitors. You'll be receiving an application form with your registration information. Bring your Great Ideas to Madison!

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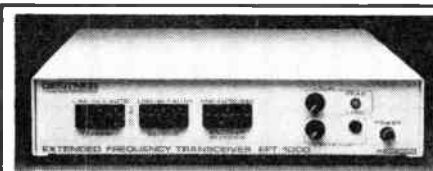
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Know Agile Downlink Dynamics

by Fred Baumgartner

Part 2

Englewood CO . . . Once you have decided to build an agile downlink for radio (see Part 1, RW, 1 August), you must determine if its primary duty is redundancy or full duty. This will affect all of

your choices from here on, in addition to the cost.

The mechanics of an agile downlink are rather straightforward:

1. The dish must be steerable so as to see every desired satellite.

2. The LNA needs to rotate either physically or electrically to see both polarities.

3. The downconverter needs to be easily tuned to several transponder frequencies.

4. Demodulators need to be able to demodulate all of the formats (SCPC, video with subcarriers, digital, data . . . whatever is desired). Furthermore, the demodulators need to be sub-frequency agile.

5. The above need to be operator controllable (user friendly).

This setup is obviously quite unlike fixed downlinks. On the other hand, it isn't all that tough either. Most of the above requirements are easily accomplished by any number of backyard TV satellite systems.

Let's assume that you have a proper site. It is unlikely that you can't find people in the backyard dish or cable businesses, or other stations that don't have some idea of what kinds of interference to expect in your area.

Borrow one of those portables mounted on a trailer, if need be.

We knew we had some small problem with a C-band terrestrial path, which meant that we would pay attention to sidelobe performance and beam width (generally larger dishes or fancier designs are less likely to be bothered by "junk" coming in from undesired directions).

Obviously you need a place without trees or buildings in the way with winter access, power and good cable paths too.

Dishes

Dishes come in two varieties, those that work all the time and those that don't. This is really a physical thing. Either they hold their dimensions in all kinds of weather or, at the worst, they fall apart. You do not need to be a structural engineer to recognize the difference.

Obviously to the better dishes usually cost more, weigh more and require bigger motors to move. If this is the backup dish, you may want to use a locally produced unit that is built to perform well in consumer use instead of a commercial-grade dish. Ask others about their experience with a given dish (also ask the cable guys).

The other consideration is size. Rather than get into G/T (a mathematical means to determine "merit" of the system), beamwidth and sidelobes, look at the NAB Engineering Handbook or to previous RW articles. In real life you can successfully pull off this project without a detailed study and heavy math.

For our purposes, we considered three criteria: cost, electrical performance and physical performance.

In terms of cost, the bigger the dish, the more expensive. In terms of electrical performance, a practical minimum is a 9' dish (3 m). In terms of physical performance, the maximum is about 12' (4 m).

Beyond that, the dish becomes mechanically difficult to move, align, maintain and/or slow. Bigger dollars are needed to overcome limitations posed by either smaller or larger dishes than the 9' to 12' range.

In our case we chose the 12' number, a commercial AFC dish made of a single piece of fiberglass. The extra performance is worth the modest extra cost in our opinion.

Dish mounts

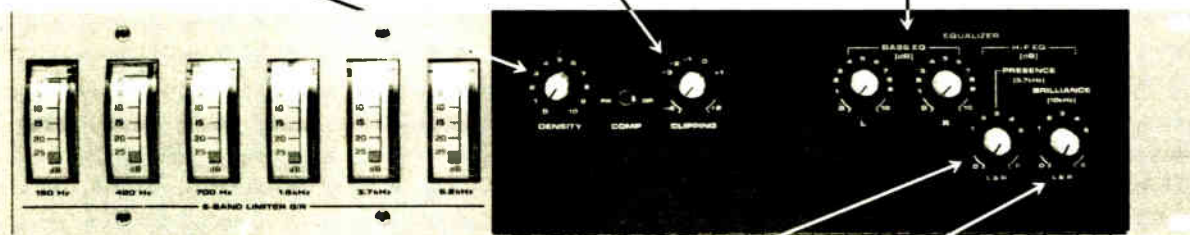
Steerable dishes are either polar mounted or AZEL. The AZEL dish has two sets of motors, one to control the azimuth and the other the elevation. The polar dish is mounted in such a way that a single motor can push the dish from east to west and the mounting forces the dish to follow the satellite arc.

(continued on next page)

DENSITY determines the input drive level to the Six-Band Limiter. Lets you have it your way—open and transparent, or solid and dense.

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Our **NEW 8100A/XT2 Six-Band Limiter Accessory Chassis** (which works with any 8100A OPTIMOD-FM) features two new high-frequency equalizer controls: PRESENCE and BRILLIANCE. They complement the original 8100A/XT's bass EQ controls, and give you *twice the flexibility* of the single HF EQ control typical of other add-on multiband processors.

With an XT2, your OPTIMOD-FM system is totally immune to operator gain-riding errors because the dual-band compressor in the main unit is converted into a smooth, slow AGC to ride gain ahead of the XT2. Any reasonable input level operates the XT2 in its "sweet spot," so there's never any need to add external, potentially incompatible compression.

This is good news because the time-constants and other processing parameters in a pure, integrated Orban system have been carefully harmonized to achieve an overall sound that's *loud* and *bright*, yet remarkably *open* and free from audible side-effects.

The XT2 also excels in the most difficult of processing tradeoffs—delivering loudness on music while keeping speech free from clipping distortion. Credit this uniquely capable performance to Orban's patented multiband distortion-cancelled clipping system—which we were able to implement in the XT2 system because the XT's circuitry is fully *integrated* into the processing system, not just tacked onto the front.

The XT2 lets you have it all: natural sound, source-to-source consistency, loudness, clear voice, and adjustability that lets you tailor bass and treble to your taste and format requirements. And thanks to its efficient single-chassis construction and its use of the main 8100A power supply, it lets you have the next step in Optimod processing at an exceptionally reasonable price: \$2075 (suggested list).

We listen to our customers. Listen to our new XT2. We think you'll like what you hear.

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orban

Installing an Agile Downlink

(continued from previous page)

From a cost and control standpoint, the polar mount makes a lot of sense. However, it is complicated to align. As dish size increases, polar mounts become even more difficult. Beyond a 12' dish, an AZEL mount begins to look better and better.

In this case we decided on the polar mount. The Microdyne polar mount for the 12' dish is very adjustable. Unlike a fixed dish, it is imperative to have a true north-south line to work from.

The Microdyne mount has an I-beam that clamps to the concrete foundation and is shiftable. We worked out the north-south line to the best of our ability and pushed the dish mount around to reach final adjustment.

The mount has a pole which is set on the north-south line at such an angle as to see the arch. Four large bolts are used to set the declination.

Declination is an additional correction factor (small compared to the elevation and azimuth adjustments) that allows for perfect tracking. Most dishes come complete with instructions and calculations to obtain the elevation and declination for your latitude.

Connecting the LNA

After making rough adjustments, it is necessary to connect the LNA and a receiver with a monitor to make the final adjustments. If you have more sophisticated tools (a spectrum analyzer and the like), you probably are beyond the scope of this article.

Borrow a TV receiver of the home variety and a TV monitor from the local cable company or satellite store—one, it is hoped, with a signal strength meter. Pick a warm day with good weather and plan to spend the whole day.

Getting a good signal is quick work; getting it perfect takes forever. Obtain a copy of *Orbit* or other magazines with listings of the birds and the programs on their transponders.

A real help is to know a good cable company. You can bum parts/equipment from them, and these folks can name a bird in three transponders or less. This saves lots of time. In any case, set it up with TV; do not try with the SCPC receiver . . . it will take forever.

There is a basic principal here. When it comes to satellites, *pictures are much easier than sound.*

The routine is much like tweaking a phaser. Use a notebook, make an adjustment and steer through the arc. Pick a transponder in the east, west and due south. With each adjustment, review the performance of each of the three transponders.

Begin with the north-south line adjustment. Go to the declination and elevation, which are interdependent. Continue to go through pass after pass until you are convinced that you can see everything that is up there and that it is dead

center in the dish's beam.

The motor on the Microdyne system runs on 120 VAC and has a controller connected to a four-pair modular phone jack. Install a jack both at the operating point and at the dish. You will note that many of the dish manufacturers define a steerable dish as one that can see only half of the arc.

In the case of the Microdyne, the motor arm attaches to the dish on a

mounting arm. A little metal work and it can be made to see the whole arc. This does increase the stress on the motor, however, since it has to move the dish farther with less extension.

Somewhere in here you have mounted the LNA and the polarity rotator. Polarity rotation can be accomplished with either a motor that moves the LNA physically, a motor that moves a director vane, or a Faraday rotator, which elec-

tromagnetically redirects the polarity.

The Faraday rotator is fast—as fast as you can vary the pot that controls the voltage—but in a power failure it is near useless.

Both mechanical types have the flaws of most mechanical things; they can freeze, bind and break. The motor-driven LNA is also expensive by comparison, and slow. The latter is a definite

(continued on page 20)

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

Engineering Sessions Offered

(continued from page 15)

engineering: hands-on, practical technical assistance is.

Specifically, among other things, Radio '86 engineers will learn how to use a Smith chart. Steve Kramer, a respected consulting engineer at Sellmeyer and Kramer, Dallas, Texas, will provide an hour-long tutorial on how to use one of the most useful engineering tools available. A Smith chart makes impedance matching and broadbanding easy.

We'll have a panel on directional antenna maintenance, and how to make your DA work. Included will be new FCC rules, practical nuts and bolts information from experienced station engineers and consultants, and a chance for lots of Q&A.

A panel on grounding—the skill and art of removing unwanted RF from audio circuits—will include experts providing tips, techniques and proven methods of success.

A panel on lightning will demonstrate how to make lightning bolts and transients feel most unwelcome.

Are you thinking about upgrading your FM? Find out how to take a Class A station to a Class C FM station, and how to avoid being downgraded on 1 March 1987. Experienced consultants, like Bob duTreil of duTreil and Rackley, and John Allen, an FAA expert, will answer your questions and help you im-

prove your FM station.

Emil Torick, co-inventor of the NAB/CBS FMX™ system, will report on FMX progress to date with receiver manufacturers, processor manufacturers and broadcasters.

A panel on FM antennas will be an all-out technical session on the pros and cons of competing FM antenna designs and installation techniques.

A panel on using AM stereo will include a rundown on what stations are doing with AM stereo, focusing on the latest new ideas. NAB intends to debut a brand-new AM stereo slide/sound promotional presentation.

We'll also have two panels on studio and audio concerns: the first panel is on studio design. Topics include how to make studios sound good, and construction tips from experienced engineers and experts. The second panel is on new studio technology. Not a "sales" presentation, the panel will discuss the optimum techniques for telephone interfaces and digital editing, and, especially, the role and impact of CD players.

We also plan to produce a "different" kind of engineering panel. It seems that we engineers often take heat because we are perceived to be unable—or, worse, unwilling—to communicate with non-technical people like PDs and managers.

I don't happen to agree that, just because we're engineers, we can't

communicate.

But there is a kind of science to dealing with people and, just like learning to apply Ohm's Law, this "people science" can be studied. If you're interested, Radio '86 offers an opportunity to develop your communication skills. We'll have several communications experts as well as some radio industry people; it should be a lively and interesting panel.

One final point: due to strong demand, NAB is sponsoring a one-day seminar on compliance with the new RF "radiation" regulations immediately prior to Radio '86. You've been hearing and

reading about the many RF radiation regulatory and technical issues. If you attend this seminar, you will learn precisely: what the new regulations are; what the proposed regulations are likely to be and how to demonstrate compliance and thereby protect your station.

It is going to be an exciting occasion! If you are an NAB member, your station has already received information on how to attend and register for Radio '86. Ask your GM. We are also making a direct mailing to chief engineers. Watch for it!

If you do not have the necessary materials, for attending Radio '86 and the RF radiation seminar, just call NAB Science and Technology at (202) 429-5346. We'll be pleased to provide the necessary information.

Tips on Agile Downlink

(continued from page 19)

disadvantage when it comes to adjusting polarity. We chose the Faraday device because it was conveniently available.

The LNA can be anywhere up to 140° K noise temperature and provide adequate service when combined with a 12' dish. Using a 9' dish, a 120° K would be the limit.

Our experience (and that of the cable folks) is that an LNA lasts about two years. The local TV shop stocks an off brand LNA with a 100° K rating for \$150.

Remembering that our first LNA was 120° K and well over \$1,000, we could

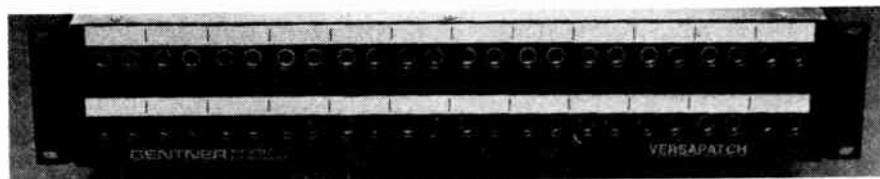
see the benefit of having spares just down the street—and, of course, with three dishes we keep one on hand ourselves. With a smaller dish, we would definitely look for a more expensive, lower noise temperature LNA in the 85° K range.

By and large, an LNA will want to see +24 VDC on the inner conductor of the coax leading from it to the downconverter. Most home grade gear has provisions in the downconverter or receiver to provide this voltage to the line. A lot of commercial gear does not.

In this case a "power block" is inserted in the 4 GHz line from the LNA that al-

(continued on page 23)

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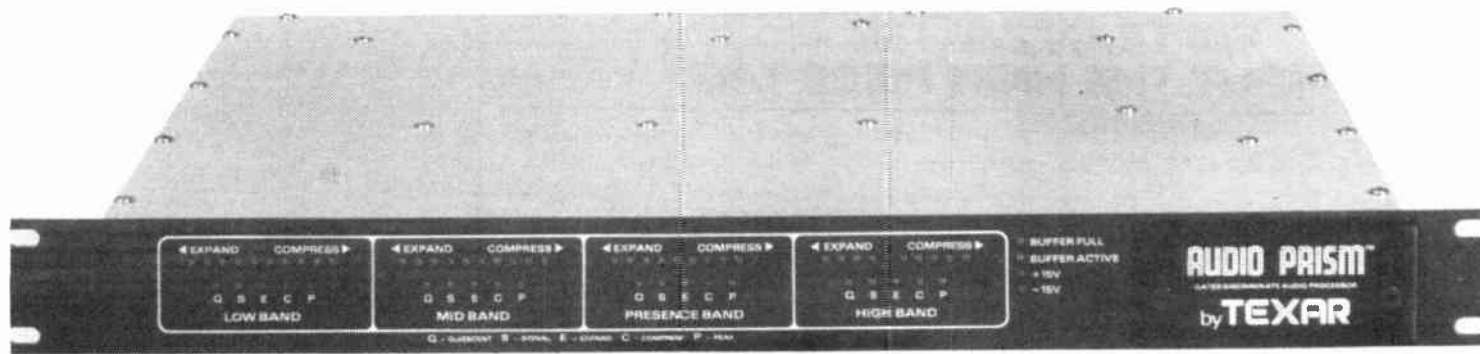
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controlled TEXAR AUDIO PRISM™ is the beginning of the future. The AUDIO PRISM delivers the modulation power for monstrous cumes, but with a clarity that keeps listeners quarter-hour after quarter-hour. An audio processor that makes you jump out of the dial at the expense of cutting your quarter-hours in half is NO bargain.

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*Summer & Fall '85 and Winter & Spring '86 ARBITRON Ratings. Total Persons 12+ Share. Mon-Sun, 6A-12M. (Used with permission.)

Xmsn Line Outlined

(continued from page 10)

ciency of the line can be determined. Formulas for determining the attenuation and efficiency are readily available in the various manufacturers' catalogs. The catalogs provide virtually all the necessary specifications and engineering data in order to select and size the transmission line to the particular application.

Testing of transmission lines can be performed in several ways by using time domain reflectometers, spectrum analyz-

ers, RF impedance bridges, L/C meters and common sense.

Physical inspections of the transmission line will many times reveal dents, kinks, holes in the outer conductor and loose and/or corroded connections.

Dehydrated air or oil-pumped dry nitrogen should be used with air dielectric coaxial lines. The pressure should be maintained at a minimal level, just enough to maintain a positive pressure on the line during all seasons but not

enough to blow the gaskets or seals on the fittings.

The digital capacitance/inductance meter is fairly effective in determining the condition of the line if the capacitance/inductance per foot of the line is known and the actual length of the line is known. Be sure that the load (ATU, etc.) is disconnected so that the load doesn't affect the readings.

The RF impedance bridge can be effective with or without the load connected. However, a more accurate method is to use it with the load removed from the transmission line and a terminating resistor placed across the line. The resistor

value should be that of the characteristic impedance of the line.

Perhaps the most practical method to check the line is to remove the load from the line. To do this, connect the line to the station dummy load with an appropriately sized RF ammeter in series with the line and the dummy load. Apply power to the line from the transmitter and record the meter reading.

Remove the power, then the meter. Reconnect the line to the dummy load directly. Insert the meter in the line between the transmitter output and the line. Apply transmitter power and record the meter reading.

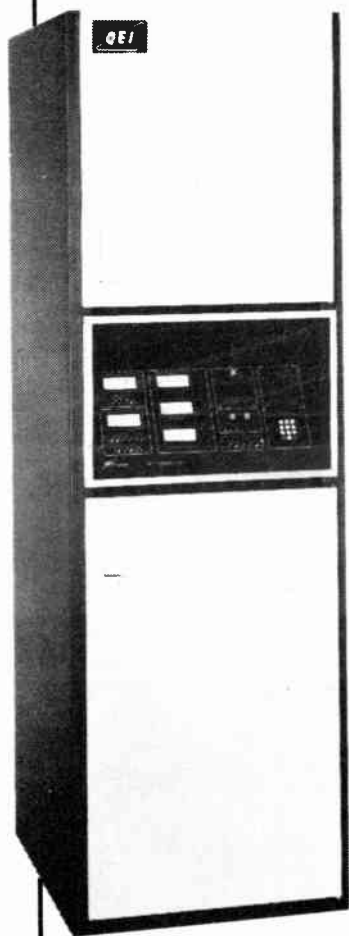
The two meter readings should be the same. If they are more than 10% different, look for a defective transmission line and/or defective connectors. It is quite common in older installations to find highly lossy lines, resulting in very noticeable power losses, particularly when using the RF ammeter testing method.

Coaxial transmission lines are so constructed that the radiation fields of the inner and the outer conductors oppose each other, and thereby eliminate potential radiation from the line. However, any wire more than 1/10th wavelength long can act as an antenna and radiate energy.

Therefore, it is important that the transmission line be properly bonded to the ground system at both ends and at appropriate intervals. This is suggested not because of the forward energy radiation, but because of reradiation induced into the outer conductor from the antenna field.

The transmission line is obviously an important factor in a well-designed and operational RF transmission system. While the primary purpose of the transmission line is to efficiently transfer energy from one point to another, the overall antenna system can be rendered inefficient due to improper transmission line selections and terminations or due to transmission line deterioration.

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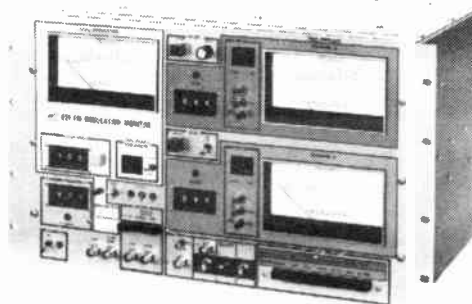
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Installing an Agile Downlink

(continued from page 20)

lows the 4 GHz to pass to the downconverter and allows the DC voltage to go to the LNA. Power blocks run about \$150, but you can find some that are more expensive, and some less.

When planning, it is good to know whether or not you need one. The 24 V to run the LNA comes from the back apron of the receiver... it could of course come from anywhere.

Terminology

Let's review differences between receivers, downconverters and demodulators. Downconverters select the correct frequency in the 4 GHz downlink band and then amplify and deliver it in the 70 MHz range. The demodulator takes that 70 MHz signal and makes it into audio, video or data, as desired. A receiver is all of that.

Now that's what should happen.

Some folks call demodulators receivers, some call the downconverter a receiver, and the gals in the front office call the whole thing a "disk" (not even dish!). Wrong.

Some downconverters do not deliver 70 MHz. Some have outputs in the 1.1 MHz range. Some of these are "block" downconverters, which means they do not filter out the desired frequency at all, but send all 12 downlinked signals as a "block" for the demodulator (which they now call a receiver) to sort out.

Some LNAs have block downconverters built in, and are called LNBs. Some LNAs have built-in downconverters that are frequency selective and are called LNCs.

Anything that does not conform to the 70 MHz IF standard we will ignore, just like we ignore wire recorders when we speak of audio storage media. If the LNB and LNC sound like an elegant way to go, you are absolutely correct, but way ahead of current technology. At this time, LNBs and LNCs are fine for TV use, but have too much phase noise for

SCPC work.

That leads us to the downconverter. We chose Microdyne's 1100-X12 "receiver." It is a receiver, as the 4 GHz goes in and out comes video, audio (the 6.8 MHz subcarrier), sync and the 70 MHz IF. If you ignore everything but the 70 MHz IF, it is a demod with extras.

This unit was built in ancient times for TV use. It has slots for 12 crystals and is remote controllable. The crystal-based local oscillators have very low phase noise, which is important to the very narrow SCPC (single carrier per channel—FM) signals, and meaningless to the very wide TV (FM) signals.

For TV use, the crystals have gone the same way as the bank of 23 crystals in CB sets. They have been replaced by synthesizers. The 1100-X12 appears on the used market frequently but is no longer in production. Other units are available, but be aware of the phase noise and dynamic range (which we will get into).

Downconverter critical

The downconverter is the central critical item and needs most of your attention.

Master control is 300' from the downlink dishes at WIBA. It is expensive to have to transfer 4 GHz that far via coax. The coax is also very easily damaged by ground shifts, kinks, leaks etc.

However, 70 MHz is sinfully easy to move via "drop" grade quality cable. We use the flooded variety, which is impossible to kink, won't leak and of course is very cheap.

To hold the two downconverters (the fixed MBS downconverter is also in here), we built a small "dog house" with thermostatically controlled heaters and cooling fans, lights and locked front and rear doors to access the front and back of the gear.

We had some concern about the summer heat posing a problem. Obviously the fan can only bring in ambient heat,

and sometimes Wisconsin does get up to 100° F, which is above the rated operating temperatures of the downconverters.

If I had it to do again, I would consider having buried a 100' long, 6" PVC pipe under the foundation of the dish so that air could be circulated through it and into the "dog house." The small size of the "dog house" makes heating much easier.

The downconverters and dish motors run on a 120 VAC line with generator backup. The environmental and utility loads are on a nonemergency line. Lines are also supplied for listening to the demods and communications.

Grounding is important, and audio and control lines are protected with MOVs, optoisolators and chokes.

I mentioned above that dynamic range is important in the downconverter. Most downconverters are designed with the expectation of rather high loss from the coax and connectors coming from the LNA. Our closeness to the LNA means that a great deal more input is available to the downconverter.

Downconverters designed for SCPC use normally have fixed front end amplifier gain set by a pot. TV-type receivers use an active AGC (automatic gain control). In TV there is a single carrier to deal with, which allows the AGC circuit to see a steady reference. In SCPC, there are many independent carriers.

The TV type AGC will "see" the many SCPC carriers added together as its reference. On a busy transponder, the total of the SCPC carriers will be about equal to the one TV carrier and everything will be fine.

However, on an unpopulated transponder, the few carriers will "tell" the AGC that it needs more gain. This may cause the amplifiers to "open up" and re-

sult in distortion which will prevent the demodulators from working or at the very least cause them to distort. To prevent this, the downconverter is remotely forced into manual and a preset gain level when in SCPC mode.

WIBA has a set of two 10 dB pads for 4 GHz which assist in optimizing the gain. One other trick is to lower the LNA voltage if overload is a question. This is a sleazy solution, but a good diagnostic tool.

The LNA will cease to function under a certain voltage (9 to 12 V or so). From that point on, the output of the LNA will increase until the internal voltage regulator kicks in (18 V or so).

A series of pads is more expensive (\$50 each), but a better tool. A series of pads for the 70 MHz line is very inexpensive, but a useful tool to see if the IF is overloaded.

Both sets of pads can be used to judge headroom—that is, the amount of signal loss that is tolerable before performance is degraded. We found that 20 dB loss in the 4 GHz line and 30 dB in the IF worked fine.

Leaving a 10 dB pad in each line assured adequate dynamic range, which is to say that the system would perform well with up to almost ten times too much or ten times too little signal. This allows for considerable system fluctuation.

This is more important in an agile radio downlink, as changing satellites means different power levels both because of the satellites' antenna design (the footprint) and the various transponder levels, not to mention the inevitable misalignment of the dish over the arc.

We have covered the outside installation of a radio agile downlink. We have a device that we can point from the comfort of the control room and it returns to us a 70 MHz IF that we will demodulate to produce audio and video. In part III, we will move inside to the demodulators and controls.

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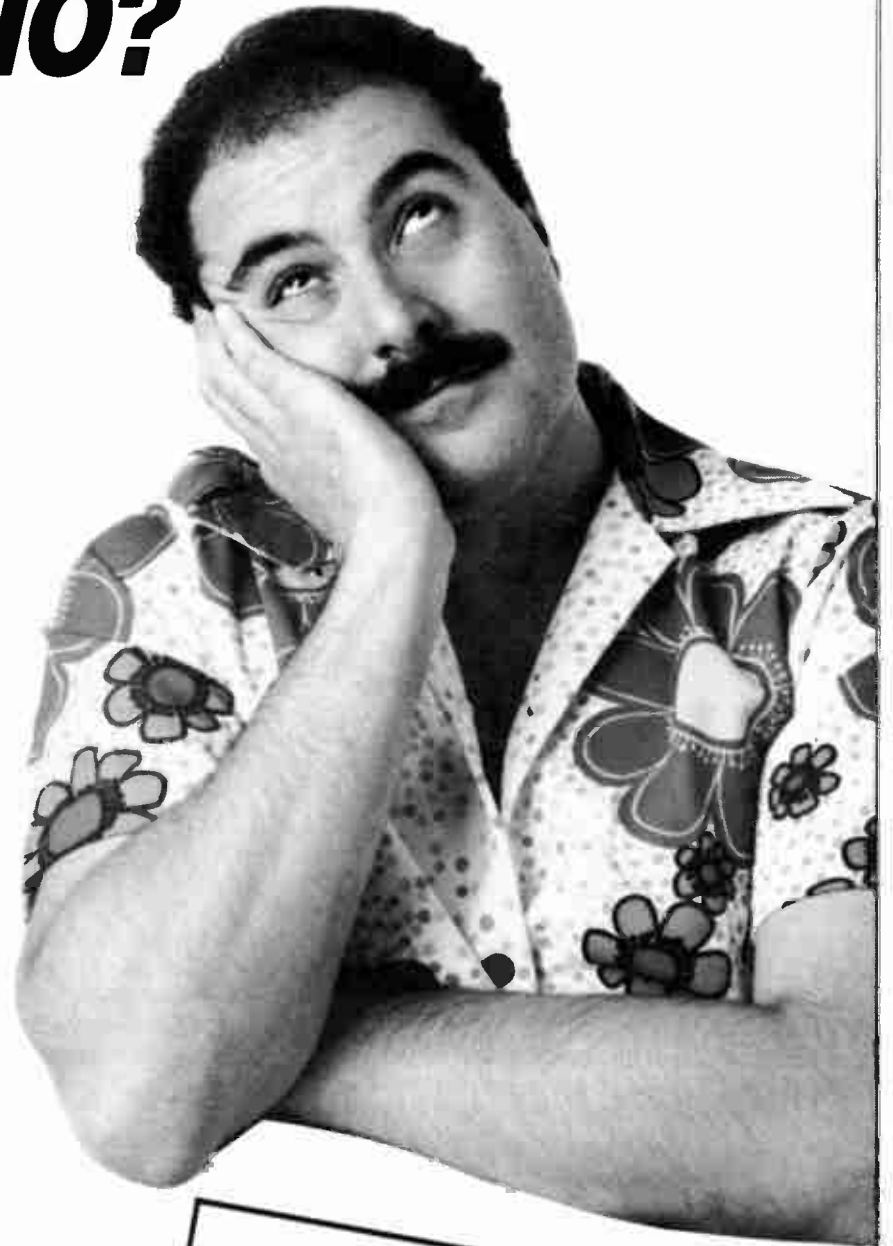
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Comments on AM Plan Varied

(continued from page 1)

added, "would (not) serve the AM industry and can hardly be termed an AM improvement."

The National Telecommunications and Information Administration (NTIA) asked the Commission to devote "renewed efforts to control inter-station interference." It said broadcasters most probably do not know "the extent to which their stations are interfering with other stations, nor how much other stations are interfering with their signals."

However, the NTIA said by allowing the purchase and sale of interference rights, the FCC would be "incorrectly" turning over to licensees its "essential role of spectrum enforcement." The Corporation for Public Broadcasting (CPB) agreed.

"Broadcast licensees are given spectrum allocation rights to provide, to the extent possible, interference-free broadcast service," the NTIA added. "It is up to the Commission to determine permissible levels of interference and to enforce those levels."

Synchronous transmitters

Several key questions still need to be answered before the Commission allows the use of AM synchronous transmitters, the NAB also warned.

While the association maintained that "there is little doubt that AM synchronous transmitters have the potential to enhance the coverage of AM stations and provide a useful and meaningful way to improve AM," it said it was concerned about allowing their widespread use.

It said more studies need to be conducted to determine the interference zone created between the main and slave transmitters, and on the effects that AM receivers utilizing synchronous detectors

or asymmetrical sideband decoders would have on the reception of synchronous transmissions.

The FCC's decision—to allow certain stations to perform experimental tests of synchronous transmitters before releasing a rule making—was endorsed by the NAB.

Electrical noise levels

On many other issues covered by the report, broadcasters voiced support for immediate action. One of the most pressing, according to the comments, is the reduction of AM noise levels.

The NAB said the FCC should "begin a comprehensive rule making proceeding designed to revamp its electrical interference rules, and ultimately to establish adequate limits on the capability of all electrical devices to degrade reception of AM broadcasts."

It added that, "because a variety of Commission rules do, in fact, attempt to regulate electrical devices which have a potential to cause interference within the AM band, it is clear . . . that the Commission has the authority to begin rule making to regulate the manufacture of all devices which create electrical noise."

Even though the FCC in 1963 established standards to regulate "restricted radiation devices," and has developed rules regarding emissions from "industrial, scientific and medical" (ISM) equipment, the NAB said current regulations fail to address interference created by new consumer devices such as cordless telephones, computers, hair dryers, light dimmers and RF lightbulbs.

"Such a rule making is necessary for the overall improvement of the AM band and to protect the public interest in high quality AM service," NAB said.

It asked the FCC to establish interfer-

ence standards that could be used by consumer equipment manufacturers and to encourage their participation in any standards setting process.

The NTIA added that "an assessment should be made of the costs and benefits of imposing noise suppression requirements on RF-emitting device manufacturers, or of imposing noise filtering requirements on AM receiver manufacturers to the extent technically possible."

"If we expect broadcasters and receiver manufacturers to make improvements, it is necessary that the airwaves be as interference-free as possible," NTIA said. "Otherwise, the sought-after fidelity can be destroyed by station interference."

However, the Electronic Industries Association's (EIA) Consumer Electronics Group, which represents receiver manufacturers, said the marketplace and the industry, not the FCC, should determine the type of receivers that are manufactured. It questioned the Commission's authority in the issue.

Class III upgrades

In another matter, the NAB asked the FCC to allow Class III daytimers to add nighttime operations at the "second hour" post-sunset (PSS) power level. It also said that fulltime Class IIIs should be allowed to increase power depending on interference protection criteria.

The NAB's recent comments expounded upon a joint NAB/Association of Broadcast Engineering Standards (ABES) petition for rule making filed in March requesting that the present 5 kW maximum power level for Class III fulltimers be raised to 50 kW.

"Adoption of the rule changes proposed in this petition would ease the arbitrary restrictions now imposed on fulltime Class III facilities and, for daytime-

only stations on these frequencies, would allow nighttime operation in the public interest," the NAB said.

DuTreil-Rackley recommended that Class IIIs, and some Class IIs, be given "low power nondirectional" night powers so long as no interference is created. It also asked for power increases of up to 50 kW on regional channels, which would allow stations to move their transmission facilities to less expensive real estate, farther from big cities.

The consulting firm advocated power increases for all stations, especially if broadband receivers are to be more widely used. "Increased power will improve the signal-to-noise ratio needed when broadband receivers are employed," it said.

Adjacent channel interference

Some broadcasters asked the FCC to initiate a rulemaking proceeding to evaluate the existing second adjacent channel interference protection ratios.

The NAB said a "meaningful" increase in AM bandwidth is limited by the presence of adjacent channel interference. It requested that the FCC establish second adjacent channel protection criteria "that will adequately protect and foster" the manufacture of wideband receivers.

Others asked the FCC to study protection ratios that, as NTIA said, would be necessary to reduce interference based on the fact that wideband signals will be broadcast and received.

DuTreil-Rackley asked the FCC to "eliminate all acceptance rules pertaining to received contour overlap." It maintained that if a station can improve or provide service without creating interference to others, it should be allowed to do so.

Duopoly and other issues

The NAB recommended that the Commission start a rule making proceeding to explore relaxing the main studio and local program origination rules, along with its one-to-a-market, cross-interest and duopoly rules.

The NTIA said relaxing or eliminating the duopoly rules, which forbid any party from owning more than one AM station in the same service area, "would facilitate new capital investment," thus resulting in the improvement in AM radio.

It asked the FCC to undertake a rule making proposal to modify the duopoly rules so that facilities with overlapping 1 mV/m contours would not bar applications from being granted for new stations, assignments, transfers or for other changes "the marketplace would support."

However, the NAB criticized a plan contained in the report that would allow the use of AM broadcast channels for nonbroadcast, "ancillary uses," such as data transmission.

It also was critical of the AM report's plan to allow AM stations to utilize FM translators. That plan, NAB said, could further harm the AM band in general by creating more incentive for listeners to switch to the FM translator.

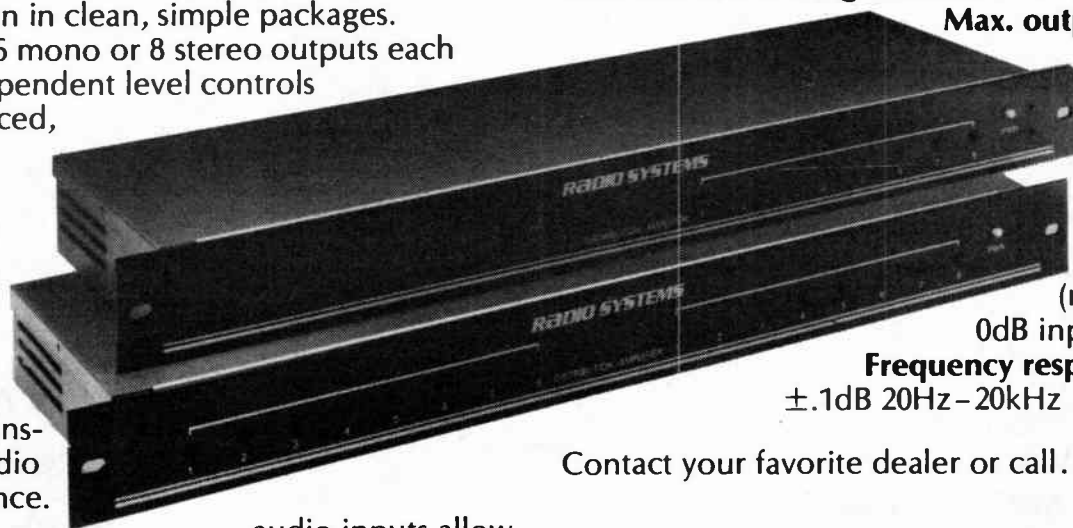
Yet, other broadcasters gave their stamp of approval to a plan that would allow AM broadcasters to use AM translator or "satellite" stations, similar to the current use of FM translators.

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Broadcast Computing

Computer Help With New Regs

by Ronald F. Balonis

Wilkes-Barre PA . . . There's a lot more to deregulation than just eliminating rules and procedures.

Small revisions and corrections are often not as newsworthy and seldom raise intense emotions, despite the fact that many of these are important and long, long overdue.

Silently, our FCC's deregulatory efforts are cleaning up many of the technical discrepancies and inconsistencies that have crept into the rules and regulations over the years.

Within one of the latest 80-90 technical clarification proceedings there is a revised way for calculating FM allocation separation distances.

The adoption of the FCC Notice of Proposed Rule Making—MM Docket No. 86-144; FCC 86-169—will give us an "updated" formula with which to calculate FM distances.

Essentially, the mid-latitude distance calculation algorithm of section 73.208 remains the same; the revision only replaces the cumbersome mid-latitude tables located in section 73.698 with two, relatively simple trigonometric formulas.

The Distance and Bearing program (Figure 1) uses this FCC 73.208 revised method to do its calculating. The two formulas are rendered in BASIC in lines 5400 and 5500 of the program, DSTBRG.BA.

As with the old table method, this one also has constraints on its use.

The Commission says it may be used to accurately determine distances up to 350 kilometers (217 miles). It says, for this method and for these distances, the calculated distance will normally be more accurate than calculations using spherical trigonometry that do not correct for the shape of the earth.

However, its accuracy deteriorates rapidly for distances beyond 475 kilometers (295 miles) and should not be used to calculate at such distances.

Except for the CLS command, I've written the program in a near-universal BASIC, and I think that almost all modern—1980 and later—computers will understand it.

To test it and check the program, enter these test coordinates: FROM: Lat.=41 14 55 E. Long.=75 52 55 W. TO: Lat.=40 22 16 E. Long.=78 59 04 W. On a TRS-80 Model 100 computer, this FCC distance calculating program gives 279.33 KM or 173.56 MI at N. 249.58° E.

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

```

0 REM DSTBRG.BA DISTANCE & BEARING
5 REM BY THE FCC 73.208 METHOD NPR 4/21/86
10 RD=45/ATN(1);REM 6/23/85 R.F.BALONIS
20 KS(1)="KM";K(1)=1.0;KS(2)="MI";K(2)=1.609344
30 PS(1)="DD.MM";PS(2)="DDMM.M";PS(3)="DDMMSS"
50 TLES=" ** DISTANCE & BEARING BY FCC 73.208 **"
95 REM--SET DATA TYPES
100 CLS:PRINT TLES;U=0;L=0;P=0:PRINT
105 PRINT "<1> KM <2> MI ";
110 INPUT " ";:U
115 IF U>2 THEN 100
120 IF U<1 THEN STOP
125 PRINT
130 PRINT "<1> ";PS(1);" <2> ";PS(2);" <3> "PS(3);
135 INPUT " ";P
140 IF P>3 THEN 100
145 IF P<1 THEN STOP
150 CLS:PRINT TLES;L=0;REM---GET COORDINATES
155 PRINT"FROM: LAT <PS(P)> ";:INPUT L
160 L1=L;GOSUB 8000; D1=D;L=0
165 PRINT" LONG <PS(P)> ";:INPUT L
170 L2=L;GOSUB 8000; D2=D;L=0
175 PRINT"TO : LAT <PS(P)> ";:INPUT L
180 GOSUB 8000; D3=D;L=0
185 PRINT" LONG <PS(P)> ";:INPUT L
190 GOSUB 8000; D4=D;L=0;PS="";PRINT
195 REM

200 GOSUB 5000:REM---DISTANCE AND BEARING
210 PRINT"DIST=";DIST;K(S(U));" & BEARING=" N";BRG;"E"
220 INPUT" **** DO ANOTHER? <T>O OR <P>ROM :"; PS
230 IF PS<>"T" THEN 100
250 CLS:PRINT TLES
255 PRINT"FROM: LAT <PS(P)> ";L1
260 PRINT" LONG <PS(P)> ";L2;GOTO 175
270 REM
5000 REM--DIST & BRG BY FCC 73.208
5100 D6=ABS(D3-D1);D7=ABS(D4-D2);D=(D1+D3)/2
5200 IF D<25 OR D>50 THEN RUN 0
5300 D=D/RD;BRG=90
5400 LA=D6*(111.13209-0.56605*COS(2*D))+0.00120*COS(4*D))
5500 LB=D7*(111.41513*COS(D)-0.09455*COS(3*D)+.00012*COS(5*D))
6000 DIST=INT(100*SQR(LA*LA+LB*LB)/K(U))/100
7000 REM
7010 IF LA>0 THEN BRG=ATN(LB/LA)*RD
7020 IF D1>D3 AND D2>D4 THEN BRG=180-BRG
7030 IF D1>D3 AND D2<D4 THEN BRG=180+BRG
7040 IF D1<D3 AND D2<D4 THEN BRG=360-BRG
7050 BRG=INT(BRG*100)/100:RETURN
7060 REM
8000 IF L=0 THEN STOP:REM--MAKE DEC DEG
8010 IF P=1 THEN D=L:RETURN
8015 IF P=3 THEN GOSUB 8020;L=D
8020 D=INT(L/100);D=D+(L-D*100)/60:RETURN
8025 REM-----END OF PROGRAM-----
    
```

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The program for Monday, September 15, is dedicated entirely to engineering management issues and supervisory situations. The instructors are Dick Hiner, John Cummuta and Jim Loupas.

The technical sessions begin on Tuesday, September 16, and continue on September 17 and 18. Please look over the agenda carefully and I think you will agree our speakers list resembles the "Who's Who in Broadcast Engineering." Technical subjects include RF radiation, DTTR standards, the impact of international agreements, contract engineering, the digital studio, solid-state radio and television transmitters, NTSC advancements and many more current topics of interest.

Don Bochert

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- \$135 - Broadcast Engineering Technical Sessions only
September 16, 17, 18. (A-86-8400-0281)
- \$ 12 - Optional Top Sirloin Steak Dinner
September 16.

To register, phone or mail this form along with your check made payable to UW-Extension to: Registration Office, The Wisconsin Center, 702 Langdon Street, Madison, WI 53706. Phone: (608) 262-7942.

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OCCUPATIONAL AREA

- 100 Professional, technical and managerial occupations
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- 300 Sales Occupations
- 400 Service Occupations
- 500 Agricultural, fishery, forestry and related occupations
- 600 Processing, machine trades, benchwork, structural, transportation and mining occupations
- 700 Other Occupations _____

Please advise us at time of registration if you are handicapped and desire special accommodations. Requests will be kept confidential.

UW-Madison provides equal opportunities in employment and programming including Title IX requirements.

Program:

MONDAY, SEPTEMBER 15

- 7:45 Registration and Continental Breakfast
- 9:15 **Introduction and Welcome**
Don Borchert, Director of Engineering, WHA Radio and Television
- 9:30 **Broadcast Engineering Management Philosophies**
H. Richard Hiner, Director of Navy Broadcasting, Washington D.C.
- 10:15 Break
- 10:30 **Modern Management Techniques**
John Cummuta, General Manager, WCFL, Chicago, Illinois
- 12:00 Luncheon - "Congratulations! You Are Our New Chief Engineer"
Jim Loupas, President, James Loupas Associates, Houston, Texas
- 2:30 **Problem Solving through Engineering Management Case Studies and Role Playing**
Dick Hiner and John Cummuta
- 4:30 Reception...Cash Bar...
- 8:30 Equipment Exhibits

TUESDAY, SEPTEMBER 16

- 7:45 Registration and Continental Breakfast
- 9:15 **Introduction and Welcome**
Don Borchert, Director of Engineering, WHA Radio and Television
- 9:30 **Is There Life After the Television Stereo Revolution?**
Jim Brown, President, Sound Engineering Associates, Chicago, Illinois
- 10:15 Break
- 10:30 **RF and Microwave Safety Standards**
Burton Gran, VP, Holaday Industries, Eden Prairie, Minnesota
- 11:15 **The Digital Studio of Tomorrow**
Mike Connell, Engineering Specialist, Quantel, Stamford, Connecticut
- 12:00 Luncheon - "Surprise! International Agreements will Affect You"
Wallace Johnson, President, ABES, Arlington, Virginia
- 2:00 **Oh My God! The FCC is Here...**
A mock inspection.
Role playing by:
Garrett Lysiak, FCC, Saint Paul
George Sklom, FCC, Chicago
George Werl, Chief Engineer, KQRS, Minneapolis
- 3:00 Reception...Cash Bar...
- 8:30 Equipment Exhibits
- 6:00 Dinner (Optional)
- 7:30 **FCC Forum**
With **Garrett Lysiak**, **George Sklom** and **Bill Borgman**

WEDNESDAY, SEPTEMBER 17

- 7:45 Continuing Registration and Continental Breakfast
- 8:30 **Field Engineering and Contract Services**
Mark Persons, **Mark Persons and Associates**, Brainerd, MN
Jim Loupas, **James Loupas and Associates**, Houston, TX
- 9:15 **High Power Transmitters Utilizing FET Switching Mode Technology**
Kevin Rodgers, Engineer, Nautel Maine, Inc., Bangor, Maine
- 10:00 Break
- 10:15 **Compact Disc Technology Comes of Age for Broadcasters**
Bill Sacks, President, Straight Wire Audio, Arlington, Virginia
- 11:15 **Optimizing Your SCA Transmissions**
Eric Small, President, Modulation Sciences, Brooklyn, New York
- 12:00 Luncheon - "Television System Advancements"
Charles W. Rhodes, Researcher, North American Philips Laboratories, Briarcliffe Manor, New Jersey
- 2:00 **Get the Boom Out: Acoustics for Broadcast Studios**
A. Bruce Jacobs, Director of Engineering, Prairie Public TV, Fargo, North Dakota
- 2:45 **Designing Antenna Systems to Comply with the New RFR Standards**
Don Markley, Consulting Engineer, Peoria, Illinois

- 3:30 Reception...Cash Bar...
- 8:30 Equipment Exhibits
- 7:30 **Broadcast Engineering Forum (Nuts and Bolts Session)**
Stephen Brown, Moderator, Chief Engineer, WLTE, Minneapolis, MN

THURSDAY, SEPTEMBER 18

- 7:45 Continental Breakfast
- 8:30 **Reliability in Solid State Television Transmitters**
Jerry E. Smith, General Manager, Thomson-LGT, Medford, New Jersey
- 9:15 "CCD Technology"
Larry Thorpe, Director of Camera Product Advancement, SONY Broadcast Corporation
- 10:00 Break
- 10:15 **Practical Applications of Elliptical Polarization for UHF Television and Other Broadcast Services**
Gaeza Di Enes, Senior Research Engineer, Andrew Corporation, Upland, California
- 11:15 **D-1 DTTR Report**
Fred Remley, Chairman, SMPTE Working Group, University of Michigan
- 12:00 Luncheon - The "Great Idea" Giveaway
Mark Durenberger, Director of Technical Development, Hubbard Broadcasting, Saint Paul, Minnesota
- 2:30 Adjournment... Goodbye 'til next year!

Broadcast Equipment Exchange

"Broadcast Equipment Exchange" accepts no responsibility for the condition of the equipment listed or for the specifics of transactions made between buyers and sellers.

AMPLIFIERS

Want to Sell

Bogen MTA 60 PA amp. \$50; McMartin MA20 FA amp. \$25. J Reichard. POB 557. Mechanicsville MD 20659. 301-373-3339.

University 100W basic amp. rack mount. excel cond. \$100. W Laughlin. KDCV. 2636 N 56. Lincoln NE 68504. 402-466-8670.

Tapescaster 3 chan remote amp. AC or battery ops. VU meter. compact metal case. like new cond. \$150 plus ship. M Gollub. Maine Reel Comm. 67 Green. Augusta ME 04330. 207-623-1941.

McIntosh M50, perfect cond. \$250; McIntosh M100, perfect cond. \$350. G Guarino. Acoustilog Inc. 19 Mercer. NY NY 10013. 212-925-1365.

Belar FM RF amp. 107.3 MHz. new 1981. \$200; Belar AM RF amp 810 kHz. new 1979. \$200; Dutch. WDDD. Marion IL. 618-997-8123.

Crown D-150, excel cond. \$425. P Costa. Eastern Snd/Video. 462 Merrimack. Methuen MA 01844. 617-685-1832.

Sigma ADA-210 dist amp. 2 stereo 1x10's or single 1x20. ins & outs. bal or unbal or any combo. new. \$300. J Bruzzese. Pampa Sids. 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/coth. W Burchett. Bur-K Inc. 842 Bellefonte Princess Rd. Ashland KY 41101 606-324-8812.

RTS 405 phono preamp. \$245. J Probst. Production Srvs. 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 AM1010 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. mint cond. \$495. W Laughlin. KDCV. 2636 N 56th. Lincoln NE 68504. 402-466-8670.

Want to Buy

Solid state 100 WRF amp or IPA for FM bdct band. J McCann. NTV Networks. 35 Adams Ave. Smithtown NY 11746. 516-423-2464.

McIntosh, Marantz, Dynaco Quad. Audio Research, etc. amps: WE. Tannoy. Altec. EV. JBL. Hartsfield. 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

Bulkhead fitting for 3-1/8" transmission line. \$25. B Umberger. WNL. 51 S Main #957. Clearwater FL 33575. 813-446-0957.

Harris CP, 2 bay on 100.1 MHz. \$750. V Argo. KYLT. Box 2277. Missoula MT 59806. 406-728-5000.

Phelps Dodge CFHP5, 96.9 MHz w/deicers. includes 75' of 3" coax w/connectors. \$4000 (if we remove). J Miner. KFMJ. 1215 NE 7th St. Grants Pass OR 97526. 503-479-5365.

Andrews self-supporting, 150' AM tower w/approx 10' square base w/insulators. obstruction lights. gd cond. BO. C Thornton. WAGE. Box 1290. Leesburg VA 22075. 703-777-1200.

Andrew PL8-65D 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.

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

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

Delta OIB1 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.

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

RCA BFH-7A 7 bay on 106.5. no deicers. \$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.

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.

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

Coax cable, RG17A/U. one roll 490'. \$200; one roll 111'. \$50. P Schneider. KPMJ. 1280 S Oxnard Blvd. Oxnard CA 93033. 805-486-2337.

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.

AUDIO PRODUCTION (OTHER)

Want to Sell

Sundholm 2100, stereo octave graphic EQ. one rack space. \$240. BO. N Lecerman. Oval Window Audio. 306 Congress St. Portland ME 04101. 207-775-7292.

dbx 166 dynamics processor, \$400; dbx 160 compressor/limiter. \$400; (2) Scully 280. \$125 ea; Electro Sound ES-505 R-R in console type mount. \$500; Sennheiser binaural mics w/head. \$400; Rainbow Prod travel case 32x24x24 w/in-case rack mount. \$500/BO. R Sanchez. KUCV. 3800 S 48th. Lincoln NE 68506. 402-488-0996.

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

Ramko DA amps, stereo. 1 in 8 out. \$150 ea/BO; Garron phase enhancer, works. \$200/BO; Ramko mic preamp/dist amp. works. \$150/BO. H Landsberg. Henry Eng. 503 Key Vista Dr. Sierra Madre CA 91024. 818-355-3656.

UREI 532 10 band graphic EQ. mono. \$150. B Umberger. WNL. 51 S Main Ave #957. Clearwater FL 33575. 813-446-0957.

Burwen dynamic noise filter. \$25. A Goble. WIOD. POB 381177. Miami FL 33238. 305-759-4311.

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. KWKY. 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.

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 Bienville 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.

Telabs stereo telco 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.

Want to Buy

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

AUTOMATION EQUIP.

Want to Sell

IGM Instacart, stereo. like new cond. \$8000. J Neilson. KVNU. POB 267. Logan UT 84321. 801-752-9764.

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

DAP 5000 automation system, 2000 random access events. audio panel. 10 source cards. Instacart interface. complete. 6 yrs old. excel cond. \$2200. Dutch. WDDD. Marion IL. 618-997-8123.

ABC network command decoder for talk radio (2); ABC network pulse decoder. J Stanford. WQUE. 1440 Canal Ste 800. New Orleans LA 70112. 504-581-1280.

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.

Automation system, inc SMC DS-20 digital switcher. DP-1 digital programmer. DP-1C brains. CCI interface. PSB pwr supply. (5) 350 RSB 24-cart Carousels. (6) Otari ARS-100s. brains rebuilt. R-R's need work. wrack mounts. \$7500/BO. H Scanlon. KFMJ. POD 1139. Arcata CA 95521. 707-822-7223.

SMC DP1 (2) memories. 6 Carousels. 4 dual carts. time announce. etc. will function as 1 or 2 systems. call for specifics. \$12000. D Grant. KEZV. 1115 3rd St. Spearfish SD 57783. 605-642-5747.

SMC 350-RSB/MEI 1188 Satmaster controller. 2 Carousels & controller in 6' rack cabinet. \$4000/BO. E Nearman. KUMU. 2005 Kalia Rd. Honolulu HI 96817. 808-941-1566.

Cetec 7000, (4) Otari ARS1000. (3) 42-tray Go-Carts. interfaces. memory dump load. real time clock. in use. avail immed. 4 yrs old. \$15000. J Miner. KFMJ. 1215 NE 7th St. Grants Pass OR 97526. 503-479-5365.

Stereo PB head for RSC 100 Carousel. new. \$50. J Gabrouy. KEZC. 699 Ave B. Yuma AZ 85364. 602-782-4321.

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

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 Instacarts. 3 racks. pres in operation. P Kessler. KZKX. 212 1st St S. Seward NE 68434. 402-643-4571.

Automated Bdct 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 1111. 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 paymt. D Mance. WQNY. 129 Main St. Dansville NY 14437. 716-335-2273.

SMC ESP1 controller, PDC5 clock. DS20 switcher. RAC30 remote control. Xtel AHP11R printer. 4 SMC 350RS Carousels. 3 Audicord A31SR cart machines. 3 Otari ARS1000 DC & more. call for details. W Howe. WQNY. 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. KKN. POB 930. Aitken MN 56431. 218-829-1326.

SMC DP-2 8K memory. super clock. time announce. (4) Otari R-R's w/autorewind. (3) stereo Insta-Carts. Xtel 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.

Want to Buy

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

CAMERAS (VIDEO)

Want to Sell

Sony DIXCM3, 126mm Tamron automatic lens. interconnect cables to 1/2 or 3/4 video recorder. tripod mount. \$5500. P Carlson. PKC Ent. POB 568. West Linn OR 97060. 503-656-6998.

JVC KY1900, like new w/case. battery. AC adaptor. \$2195. J Kaufman. Natl Rec. 460 W 42nd. NY NY 10036. 212-279-2000.

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CAMERAS . . . WTS

Panasonic WV3990B color camera w/3 50' cables, remote control, battery charger, less than 200 hrs use, \$2600. M Hamilton, WSVL, POB 338, Shelbyville IN 46176. 317-398-9757.

JVC BY-110U, w/newer mdl updated 10:1 zoom lens, 3 tube, power supply/charger, 7 batteries, other access, \$3000. B Dombrowski, WhirlWind Prod, 10356 W Warren Ave, Dearborn MI 48126. 313-584-4038.

JVC KY 1900 color cameras (3), two 10x1, one 6x1, w/case, battery pack charger & AC, \$2750 for 10x1 & \$2500 for 6x1. P Costa, Eastern Snd & Video, 462 Merrimack, Methuen MA 01844. 617-685-1832.

JVC 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, L.N. \$3000. J Bruzzese, Pampa Stds, 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.

Want to Buy

JVC CCU/fu/w JVC KY1900 camera. 1 Kaufman, Natl Recd, 460 W 42nd, NY NY 10036. 212-279-2000.

CART MACHINES

Want to Sell

Tapecaster 700 R/P, gd cond, just realigned, \$475; **Tapecaster 700 P**, gd cond, just realigned, \$300; **UMC Beucart 100** series, one R/P & one play, gd cond, includes rack mount for both if purchased together, w/manual, \$1600/R/P & \$900/play. M Lewis, Africa News Service, 720 9th St, Durham NC 27705. 919-286-0747.

BE 2100RPS, like new, hardly used, \$1750. B Guthrie, Stage 4 Prod, 7352 Newburgh, Westland MI 48185. 313-421-5330.

Cue det card & control card for Ampro cart, \$85/both. J Stanford, WQUE, 1440 Canal S-800, New Orleans LA 70112. 504-581-1280.

Gates Criterion 80 w/record amp, \$400. C Springer, KSEC, Box 890, Lamar CO 81052. 303-336-2206.

Spotmaster 505 rack mount, R/P w/solid state electr, \$450 +ship. J Emmel, Emke Media Ent, POB 401, Olyphant PA 18447. 717-383-1118.

ITC SP for trade w/Tomcat PB cart machines. S Brown, WLTE, 215 S 11th, Mpls MN 55403. 612-339-1029.

ITC 30 cart decks, mono (2), \$500 ea. A Goble, WIOD, POB 381177, Miami FL 33238. 305-759-4311.

BE Spotmaster 2000 mono PB, gd cond, \$225 plus ship; **Contel 101P-B** mono PB, gd cond, \$150 plus ship. M Gollub, WMJS, Box 547, Prince Frederick MD 20678. 301-535-2201.

Nortronics QK-114 cart head mounting kits, new. BO. N Lederman, Oval Window Audio, 306 Congress St, Portland ME 04101. 207-775-7292.

Nortronics QK-114 cart head mounting kits, BO. N Lederman, Oval Window Audio, 306 Congress St, Portland ME 04101. 207-775-7292.

ITC WRA-1874 stereo record units (2) for use w/3-D decks, excel cond, \$650 ea. D Fisher, 4185 Arch Dr, #202, Studio City CA 91604. 818-505-9490.

Spotmaster cart w/timer, \$200. M Phillips, Phillips & Co, POB 985, Laurinburg NC 28352. 919-276-1306.

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.

Want to Buy

Harris Criterion 80, or ITC mono R/P w/150 Hz sec tone record capability. G Peterson, KIMM, POB 8205, Rapid City SD 57709. 605-348-1100.

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.

ITC RP mono w/3 cue tones. J Hunter, KBRE, 450 W 4th St, Cedar City UT 84720. 801-586-5273.

CASSETTE & REEL-TO-REEL RECORDERS

Want to Sell

Scully 100, 16 & 24 trk deck w/audio upgrades. R Robinson, TNA Stds, 10 George St, Wallingford CT 06492. 203-269-4465.

Otari Mark III, 8 trk, \$3500. R Robinson, TNA Stds, 10 George St, Wallingford CT 06492. 203-269-4465.

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Teac V-350C (2), \$89; **Teac V-300**, \$79. P Costa, Eastern Snd/Video, 462 Merrimack, Methuen MA 01844. 617-685-1832.

Revox A-77 (2), gd cond, just aligned, 3.75/7.5 ips, w/manuals, both in wood cabinets, \$500 ea; **Tascam 122B (2)**, gd cond, w/manuals, \$500 ea. M Lewis, Africa News Service, 720 9th St, Durham NC 27705. 919-286-0747.

Ampex 351 mono in metal rack, \$400. G Guarino, Acoustilog Inc, 19 Mercer, NY NY 10013. 212-925-1365.

Scully 100 8 & 16 trk, w/Audiotronics 501 console, \$10,000/both. J Nave, Pickin Post, POB 982, Watertown Hwy, Lebanon TN 37087. 615-449-1770.

Ampex AG-440B 2 trk in roll-around console, w/new heads & sapphire guides, excel cond (2), \$1000 ea, must pick up in LA area. H Landsberg, Henry Eng, 503 Key Vista Dr, Sierra Madre CA 91024. 818-355-3656.

MCI JH-110-4 4 trk, 30/15/7.5 ips w/1/2" & 1/4" heads & remote control low profile console, \$3000. T Jones, KNXR, 220 S Broadway, Rochester MN 55904. 507-288-7700.

Ampex 350, 351, 300 hard to get elect parts, record relays, coils, xformers, switches, etc, limited numbers. R Meyers, Sound Masters, 4700 SW 75 Ave, Miami FL 33155. 305-372-5594.

Magnecord PT6, 3 mono 2 stereo, some disassembly but complete. BO. R Meyers, Sound Masters, 4700 SW 75 Ave, Miami FL 33155. 305-372-5594.

Ampex 300, (3) transports, & (3) elect, \$300/ot. R Meyers, Sound Masters, 4700 SW 75 Ave, Miami FL 33155. 305-372-5594.

Ampex 300-8, 1" 8 trk restored, new tubes w/remote, \$3000. T Papa, Santa Monica Snd, 2114 Pico Blvd, LA CA. 213-450-2119.

Magnecorder PT6 (2), BO. J Curtis, KFRO, POB 792, Longview TX 75606. 214-663-3700.

Ampex 440A w/roll around, needs work, \$800. B Makson, WSBH, 56 Jagger Ln, Southampton NY 11968. 516-283-9500.

Ampex 602 stereo, gd cond, \$150; **Sony audio cassette Carousel RD 6000**, \$250. J Reichard, POB 557, Mechanicsville MD 20659. 301-373-3339.

Grundig stereo deck w/MR, \$40; **Pioneer F2121** stereo w/wooden cabinet, \$125; **Technics M205** stereo, \$100; **Technics M227X** stereo, \$100, +ship on all. J Emmel, Emke Media Ent, POB 401, Olyphant PA 18447. 717-383-1118.

AMI record only high speed open reel duplicators (12), w/8 trk cartridge heads, fits any format w/bias traps in wood console, \$150 ea/BO. Natalie, Studio 2, 9733 Culver Blvd, Culver City CA 90230. 213-558-8832.

Ampex 500 2 trk 1/4", 7.5-15 ips, play only w/console, gd cond (2), \$450/both or BO. Natalie, Studio 2, 9733 Culver Blvd, Culver City CA 90230. 213-558-8832.

Scully 16 16 trk 15/30ips xformerless, w/sync master remote, \$5000. G Guarino, Acoustilog Inc, 19 Mercer, NY NY 10013. 212-925-1365.

Ampex 350-351 (3) w/Novonics or 440 elect, mono, in use, \$400 ea or \$950 all; **Teac 501**, \$200; **Technics M224** cassette decks, \$75. David, Waves Snd Rec, 1956 N Cahuenga, Hollywood CA 90068. 213-466-6141.

Ampex 440 PB stereo, \$200; **Ampex 351 PB** mono, \$100; **Ampex 350 PB** mono & guts of another, \$100. A Goble, WIOD, POB 381177, Miami FL 33238. 305-759-4311.

ITC 850 R/PB, mono (2), \$300 ea; **Ampex 600A (2)**, \$60/both. A Goble, WIOD, POB 381177, Miami FL 33238. 305-759-4311.

Otari MX5050MKII-4 4 trk 1/2", like new cond, BO. R Kaufman, POB 29804, Atlanta GA 30955. 404-646-9911.

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

Scully 270-2 play only machines (2) w/o heads; elect & transport fully operational when removed from automation system, \$600 ea. E Walters, WTCR, 606-739-8427.

Tascam 58-0B 8 trk 1/2" prod recorder, new in box, w/rack mount adapters, \$4500. B Dombrowski, WhirlWind Prod, 10356 W Warren Ave, Dearborn MI 48126. 313-584-4038.

Scully 100 16/8 trk, needs work, \$3500. T Maguire, TMI Engr, 415 W 55th, NY NY 10019. 212-969-9494.

Teac 1/4 trk 7" reel capacity, \$250; **Magnecord 728** rack mount, needs some mechanical work, 10" reel capacity, \$100. T Papa, Santa Monica Snd, 2114 Pico Bl, Santa Monica CA. 213-450-2119.

Revox A-77 1/2 trk w/spk & amp, gd shape, \$695; **1/4** trk **Teac 2300**, \$295. P Costa, Eastern Snd/Video, 462 Merrimack, Methuen MA 01844. 617-685-1832.

Uher 4000 Report-L 2 trk, w/battery charger, main operated power unit & Siemens mic, like new, BO over \$450. A Bassing, 7303 Holly Ave, Takoma Pk MD 20912. 301-587-9020.

Akai GX-6000, 10 1/2" reels, 7.5 & 3.75" speeds, 4 trk stereo, gd cond, w/manual, \$100 plus ship. M Gollub, WMJS, Box 547, Prince Frederick, MD 20678. 301-535-2201.

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Nortronics 8 trk 1" erase & combined R/P heads, BO. R Robinson, TNA Stds, 10 George St, Wallingford CT 06492. 203-269-4465.

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

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

Wollensak 2770 A/V 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.

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

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Scully 280 8 trk, \$3500; **Scully 280-B 2** trk \$2250. W Burchett, Bur-K Inc, 842 Bellefonte Princess Rd, Ashland KY 41101. 606-324-8812.

Tascam 80-8, 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.

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

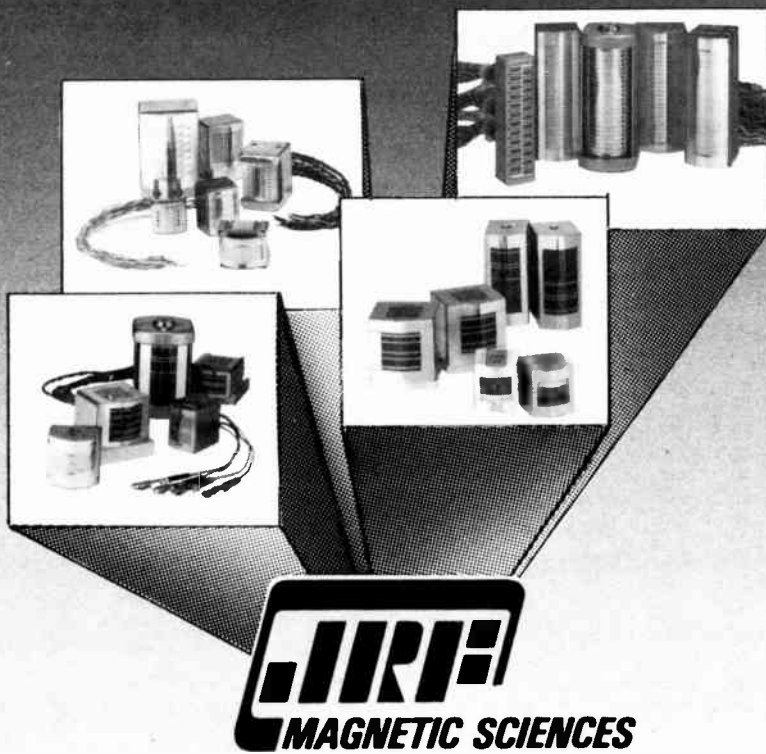
Teac TD700 3 speed, rack mount R-R w/10-1/2" reels, excel cond, \$800. D Hastings, WKYB, POB 1000, Hemingway SC 29554. 803-558-2558.

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.

Revox 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.

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Revox 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 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 280-8 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 380-4 4 trk w/sel-synch, comp w/cabinet, gd working cond, \$400. I Kaufman, Natl Recdg, 460 W 42nd St, NY NY 10036. 212-279-2000.

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

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.

Nortronic 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.

Nortronic 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.

Want to Buy

Ampex MM1000 capstan servo motor, tape lock access, sync lock access, Auditec system, H Henson, Henson Prod, 4569 Havencrest Rd, Winston Salem NC 27106. 919-924-8717.

Ampex AG 4408-2 or 440C-2 recorders. Bob Lindahl, Northwestern Inc. 800-547-2252.

Ampex 600, 601, 602, AG600, 620, 621, 622 etc. amp/speakers, fair prices, depending on cond. G Harris, Theatre Works USA, 131 W 86th, NY NY 10024. 212-595-7500.

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.

Revox 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.

CATV-MATV EQUIP.

Want to Sell

Sony demods, chan 4, 5, 7, 9, 11, 13, \$100. R Peterson, Pacific Comm, POB 7668, Olympia WA 98507. 206-754-7081.

Jerrold Commander modulator, chan 2, \$250; Dynair Dynamod TX4A chan 11, \$150; Dynair Dynatune demod RX4B, chan 11, \$250; Dynair Dynamod TX4B chan 4, \$300. J Reichard, POB 557, Mechanicsville MD 20659. 301-373-3339.

CONSOLES

Want to Sell

Altec 250 SU, excel cond, tube type, \$700. B Woolf, Audio & Recdg Systems, 2986 Edidin Dr, Jacksonville FL 32211. 904-744-1661.

Autogram, BE, UREI studio consoles, new. Let BAI bid on your needs. Broadcast Automation, 4125 Keller Springs, #122, Dallas TX 75422. 214-380-6800.

Electrodyne console parts, (6) 710 modules, (20) SM-9 switch modules, oscillator, limiters, line amps. R Robinson, TNA Stds, 10 George St, Wallingford CT 06492. 203-269-4465.

Ramko DC8MS 8 chan, 21 input stereo, excel cond, \$1550. B Van Prooyen, Van Prooyen Bdcg, 628 Mulford Dr SE, Grand Rapids MI 49507. 616-452-0133.

Russco Studio Master 505, 5 pot mono, gd shape, \$700. B Umberger, WNLT, 51 S Main #957, Clearwater FL 33575. 813-446-0957.

RCA BC3, disassembled, case, guts, front panel, PC boards new, \$100. R Meyers, Sound Masters, 4700 SW 75 Ave, Miami FL 33155. 305-372-5594.

Studer console for B67, \$200; Neve pots, wide assortment at gd prices. G Guarino, Acoustilog Inc, 19 Mercer, NY NY 10013. 212-925-1365.

RCA BC17 3 chan mono, \$100. A Goble, WIOD, POB 381177, Miami FL 33238. 305-759-4311.

Collins 212S, stereo 6 chan, w/complete spare parts, \$500 plus frt. F Spinetta, KCEA, POB 2585, Atherton CA 94026. 415-321-6049.

IC-10 stereo, new, BO. R Kaufman, Ricky the K's, POB 29804, Atlanta GA 30359. 404-636-9911.

Teac AX-20 mixdown panels (2), \$20 ea. W Laughlin, KDCV, 2636 N 56, Lincoln NE 68504. 402-466-8670.

Ramko DC8MS 8 mixer stereo w/LC-2 remote control & 2 SP-8/E stereo TT preamps. G Peterson, KIMM, POB 8205, Rapid City SD 57709. 605-348-1100.

MCI 2001 opamps (116), real cheap. M Feidler, Mahoney Feidler Prod, 5346 Dupont Ave S, Mpls MN 55419. 612-822-0013.

Gates Statesman, excel cond w/extra modules, \$1200. J Stizinger, Calvary Baptist Church, 1380 Valley Forge Rd, Lansdale PA 19446. 215-368-7538.

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 Bdcg, 114 Circle Dr, Rocky Mt NC 27804. 919-443-7870.

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 Cilurzo, 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.

Want to Buy

RCA BC7A or B, or comparable stereo console, also need spare parts, for school district purchase. M Kosack, C&G Assoc, 516-489-1071.

Gates stereo Executive, gd cond & reasonable price. M Kosack, C&G Assoc, 516-489-1071.

RCA BC3 parts & spares. L Scott Jr, WMJS, PO Drawer 1729, Bartow FL 33830. 813-533-4654.

DISCO & SOUND EQUIP.

Want to Sell

Barwen 1201A dynamic NR, new, \$150. I Kaufman, Natl Recdg, 460 W 42nd, NY NY 10036. 212-279-2000.

Delta-Lab DL-4, \$375; Loft DDL 440, \$275; Eventide phaser, \$350; Omni-Craft 4 chan noise gate, \$250; UREI 550 9 band stereo graphic EQ, \$425; Alesis XT digital reverb, \$425, all in gd to excel cond. P Costa, Eastern Snd/Video, 462 Merrimack, Methuen MA 01844. 617-685-1832.

Publison, effects processor, does everything, BO. R Kaufman, POB 29804, Atlanta GA 30955. 404-646-9911.

Tapco 2200 graphic EQ, \$95; Bogue MXM, 5 input, road mixer, XLR, \$50. T Papa, Santa Monica Snd, 2114 Pico Bl, Santa Monica CA. 213-450-2119.

Realistic 10-band stereo EQ w/mixing dubbing facilities, \$75 +ship. J Emmel, Emke Media Ent, POB 401, Olyphant PA 18447. 717-383-1118.

Sundholm 2100, stereo octave graphic EQ, one rack space, mint, \$240/BO. N Lederman, Oval Window Audio, 306 Congress St, Portland ME 04101. 207-775-7292.

EV M8CA 8" speaker, new in box, \$25. W Laughlin, KDCV, 2636 N 56, Lincoln NE 68504. 402-466-8670.

Radio Shack Nova-5 speakers (2), \$40 ea/\$70 pair +ship. J Emmel, Emke Media Ent, POB 401, Olyphant PA 18447. 717-383-1118.

dbx 224 Type II NR system for tape & disc stereo unit, prof series, \$90 plus ship. M Gollub, Maine Reel Comm, 67 Green, Augusta ME 04330. 207-623-1941.

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 111B, new, \$495; Apex 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 poings, \$275. B Walker, Hoyt & Walker, 3422 Old Cantrell Rd, Little Rock AR 72202. 501-661-1765.

AKG 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.

Want to Buy

Janzen electro stats & DuKane Ionovac tweeters. J Anthony, Stancor Audio, 8 Passaic St, Hackensack NJ 07601. 201-265-5200.

LIMITERS

Want to Sell

Harris MSP-90 tri-band audio processor, mint cond, \$1500 or trade for Optimod 8000A. B Umberger, WNLT, 51 S Main #957, Clearwater FL 33575. 813-446-0957.

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.

RCA BG-A1 tube limiters, same as BA-6A w/warm punchy sound, \$700 ea/BO. Natalie, Studio 2, 9733 Culver Blvd, Culver City CA 90230. 213-558-8832.

UREI LA-4 compressor/limiters, pair rack mounted, new cond w/instr, \$550. I Kaufman, Natl Recd, 460 W 42nd, NY NY 10036. 212-279-2000.

Inovonics 230 multiband audio processor in gd working order, \$500; Orban Optimod 8000A in gd working order, \$1700. C Springer, KSEC, Box 890, Lamar CO 81052. 303-336-2206.

DAP 310 w/manuals, recently aligned, \$750. S Wilson, KLSF, 803 S Rusk, Amarillo TX 79106. 806-371-9797.

RCA BAGA tube limiter, \$350. T Papa, Santa Monica Snd, 2114 Pico Bl, Santa Monica CA. 213-450-2119.

CRL AM4 APP400, PMC300, SEP400, BO; Limpander LE35B, BO. J Curtis, KFRO, POB 792, Longview TX 75606. 214-663-3700.

UREI 1176 peak limiters, 5 yrs old, work well, \$200 ea/BO. H Landsberg, Henry Eng, 503 Key Vista Dr, Sierra Madre CA 91024. 818-355-3656.

Kahn Symetra-peak SP58-1A, \$100. B Umberger, WNLT, 51 S Main #957, Clearwater FL 33575. 813-446-0957.

Dubby 334 NR unit, \$50. A Goble, WIOD, POB 381177, Miami FL 33238. 305-759-4311.

Orban 9100A2 set up for C-QUAM, excel cond, superb sound, \$4200. C Hemming, KBOR, POB 3407, Brownsville TX 78523. 512-544-1600.

Elcom WBL 11 composite clipper, \$200. B Umberger, WNLT, 51 S Main #957, Clearwater FL 33575. 813-446-0957.

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Innovonics 220, audio level optimizers (2), \$250 ea. Steve Portier, WNOE, 529 Bienville St., New Orleans LA 70130. 504-529-1212.

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GREGG LABS Model 2542-2 w/Multiband Gain & Peak Control (5-Band Crossover) for incredible loudness w/o audible distortion, incl. versatile Phase/Amplitude EQ to improve transmitter/antenna system performances w/multiturn adjustments for two preset modes of operation, minimizes tilt & ringing non-linearities. Two separate line amplifiers & multitrack controls provide independent outputs to feed two transmitters. List price was \$5,250. NOW \$3,935—a 25% discount (1 only). Call 217/222-8200 Ext. 3538 or 3466.

Orban 9100A1, mint cond., used less than 1 yr. w/manual. M Pittman, WAMN, POB 631, Annapolis MD 21404. 301-269-0700.

Orban 81001 processor, excel. \$3500. T Gaier, KQXR, POB 2700, Bakersfield CA 93303. 805-328-1410.

Urei 1178 stereo, mint, w/srvs manual, \$500. M Paradiso, Ultimate Image, 7200 Dunfield, LA CA 90045. 213-410-1009.

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.

Innovonics 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.

Collies 260-1 limiter; Gates 994-6543-001 limiter; Gates Sta-Level, 80 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 Dietterich, 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.

Optimod 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-40HAM mono audio processor, \$300. M Persons, KKIN, POB 930, Aitkin MN 56431. 218-829-1326.

Want to Buy

Orban 8100A or 8000 FM Optimod. J Paf-barger, 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.

MICROPHONES

Want to Sell

RCA 74B, new ribbons, excel cond. \$60. B Woolf, Audio & Recdg Systems, 2986 Edidin Dr, Jacksonville FL 32211. 904-744-1661.

Turner 2302 dynamic, new in box, \$30; Turner 450D lo-Z paging mic(s) have several, new in boxes, \$10 ea. W Laughlin, KDCV, 2636 N 56, Lincoln NE 68504. 402-466-8670.

EV RE-15 & RE-16 w/metal cases, vg, \$125 ea. J Emmel, Emke Media Ent, POB 401, Olyphant PA 18447. 717-383-1118.

Sennheiser 441U, excel cond, w/hard case, \$300. M Lewis, Africa News Service, 720 9th St, Durham NC 27705. 919-286-0747.

RCA BK5B mics w/yokes, no shock mounts, factory recond, \$140 ea. M Phillips, Phillips & Co, POB 985, Laurinburg NC 28352. 919-276-1306.

Canon UA-331; P3CG-12S; UA3-12, both male & female connectors, new, several of ea. BO; EV 664, BO. M Kosack, C&G Assoc, 516-489-1071.

Altec 21B tube omni condenser mic. R Robinson, Trod Nessel 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 44BX in line cond, \$350; RCA 77DX mic, excel cond, \$325. L Syner, Box 182, Floral Park NY 11001. 718-347-2940.

Baby Boom mike stands (7), \$35 ea. W Burchett, Bur-K Inc, 842 Bellefonte Princess Rd, Ashland KY 41101. 606-324-8812.

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.

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.

Want to Buy

RCA boom mfg by Mole-Richardson 40's. L Scott Jr, WJMS, PO Drawer 1729, Bartow FL 33830. 813-533-4654.

EV RE20. A Kosack, C&G Assoc, 516-489-1071.

MISCELLANEOUS

Want to Sell

Spelman HV pwr supply, 0-40 kV at 2 mA, \$400. T Maguire, TMI Engr, 415 W 55th, NY NY 10019. 212-969-9494.

Kapco modular rack pwr supply, 8 modules, \$250. T Maguire, TMI Engr, 415 W 55th, NY NY 10019. 212-969-9494.

Telemation TPD 100 pwr dist panel; ITT phone network for office, 15 phones plus electr networking equip; Laird Telemedia 2508-2520 remote control film slide for TV prod. J Baltar, Maine Reel Comm, 67 Green, Augusta ME 04330. 207-623-1941.

ASR-33T send & receive w/stand, rolls of paper, ribbons, punchtape paper, BO. J Emmel, Emke Media Ent, POB 401, Olyphant PA 18447. 717-383-1118.

Rotary-dial, 3-line telephones (6) w/in-dividual hold for ea line, does not require Amphenol, just modular, various colors. \$25 ea; Record-a-Call 560 telephone answering machine, not remoted, \$65 +ship. J Emmel, Emke Media Ent, POB 401, Olyphant PA 18447. 717-383-1118.

BNC cables, various lengths, 20¢ per foot. R Peterson, Pacific Comm, POB 7668, Olympia WA 98507. 206-754-7081.

Riton T108E/G/J modem, BO. B Umberger, WNLT, 51 S Main #957, Clearwater FL 33575. 813-446-0957.

TI Silent 700 ASR electronic data terminal, incl Schafer encoder & decoder (800 VEL); Extel printer; fully operational, \$6000 package. E Walters, WTCR, 606-739-8427.

Advent proj TV's, gd for parts, BO. T Maguire, TMI Engr, 415 W 55th, NY NY 10019. 212-969-9494.

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.

Vikron 5742, mono play heads for cart/R use (5), \$60 ea, all for \$250. D Peluso, DGP Consultants, 2900 E Charleston Ste 197, Las Vegas NV 89104. 702-384-0081.

Sparta tech manuals, new audio manuals, \$10 ea; xmb manuals, \$25 ea; specify mdl of product wanted. D Peluso, DGP Consultants, 2900 E Charleston Ste 197, Las Vegas NV 89104. 702-384-0081.

AP wire copy paper, 30 cases, BO or trade. B Musso, WCCD, 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 IX-80 printer, color dot matrix, hardly used, BO. R Hill, WTPA, 107 E Main St, Mechanicsburg PA 17055. 717-697-1141.

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: _____.

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Orban is hiring senior-level electronic engineers to design new products for both our pro audio and broadcast markets.

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HELP WANTED

Metroplex Communications seeks engineers w/EE degree or minimum 5 yrs related exper for East Coast markets. Contact Dough Holland, Uplink Engr, 1635 South 21st Ave, Hollywood FL 33020. 305-920-6438.

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.

POSITIONS WANTED

Station mgr seeking AL, GA or SC position, highly qualified. BJ Gilreath, POB 129, Orchard Hill GA 30266.

WBZ HANDY REPAIR MAINT seeking an individual experienced in all phases of broadcast engineering. A thorough knowledge of RF systems is desired. Contact Norm Avery, Engineering Manager, WBZ Radio, 1170 Soldiers Field Road, Boston MA 02134. (617) 787-7000.

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SBE Certified AM/FM. 8 yrs CE, BA journalism, voice, automation, seeks Midwest/Upper-MW. B McBride, KWBE/KMAZ, Box 10, Beatrice NE 68310. 402-228-5923.

CE radio, 11 yrs exper AM/DA/FM, also RPU, STL, TSL & announcing exper, ops mgr, prefer Northeast. Write: RW, POB 1214, Falls Church VA 22041. Attn: Box 9-1.

Eng will consider air shift, 2 yrs formal training, w/7 yrs exper, certified w/FCC general, 25K min, all markets, currently employed. Write: RW, POB 1214, Falls Church VA 22041. Attn: Box 8-2.

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 Gottesman, 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.

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MISC . . . WTS

Symetrix 104 telephone interface system. 2 mos old, like new. \$1000. K Harnack. WPAD. 1700 N 8th St. Paducah KY 42001. 502-442-8231.

Want to Buy

UTC HM1-100 high pass filter. R Robinson. TNA. 10 George St. Wallingford CT 06492. 203-269-4465.

Station or network metal ID's for mikes & mike stands; also AFRS transcriptions. L Scott Jr. WMJS. PO Drawer 1729, Bartow FL 33830. 813-533-4654.

RCA electron tube handbook, 5 loose-leaf binders, gd cond. \$50. J Glass. WNIU. Northern IL Univ. Dekalb IL 60115. 815-753-0212.

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

McMartin TBM-3500 baseband FM; TBM-2200A stereo & pilot freq; TBM-2000B SCA. all solid state & in excel cond. C Springer, KSEC, Box 890. Lamar CO 81052. 303-336-2206.

Belar FMM1 FM mod monitor, gd cond. \$750; RCA mod monitor for AM. \$800. B Jeffreys. WROK. 1100 Tamarack Ln. Rockford IL 61125. 815-399-2233.

Gates M-5693 mod monitor, set for 1370 kHz; GR 1181-A freq monitor. J Curtis. KFRO. POB 792. Longview TX 75606. 214-663-3700.

TFT 753, \$900; Belar AMM-1, \$400 ea. Steve Portier. WNOE. 529 Bienville St. New Orleans LA 70130. 504-529-1212.

Gates GTM-88F FM freq mon; Metron 506-B-1 AM mod mon. BO plus ship. M Rockwell. WNBI. 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.

Want to Buy

Tower type accepted directional antenna monitors, 3 or more. D Davis. KMIN. POB 980. Grants NM 87020. 505-287-2989.

MOVIE PRODUCTION EQUIP.

Want to Sell

Magnetic sync recorder 16mm w/24" rack. David. Waves Snd Rec. 1956 N Cahuenga. Hollywood CA 90068. 213-466-6141.

Beattie-Coleman K 25 Polaroid oscilloscope unit used to film oscilloscopes using a Polaroid camera mounted on special housing. \$45 plus ship; Vicon V113-V100 pan tilt & solid state lens control unit w/pedestal mount for surveillance camera. \$125 plus ship. J Baltar. Maine Reel Comm. 67 Green. Augusta ME 04330. 207-623-1941.

B&H 550 16mm sound projectors (2). optical sound. 2000' capacity. inc extra exciter. projection lamps. reels. fair cond. \$100 for one & \$175 for both. plus ship. M Gollub. Maine Reel Comm. 67 Green. Augusta ME 04330. 207-623-1941.

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.

RECEIVERS & TRANSCEIVERS

Want to Sell

TG43 mobile units (2). 161.76 MHz. \$100. A Gable. WIOD. POB 381177. Miami FL 33238. 305-759-4311.

Motorola HT-200 VHF 2 chan w/2 ants (rubber & tele). manual. \$100. D Jordan. POB 6349. Evansville IN 47712. 812-963-6882.

GE Porta-Mobil One, 161.76 MHz (4). 2 chargers & mics. \$250/all. A Goble. WIOD. POB 381177. Miami FL 33238. 305-759-4311.

Yaesu FRG 7 comm rec. excel cond. \$185. M Goodman. Interport Group. 6621 Gettisburg 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 Gettisburg Dr. Madison WI 53705. 608-833-6948.

REMOTE & MICROWAVE EQUIP.

Want to Sell

Moseley PCL 28 STL. tube type. split band system. working when removed from service approx 4 yrs ago. BO. B Umberger. WNLT. 51 S Main #957. Clearwater FL 33575. 813-446-0957.

Elgin ERC 19654 recorder connector. interface to telephone line. \$50. B Umberger. WNLT. 51 S Main #957. Clearwater FL 33575. 813-446-0957.

Shafar 400-RR RC system. J Curtis. KFRO. POB 792. Longview TX 75606. 214-663-3700.

Gentner Telemix IX telephone hybrid. \$1500. A Goble. WIOD. POB 381177. Miami FL 33238. 305-759-4311.

Gates RDC10 remote control, gd for parts only. BO. B Umberger. WNLT. 51 S Main Ave #957. Clearwater FL 33575. 813-446-0957.

Ampex 440 remote control. \$40. B Umberger. WNLT. 51 S Main #957. Clearwater FL 33575. 813-446-0957.

Micro Controls DRCR-9/RCT-9 RC system. setup for phone line. can be adapted for subcarrier. \$1200. D Woodcock. WNW. 5606 Medical Circle. Madison WI 53719. 608-271-1025.

NEC earth stations, 2-3 yrs old. like new cond. 5.5 meter k-band. avail immed. \$120,000 ea. ISAUS. POB DD. McLean VA 22101. 703-759-2094.

Modulation Assoc Transtar AC demod shelf. inc down converter. (2) SCPC demods. cue decoder card & printer card. & power supply. \$2500/BO. K Bartz. KWQB. Box 1301. Fargo ND 58107. 218-236-7900.

Potomac RC16+. like new. for AM/FM. in service. microwave or phone line. 16 chan control & status. digital display. video monitor & printer capacity. BO. H Reinders. WWIB. Hwy 27 & County T. Cornell WI 54732. 715-726-1229.

Harris 6550 satellite rcvr, tuned to AP/UPI transponder on Westar 3 w/dist amp. \$1750. V Argo. KYLT. Box 2277. Missoula MT 59806. 406-728-5000.

Hughes aircraft terminals earth stations, 2-3 yrs old, like new cond. 5.5 meter k-band. avail immed. \$140,000 ea. ISAUS. POB DD. McLean VA 22101. 703-759-2094.

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 xmtr RC unit. use whlco line only. 9 chan. not been used since recon. \$1100. M Meyer. KLOP. POB 70. Madison MN 56256. 612-598-7301.

RCA PBR-15s, like Moseley TRC-15AW but only have xmtr 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 SCGB, SCDB 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 xmtr system. \$2000 or trade for quality R.R. D Doughty. WTLB. Utica NY 13503. 315-797-1330.

Microwave Assoc MAG-C, comp xmit & receive stations in racks. 1 video & 2 audio chan. 6987.5 MHz. new cond. BO. T Smith. CCI Prod. 192 Lancaster Ave. Fraser PA 19355. 215-289-1729.

Want to Buy

M/A-Com sat rcvr & Wegener 1600 series demod for SMN Star format. L Dupree. KSYL. Box 7057. Alexandria LA 71301. 318-445-1234.

STEREO GENERATORS

Want to Sell

Harris MS-15R stereo gen. mint cond. \$1500 or trade for Optimod 8000A. B Umberger. WNLT. 51 S Main #957. Clearwater FL 33575. 813-446-0957.

RCA BTS 1B stereo gen. vgc. \$500. B Umberger. WNLT. 51 S Main #957. Clearwater FL 33575. 813-446-0957.

SWITCHERS (VIDEO)

Want to Sell

Dynair 153A switcher, B&W. \$1500 plus ship. J Baltar. Maine Reel Comm. 67 Green. Augusta ME 04330. 207-623-1941.

TAPES, CARTS REELS

Want to Sell

Audiopak A2 (460) mostly 40's & 70's. also winding machine. \$2.50-3.00/cart. K Barnett. WWTR. Ocean City MD. 301-289-4545.

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.

Video cassettes, 3/4" various brands. \$5 ea. T Papa. Santa Monica Snd. 2114 Pico Bl. Santa Monica CA. 213-450-2119.

Various used carts, (90) in different lengths. \$45/all. R Haan. KDCR. Sioux Center IA 57250. 712-722-0885.

Blank 3/4" tapes, 20 assorted. \$100. M Hamilton. WSVL. POB 338. Shelbyville IN 46176. 317-398-9757.

Audiopak AA3 approx 200. \$1 ea plus ship; Fidelipac 300's & Audiopak A2 mix, about 50. 50¢ ea plus ship. R Childress. KCLB. 50 Mark West Springs Rd. Santa Rosa CA 95401. 707-528-9236.

Fidelipac 300's, (100). need reloading. 25' ea. E Ford. KETR. 321 E Chapman. Fuller ton CA 92634. 714-879-1555.

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.

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Brokers, dealers, manufacturers and other organizations who are not legitimate end users can participate in the Broadcast Equipment Exchange on a paid basis. Listings are available on an \$18/25 word basis. Call 800-336-3045 for details and complete display rates.

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
 Positions Wanted Without Box Number

Text (25 words maximum): _____

Name _____ Title _____

Company/Station _____

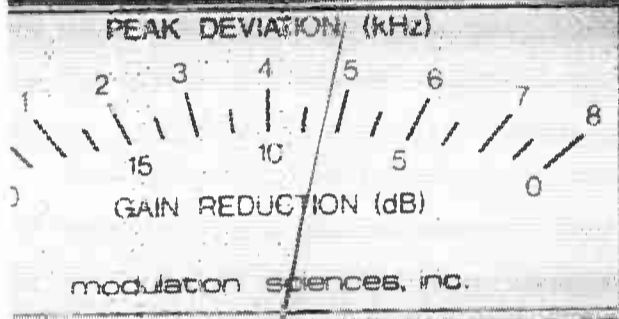
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E.J. PRYOR, JR.

Broadcast Technologies, Inc.

"I have been operating one SCA on 67kHz on my Dallas, TX station for some years. After many years of the normal problems of crosstalk, noise, etc., Modulation Sciences came forward with the 'Sidekick' SCA generator. I have never spoken out for a particular device in this column before, but I found that virtually every problem I had been experiencing disappeared when I finally got one of these units and installed it at the studio between my stereo generator and composite STL. I found that the crosstalk, main to sub and sub to main, was improved almost 20db and the system noise was markedly improved also. There is no measurable degradation to the stereo performance or loudness whatever. With the new rules allowing stations to increase their total modulation 5% for each 10% of injection, the main channel (mono) level suffers a negligible 0.5db reduction in loudness."

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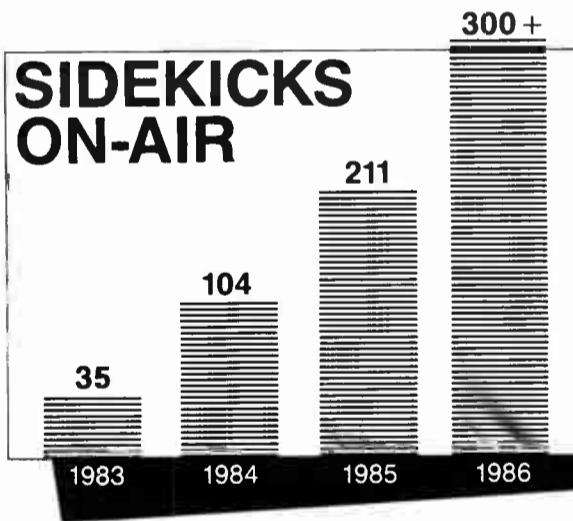
From SCA: Radio Subcarrier Report

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