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FCC May Move on AM Stereo

by David Hughes

Dallas TX ... The FCC has indicated that it is planning to issue a "statement" by late spring or summer that could formally indicate that a defacto AM stereo standard has been reached.

The news follows comments at the March NAB show from FCC Mass Media Bureau (MMB) Chief Jim McKinney.

While stopping short of endorsing Motorola's C-QUAM system, McKinney said that broadcasters should have no trouble determining that a standard has

been reached.

The FCC's planned AM stereo statement, according to Bill Hassinger, McKinney's engineering assistant, will be the Commission's formal response to a petition filed by Texar Inc. last fall asking the FCC to abandon its marketplace approach and select an AM stereo standard.

"It will be our version of how the (AM stereo) world looks," Hassinger told RW. However, he would not comment on whether the statement would be official FCC recognition that a de-

facto AM stereo standard has been reached.

The announcement would mean more good news for Motorola's C-QUAM system. Only days before the show, Canada picked C-QUAM as its AM stereo standard.

NTIA study hangs in balance

According to Hassinger, the FCC "will make an appropriate response" to the Texar petition when the National Telecommunications and Information Administration (NTIA) releases its report

on multisystem receivers in late spring or summer.

In February, the NTIA released a report on the state of AM radio, which skirted the choice between C-QUAM and the Kahn ISB systems as a defacto standard. Instead, the NTIA said it would study this spring the "technical viability" of multimode AM stereo chips.

Hassinger said that the Commission had been planning to respond when the NTIA first released its February report, but it would have been "awkward" for the FCC to make a statement before the multimode study.

However, despite news of an AM stereo statement, Hassinger stressed that the Commission "is not looking to reopen the issue" with a petition for rule-making. "The FCC will follow (the NTIA study)," Hassinger said. "We want to do it quickly."

Yet, at press time, McKinney told RW that he would not comment on whether the FCC would definitely release a statement following the NTIA study. "What we will do is uncertain ... Who knows," he said.

McKinney's comments

At the NAB show, McKinney came very close to endorsing C-QUAM as the victor in the marketplace battle for an AM stereo standard.

On 30 March, in a radio management session at the show entitled "Jim McKinney and You," the MMB head said that "100%" AM stereo receivers get Motorola, while only 2-3% get the Kahn system. "That's a very demanding statistic," he said. "Every country that has selected a system has selected Motorola."

"I look at the data and to me, if I were a broadcaster, I wouldn't have any trouble ... determining which one had already won," he said.

The audience, in response to McKinney's query, indicated by its applause that it favored the FCC to pick a standard rather than continue its marketplace approach. He added that the FCC's marketplace decision was "before my watch" as MMB chief.

"Should we do it (set a standard) now, and will we do it now—I've got a sneaky feeling that this matter is going to be examined one more time by the Commission," he said in reference to the Texar petition. "All we're waiting for now is the further quote, study, unquote from the laboratory in Boulder under NTIA."

McKinney said he regretted, personally, that the NTIA did not find that the marketplace had already decided the issue.

"Too few" conversions

Earlier in the show, in addressing the Radio Engineering Seminar on 27 March, McKinney said that "too few"

NRSC Shines in Dallas

by Alex Zavistovich

Dallas TX ... Members of the National Radio Systems Committee (NRSC) hailed the NAB convention as a success for the committee's AM radio pre-emphasis/deemphasis standard, citing support from receiver and processor manufacturers, as well as general interest from broadcasters.

The NRSC standard, adopted in January, recommends a 75 μ S transmitter preemphasis and corresponding 75 μ S receiver deemphasis, as well as a proposed 10 kHz bandwidth limitation and filter requirements.

Although many companies rushed to implement the standard into processing and receiver equipment to be unveiled at the convention trade show, not all engineers spoke in favor of the committee's decision.

Mike Dorrough, president of Dorrough Electronics, a processor manufacturer, opposed the 75 μ S preemphasis curve. He said there is "some fallacy" in the committee's thinking regarding the standard.

"My proposal to the committee, through a member, was a maximum of 35 μ S, with reservations," Dorrough told RW. "The broadcasters, given time, will see real degradation of their audio, even given the better radios," he said.

Dorrough maintained that "with the rapid advancement of audio technology, the committee does not have all the facts."

Objection withdrawn

Concern over the 75 μ S preemphasis curve was not the first objection raised to the voluntary standard. During a public comment period following adoption of an interim version of the standard

(continued on page 4)



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Interim DST Measure Passed

by David Hughes

Washington DC . . . At the last minute, just before the March NAB show, the FCC scaled back its plans to give AM daytimers affected by the extension of daylight savings time (DST) a 50 W minimum pre-sunrise authority (PSA) power level.

In an "interim" measure, adopted in late March and announced in early April, the Commission said that, instead, it would institute a 10 W PSA minimum for pre-sunrise operations during most of April 1987.

However, the FCC left the door open for a further rulemaking action to address the 50 W PSA limit for the DST extension in April 1988.

Loss of morning drive time

Daytimers had requested the PSA minimum limit because of the loss of an hour of morning drivetime each day from 5-26 April. Last year, Congress approved a three-week extension of DST,

which now starts on the first weekend in April rather than the last.

In a January Notice of Proposed Rule Making, the FCC asked for comments on a 50 W PSA minimum power limit for the period DST is extended in April.

Most of those comments, especially those from fulltime AMers, including clear channel operations, were critical of the PSA power hikes contending that increased interference would result.

In its interim ruling, the Commission indicated that daytimers that already have more than 10 W PSA will not be affected by the decision. Stations that have less than 10 W PSA should have received notice that they can operate at the new interim minimum power during the three week period.

However, FCC Audio Services Division Chief Larry Eads told RW that some daytimers with less than 10 W PSA may not be allowed to operate at the minimum limits because of "conflicts" with Canadian and Mexican agreements.

Eads maintained that the FCC will

continue to study the issue and make a final ruling on the 50 W PSA limit in time for the DST extension in April 1988. "We had too short a time frame to completely study the full interference problems," he said.

Daytimers disappointed

Despite the possibility of a 50 W PSA limit for next April, David Palmer, head of the NAB Daytimers Committee, was disappointed about the 10 W interim limit. "It was a very bad decision to back off (the 50 W limit)," he told RW.

He added that the more powerful, full time AMers swayed the Commission's decision.

NAB Counsel Barry Umansky added that "the FCC just ran out of time for a full blown rulemaking proceeding. They want to be very careful that no increase in interference is created."

The FCC docket number is MM 87-3. FCC contacts are Larry Eads at 202-632-6485, or Louis Stephens at 202-254-3394.

FCC Clips

EBS Status Report

The Emergency Broadcast System (EBS) was activated 1,167 times in 1986, the FCC reported in a March notice.

The system was utilized for a wide variety of emergencies the Commission said, including flash floods, snowstorms, tornadoes, thunderstorms, high winds, gas and other toxic substance leaks, a potential dam break and a "911" telephone outage.

Figures released by the Commission show that the most frequent users of the EBS system last year included WHBC, Canton, OH (50 times), WIMA/WIMT, Lima, OH (46 times), KGNC, Amarillo, TX (34 times), WOHI/WELA, East Liverpool, OH (13 times) and WSLM, Salem, IN (12 times).

The FCC added that with the 1986 totals included, the EBS system has been activated 7,097 times during the past 10 years.

For more information, contact the FCC's news media information office at 202-632-5050.

McKinney Receives Award

FCC Mass Media Bureau Chief James McKinney has received the Commission's Distinguished Service Award.

The award, a gold medal, is presented each year to an employee for "sustained extraordinary accomplishments related to the mission and objectives of the FCC," the Commission said.

In his 24 years with the FCC—the last four in his current position—McKinney has, according to the Commission's 25 March announcement, reduced backlogs, eliminated unnecessary regulations and opened up new opportunities in broadcasting.

The FCC also said that it presented Meritorious Service Awards to Office of Plans and Policy Chief Peter Pitsch, Common Carrier Bureau Deputy Chief for Operations Gerald Vaughan, and Office of General Counsel, Administrative Law Division Secretary Wendy Whitley.

For more information contact the FCC's news media information office at 202-632-5050.

Ownership Form Revised

The FCC has revised Form 323, which is used to collect information about the ownership of commercial broadcast station licensees and permittees, in order to reflect changes in the Commission's multiple ownership rules.

Commercial stations are required to submit an ownership report once a year—usually on the anniversary of filing the station's license renewal application.

Copies of the new form, along with a March notice explaining the changes, are being sent to all commercial stations, the FCC said.

In order to obtain additional copies of updated Form 323, contact the FCC's Operations Support Division at 202-632-7272. For more information about annual ownership report filing requirements, contact LeAudrey Alexander at 202-632-7258.

AES Prez-Elect Dies

New York NY . . . Richard C. Heyser, president elect of the Audio Engineering Society (AES), died 14 March, the AES reported.

Heyser was elected to become the next AES president in mid-1986. His term would have started in October 1987.

Heyser had been an active member of the AES for almost three decades. He had served as governor of the society from 1983 to 1984 and was active in AES's standards work. He had also served as chairman of the Audio Polarity Committee and was a senior editor of *Audio* magazine, and a reviewer for the *AES's Journal*.

Since 1956, Heyser had been associated with the Jet Propulsion Laboratory of the California Institute of Technology in Pasadena, CA, where he was a member of the technical staff. According to

the AES, his work involved communication and instrumentation design for all major space programs, beginning with the conceptual design of America's first satellite, Explorer I.

He had been involved in the application of coherent spread spectrum techniques to improve underwater sound research and medical ultrasound imaging. Heyser had also been awarded nine patents in the field of audio and communication techniques.

"His creativity in audio technology and his service and concern with the AES will be missed by the audio engineering fraternity and industry," the AES said.

At press time, the AES indicated that its board of governors was scheduled to meet in late April to decide on a successor. Contact the AES at 212-661-2355.

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FMX Gets Boost at NAB Show

by David Hughes

Dallas TX ... Proponents of FMX gave the FM stereo extension system a boost at the March NAB show with the formal unveiling of improvements that reduce multipath interference.

There was also news that two semiconductor manufacturers will produce chips for FMX system receivers.

The latest developments, which follow the early March announcement that a new ownership structure—called Broadcast Technology Partners (BTP)—had been formed for FMX development and promotion, have the system back on track, according to Emil Torick, who co-developed the system with NAB VP/Science and Technology Tom Keller.

However, some equipment manufacturers, having shelved plans to show new FMX generators at this year's show, continued to maintain a "wait and see" attitude until they receive more data about FMX improvements from Torick.

New IC chips

At the NAB show, Torick and the NAB announced that two semiconductor manufacturers—Sanyo Semiconductor Corp. and Sprague Electric Co. will make available later this year integrated circuits to equip FM receivers.

Torick indicated that this is the latest step in the plans for commercial availability of the integrated circuits. He said the IC development will permit receiver manufacturers to market FMX compatible FM receivers by early 1988.

With IC manufacturers Sanyo and Sprague on board, "The system is poised and ready to fly," he said.

Torick added that "there are indications that at least one auto manufacturer will offer FMX-equipped radios in the 1989 model year."

Status report

According to an FMX "status report" Torick and BTP released at the show, the hesitation of generator manufacturers was attributed to delays in "the issuance of a final system technical specification which would permit product finalization and marketing."

"That specification," the report said "was never completed or issued—because of the closing of the CBS Technology Center in September 1986. Equipment manufacturers had little choice at that time but to suspend development and marketing plans until the licensing situation could be clarified."

In reference to problems reported in FMX system on-air tests in 1986, the report said that, since then, "several modifications of the system were adopted to resolve remaining technical concerns about system compatibility, especially with respect to multipath reception."

In a speech delivered at the show, Torick said that changes in the noise reduction system have resolved problems of severe multipath-type interference that were reported last year.

He admitted that in past tests, the

FMX system produced bursts of noise characteristic of multipath events, along with bursts of programming.

Along with the technical changes in FMX, there is also new financial backing. In early March, the creation of BTP was announced.

The partnership, formed after CBS's decision late last year to close its Stamford, CT-based Technology Center, where FMX research had been conducted, includes a Detroit investment group lead by consultant John F.X. Browne, along with Torick, Keller, CBS and the newly created NAB for-profit subsidiary NAB Technologies.

"Now that the uncertainties of FMX have been resolved, it's accurate to say that the system is off and running," Torick said in a speech at the show.

Manufacturers react

According to Torick, generator manufacturers have indicated that they plan to "resume testing of their own prototype equipment."

While most indicate that they are waiting for more data on the FMX improvements from Torick, at least one firm is openly optimistic about FMX's future.

Inovonics President Jim Wood said he remains "an undaunted advocate" of FMX. "I feel very good about it."

Since the FMX modifications an-

nounced at the NAB show, Wood said his firm has received "a number of requests, even from some who did not want to touch it before the show" to demo the Inovonics Model 705 FM/FMX stereo generator, which features an add-on FMX option.

"I'm satisfied with the changes," Wood said. "The FMX multipath problem seems fairly comparable with standard FM."

The 705 generator is available in limited quantities now, with the FMX upgrade package available by mid-to-late spring, he said.

Wood added that Inovonics offers buyers of the FMX-capable 705 a two year guarantee that it will upgrade the unit if more changes are made in the FMX system.

Wait and see

Yet other generator manufacturers' representatives, like Howard Mullinack of Orban Associates, said they are still waiting to receive specifications on the upgraded FMX system from BTP.

When Orban does receive the data, Mullinack added, it will modify a prototype generator and conduct lab tests. If those are successful, on-air tests would be scheduled, and if those are also successful, Orban would market an FMX generator.

However, Mullinack said that Orban has urged Torick's forces "to take their time. They only have one more shot."

Circuit Research Labs (CRL) Sales and Marketing Director Ray Updike said that while his firm unveiled a new generator, the SG-800A at the NAB show that is adaptable for future FMX upgrade, CRL is "waiting for more information" from Torick.

While CRL "may get into the FMX business somewhere down the road," Updike said it still had not heard from Torick regarding the FMX improvements.

Aphex Systems Product Manager Jon Sanserino said his firm "has not decided

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New Standard Hailed at Show

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in September 1986, Bonneville International Corporation also cited problems with the recommendations.

Bonneville, a multiple station owner based in Salt Lake City, spoke against the 10 kHz bandwidth limitation and the magnitude of preemphasis suggested by the standard.

Since then, however, Bonneville has withdrawn its objections, according to NAB Director of Spectrum Engineering and Regulatory Affairs Mike Rau. Rau, an NRSC member, said Bonneville initially had been unable to test the various aspects of the standard.

Following testing, however, the company chose to withdraw its complaints, he said.

Outstanding support

Apart from the objections raised by Dorrough, the NRSC standard received many endorsements from manufacturers, broadcasters and government officials.

FCC Mass Media Bureau Chief Jim McKinney, during the convention's AM Improvement session, urged attendees to tell their station owners and managers, "We cannot wait. We have to implement the NRSC standard and AM stereo right now! If we do not, we will continue to lose listeners, share and revenue."

Noting that "the NRSC objective is to obtain technical comparability with FM," McKinney told the audience, "you have a choice to join other AM broadcasters in your area to improve the whole band."

On the show floor, support for the NRSC was "outstanding," said CRL Marketing Director Ray Updike. The company's exhibit floor demo of AM stereo with the NRSC standard compared to FM drew enthusiastic comments.

CRL unveiled four new products at the convention, upgrading its limiters to the NRSC standard, Updike said.

Response from the broadcast community during the show was so great, he noted, that the company found it ne-

cessary to "double the buy" on its first production run of the products.

Updike estimated that "fewer than 1%" of the broadcasters he spoke with during the convention reacted negatively to the pre-emphasis decision. Of those, most objected to reducing the bandwidth from 15 kHz to 10 kHz.

Still, Updike maintained, many of the broadcasters who raised the bandwidth objections changed their minds when reminded that most receivers currently in use have a 3 kHz bandpass.

"I think everyone understands that we need to (implement the standard) to re-establish AM as a viable medium," he commented.

Other processor manufacturers also introduced products at the NAB which are compliant with the NRSC standard.

Orban Associates showed some 10 kHz filter devices, as well as retrofit modules for both stereo and mono 9100 Optimods.

Texar incorporated the standard in its Phoenix digitally controlled audio processor for monaural AM and has redesigned its AMC-1 modulation controller to include the NRSC recommendations.

Aphex also announced the availability in its product line of 75 μ S processing with a 10 kHz stopband filter, although

the company did not directly identify the offering as being compliant with the NRSC guideline.

The adoption of the standard has not ended the work of the NRSC, which held a meeting of its subgroup on methods and procedures on 26 March before the NAB convention to discuss implementation of the standard and research into the "RF mask"—the maximum permissible level of RF emissions from AM broadcast antennas.

According to NewCity Communications' VP/Engineering John Marino, co-chairman of the NRSC subgroup, much of the meeting centered around identification of the problem of spurious emissions and possible solutions.

One of the topics addressed in the meeting was a standard method for measuring adjacent channel interference, Marino said. Use of a splatter monitor was among the methods suggested, he said.

The NRSC subgroup also plans to have the NAB "act as a clearing house" for broadcasters with questions on how to clean up spurious emissions.

Through the association's NRSC hotline—1-800-NAB-NRSC—broadcasters will get help on implementation of the standard. The number will also provide

advice on emissions caused by items such as transmitters, antenna designs and large arrays, Marino noted.

The hotline number has been operational since the second week in April, with a steady amount of calls coming in, according to Rau.

Further antenna emission research

The need to increase the subgroup's body of information on the subject of antenna emissions was also agreed upon during the meeting.

To that end, Marino said, the group has decided to contact consulting engineers, including phasor designers and antenna pattern designers, for their field experiences.

The subgroup also opted to elicit the help of transmitter manufacturers regarding problems likely to occur in older transmitters following implementation of the standard, Marino said. Harris and Nautel have agreed to work with the NRSC in identifying the problems, he added.

The next meeting of the subgroup on methods and procedures is scheduled for 6 May in Quincy, IL, Marino said. The next full meeting of the NRSC is slated for 4 June in Chicago, during the Consumer Electronics Show.

For additional information, contact Mike Dorrough at 818-999-1132, Ray Updike at 632-438-0888, John Marino at 203-333-4800, or Mike Rau at 202-429-5346.

FCC May Issue AM Stereo Statement

(continued from page 1)

have converted to AM stereo. "We have to implement the NRSC standard and AM stereo right now," McKinney said.

"Those who counsel falsely that you should wait a little while longer—wait until more studies are made; wait until the next line of AM stereo equipment is released; wait until more receivers are in your market—those broadcasters are doomed in this age of consumer interest in better quality."

Commissioners James Quello and Mimi Dawson, in a panel discussion at the show, indicated in hindsight that the

FCC's marketplace decision was a mistake.

Kahn Communications President Leonard Kahn, who has refused to discuss the matter with *RW*, was quoted in *Radio and Records*, a trade publication that focuses on radio programming, as saying that McKinney's comments were "Mr. McKinney's unofficial opinion" and not official statements from the Commission.

McKinney told *RW* that he met with Kahn on 13 April. There was no word on what was discussed.

Texar President Glen Clark, whose company filed a petition with the FCC last fall asking for the selection of an AM stereo system, said that while he "can't tell what's in McKinney's mind... (his) quotes leave a pretty clear picture" about the FCC's intentions regarding AM stereo.

Motorola developments

McKinney's comments come as good news to Motorola, which has more than 350 stations lined up in the US, as compared to fewer than 100 for the Kahn system.

In a press conference at the show, Motorola praised a decision by Canada's Department of Communications only days before the show to select C-QUAM as the nation's AM stereo standard.

The firm said that the Canadian decision is expected to "accelerate the production and marketing of AM stereo receivers and the conversion to AM stereo by broadcasters in Canada."

Motorola also announced the introduction of four new AM stereo receiver chips which, according to Frank Hilbert, manager of AM stereo for the company, will "allow us to get into any receiver made by the end of 1987."

Motorola also indicated that its semiconductor division has shipped more than 10 million C-QUAM chips to a total of 40 receiver manufacturers.

The firm also predicted a growth in the number of C-QUAM equipped car radios—from 2 million to 2.6 by next year—and said that it has signed on its 500th station worldwide.

Motorola representatives also expressed frustration at the preception that the AM stereo marketplace has "stagnated," fostered in part by the NTIA's study.

Pointing to its 500 stations, the number of C-QUAM-only receivers, and countries which have chosen a single standard, AM stereo broadcasting manager Chris Payne said, "Why doesn't somebody get the picture here? It's going to be a single system."

When asked if Motorola was cooperating with the NTIA study of multisystem technology in Boulder, Hilbert said the company was providing information the NTIA had requested, but was not sure if it would supply any equipment until more was known about the type of tests being conducted.

Contact Jim McKinney or Bill Hassinger at the FCC, 202-632-6460.

FMX Boost

(continued from page 3)

to go ahead (with FMX) or drop it yet."

While Aphex is also waiting for data from Torick, it is keeping its FMX options open with a port for an FMX upgrade on its Ultra-linear generator.

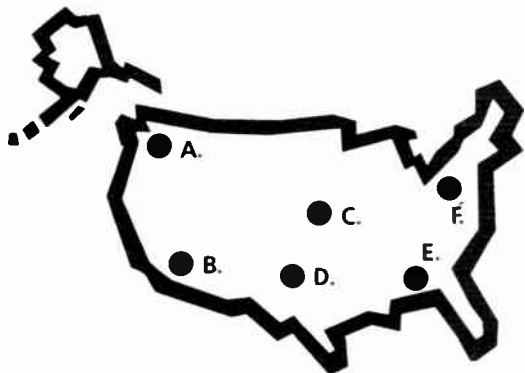
Also at the show, RE Instruments indicated that it will provide FMX test generators for engineering and manufacturing applications.

The convention also featured a demonstration of FMX featuring a multipath simulator, with gear provided by CRL and NAD Electronics, which has an FMX tuner available.

For more information on FMX contact Emil Torick at BTP, 203-622-2643, or Tom Keller at the NAB, 202-429-5346.

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Early days of automation

Dear RW:

"Reminiscing About Automation" (15 February RW) caught my attention. But I have a few additional comments about some of the events.

First let's give Gates credit for the first unit to operate without human hands—the NightWatch. It used a Seeburg and a single tape for announcements.

Dexter Haymond, then owner of KGEE in Bakersfield, CA, commissioned Paul Schafer to build a more elaborate machine that would do more things. It was wired with blue wire.

When I first saw it I said, "I gotta have one." It looked like the answer to many of my problems at KTKR in Taft, CA. One thing led to another and Paul was never able to follow through with the deal we made.

The result was that with the help of Clyde Shaler we built our own machine and later formed the company Shaler-Aitken Communications and in turn produced a number of units.

We showed IGM a machine before they had produced their first working unit. With help from Texas Instruments we built the first integrated circuit automation system. We worked out a scheme to cue the records in the Seeburg.

The last system sold by Aitken Communications (Shaler left the company in 1960) was installed at a station in Lake Isabela, KVLII, in 1983.

So far as I know, only one of the old Seeburg machines is still in daily operation. It is at Show Low, AZ at KVWM. It has been in constant use since 1962. That is a record that will be hard to beat.

A number of the integrated circuit systems are in use. I have an order for a spare part now and then which keeps me posted on where they are and how they are working.

When the big boys began to see what some of us were doing and spent their millions for development, it came time for us to let them have at it. It was fun.

On December 18, 1986, Aitken Communications, Inc. was sold to Metromedia through a Bakersfield branch of the company. Metromedia is now awaiting approval of their sale to Southwestern Bell. I at present will remain as manager.

Kenneth Aitken
Aitken Communications
Taft, CA

More AM concerns

Dear RW:

I wholeheartedly agree with Richard Wagner's letter in the 15 February issue. There are few, if any, decent AM tuners/radios available in the "marketplace."

The discount chains and stereo dealers who display car stereo systems *never* have the AM antenna amplified. I think that my experience is universal when

(continued on page 8)

The NAB is to be congratulated for its 1987 convention. Both exhibitors and attendees were pleased with the upbeat show.

Exhibitors were happy with the number of sales and good leads they got. Broadcasters were in Dallas to buy, not just look.

There were significant product introductions. Compact discs have finally found their place in radio as many companies offered new CD hardware and software.

Also "digital" became more than a buzzword. The industry saw the introduction of the first digital cart machine, an R-DAT prototype was shown and the first AM transmitter with a digital modulator was introduced.

In the area of new technology, the NAB hosted an impressive demonstration of the NRSC preemphasis/deemphasis standard, and described improvements for FMX.

Build On Success

Away from the equipment exhibit, the NAB's Engineering Conference was also well received. The all-day AM improvement session the day before the show opened was well-

attended and many other useful papers were presented.

Since the NAB worked with the exhibitor's advisory committee to resolve many problems that riddled the 1986 show, the result was a smoothly run exhibition.

Next year, NAB returns to Las Vegas. While that city offers conveniences and entertainment that enhance a convention, the exhibit hall itself is still too small for the NAB show.

In the months ahead NAB must work to address the problems that arose the last time the convention was in Las Vegas. Particularly, if the Hilton Center is used for overflow exhibits again, NAB should develop a plan to insure that these exhibits, which were sparsely attended in 1985, get better traffic.

Careful planning could make the 1988 show rival or exceed this year's success.

—RW

Pirates Can Also Be Pioneers

by Bruce Elving

Adolph MN ... The article, "FCC Battling Pirate Stations" in 15 March RW was of interest to this student of the media.

Thirty years ago I had a hand in starting a pirate radio station at the University of Minnesota-Duluth that has grown to become 100 kW KUMD. This is a public radio station, deriving much of its support from the community.

The staff of KUMD recognizes the "extra-legal" start that I gave it with a McGee Radio phono oscillator in the fall of '56, as the date of the station's beginnings, and recently concluded a 30-year anniversary celebration.

The antenna was a long wire strung between two campus buildings, insulated by a Coke bottle. A home-built console was soon constructed, and building space was donated by a sympathetic university administration.

I believe it was a disgruntled engineer who turned the station in to the FCC two years later. The Commission did not even know who to send the complaint to. It wound up at KUMD-AM Minneapolis.

This experience with on-air AM, which had since grown to a 250-watt transmitter and 880 kHz crystal provided the background for going to FM, first on the noncommercial frequency of 89.1, and later, when commercial rock WDTN went silent, the University made the successful bid for 103.3.

Bruce F. Elving, an occasional RW contributor, has a PhD from Syracuse University and publishes the FM Atlas and Station Directory and FMedia! newsletter. He can be reached at (218)879-7676.

Later, like the Louisville translator operator mentioned in the article, I experimented with FM radios and translators.

In fact, I operated such a station and described it in detail to the FCC monitoring office in Grand Island, Nebraska, hoping they would note its legality under Part 15 of the rules, or grant an exception.

Guest Editorial

It took them six months to reply, but when they did, a letter came certified mail demanding that I shut down my "translator."

I then filled out forms and sent to the Commission an application for an experimental license to test very low-power FM translators, and again had the application rejected.

I can point to early television translators that were set up in the mountains of Pennsylvania and Oregon in the 1950s as an example of the pirate-type broadcasting that the FCC finally had to recognize as legitimate, and which subsequently became legal.

A new communications service—translators—was created. It took many years of FM translators on the air in Norway and Italy before the FCC finally consented to legalize such an animal in the US in 1971.

Another source of "pirate" activity can now be found in the mere act of reception. The ill-conceived Electronics Communication Privacy Act makes it a criminal offense to monitor, or even attempt to monitor certain electromagnetic communications.

These include cellular telephone calls and "subcarriers" that are "not readily accessible."

The legislation gives people buying cellular telephones and other users of the spectrum a false sense of security.

It also defies the laws of physics and pays no attention to the innate curiosity of people who like to explore the spectrum simply because it's there.

This is legislation more properly relegated to the days of Nazi Germany or some of the governments of eastern Europe—not for a supposedly free country like the United States.

I am not in favor of unrestricted pirate broadcasting, but I do see the need for continued experimentation via the airwaves in ways that people without access to large sums of money can make a contribution (other than being on a local call-in show) and in ways that do not generate interference.

Indeed, the history of broadcasting in North America is rich with examples of how electronic miscreants have blessed this nation with the fruits of technologies overlooked by government and industry alike.

The Commission is in the process of deregulating call letters, overcoming historical taboos that serve no useful purpose (such as having the Mississippi River divide K and W stations).

I look forward to further deregulation, and the commission's encouraging technologies like amateur broadcasting to the public, ultra-low-power translators with possible program origination, and unrestricted public access to subcarriers on FM radio at 67 and 92 kHz, and TV's SAP and PRO channels.

Let's encourage the FCC to bring deregulation full circle!

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SBE Plans Larger Convention

by Alex Zavistovich

Dallas TX ... Plans for the 1987 national convention of the Society of Broadcast Engineers (SBE) are well under way, and at a 28 March meeting of the SBE board—held during the NAB convention—themes for the event's technical conference and possible new sites for the 1988 convention were discussed.

The SBE also announced that the National Frequency Coordination Council (NFCC) has created a standard data base format for use by volunteer frequency coordinators.

Exhibit floor space for the 1987 SBE show is "selling extremely well," according to SBE Executive Director Andy But-

ler. The number of booths at this year's show will be increased from 220 to 425.

John Battison, who organized the technical conference for last year's SBE convention, is working on a schedule of papers and sessions for this year's event, Butler said.

Recommendations for specific topics and interest areas for the conference are being solicited, added SBE President Richard Rudman. Possible themes include FM technology and AM improvement, he said.

The SBE has come out in favor of the work of the National Radio Systems Committee (NRSC), Rudman stated. He added that the SBE convention would be another good forum for promoting the

NRSC's efforts.

The board also entertained proposals for alternate locations for the 1988 convention. In addition to St. Louis, suggested sites include Lexington, KY, East Lansing, MI, Atlanta, GA and Kansas City, MO.

Butler and Rudman said they anticipated that a decision on the 1988 location would be made at the SBE's executive board meeting in July.

A meeting of the NFCC, which is composed of various broadcasting groups, followed the SBE board meeting. The chairman of the SBE's volunteer coordination effort, Jerry Dalton, has been working closely with the NAB, Rudman said.

A software package is ready for distribution from the SBE to any volunteer coordinator. The package allows a coordinator in any location to call another and download an information file in a consistent, usable format.

In a separate session at the convention, Rudman addressed the issue of spectrum management, maintaining that the FCC's marketplace model is faulty because it "does not take into account anything besides economics."

Rudman contended that the FCC has offered "few, if any, incentives for people to become spectrum efficient."

The SBE is planning to file comment on FCC Docket 87-14, in which, according to Rudman, the Commission is "attempting to take away the bottom 2 MHz of the 220 band" from amateur radio.

"The forest preserve where new electronic knowledge is grown for communications has traditionally been amateur radio," he maintained.

"Any attempt to cut down the spectral trees of 220 and give them over to the chainsaws of land mobile we (the SBE) see as not being in the interest of conservation."

In other SBE board news, Butler noted that the society's certification committee has established a new level of certification.

The program, he said, will recognize "professional broadcast engineers"—engineers with 20 or more years of professional broadcast experience.

Eligibility requirements include recommendation of the candidate by two already certified senior broadcast engineers, Butler explained. The committee is now accepting applications; forms are available through the national office in Indianapolis.

The SBE also recognized a new chapter, number 103, in Nashville, which was chartered 27 March. Two additional chapters—one in Houston, the other in Toledo—are also being formed, Butler added.

In other matters, the SBE's education committee is surveying broadcast engineers regarding educational requirements for successful entry-level work in the broadcast engineering field.

Butler said the SBE is trying to get "as wide and statistically supportable a distribution as possible" for the survey. Names are being drawn from the membership rolls of SBE and SMPTE, as well as from the mailing lists of several publications.

The board also approved a motion from the Ennes Scholarship Foundation to award two \$750 scholarships this year, rather than the single \$1000 scholarship normally granted. Two equally qualified candidates were considered this year, Butler noted.

Two Alpha Epsilon Rho scholarships were granted this year, he added. The awards were presented in St. Louis 2 April.

A resolution was also passed to make the SBE's by-laws committee a permanent committee rather than an ad hoc group. Charles Hallinan, the SBE's founder, will act as permanent chairman, Butler said.

The committee was directed to include proposed by-law changes on the fall 1987 ballot for membership vote. The changes will be published in the next issue of *The Signal*, Butler said.

Rudman noted that the issue of regional representation would not be included in the revisions.

For additional information, contact the SBE at 317-842-0836.

RADIO Classics

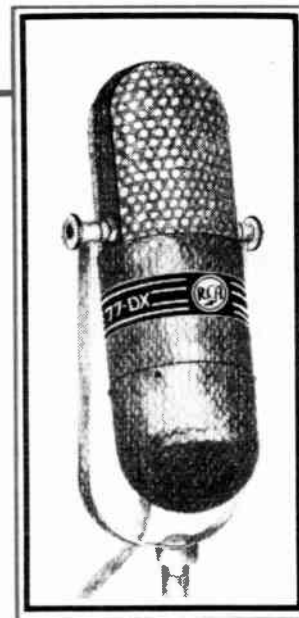
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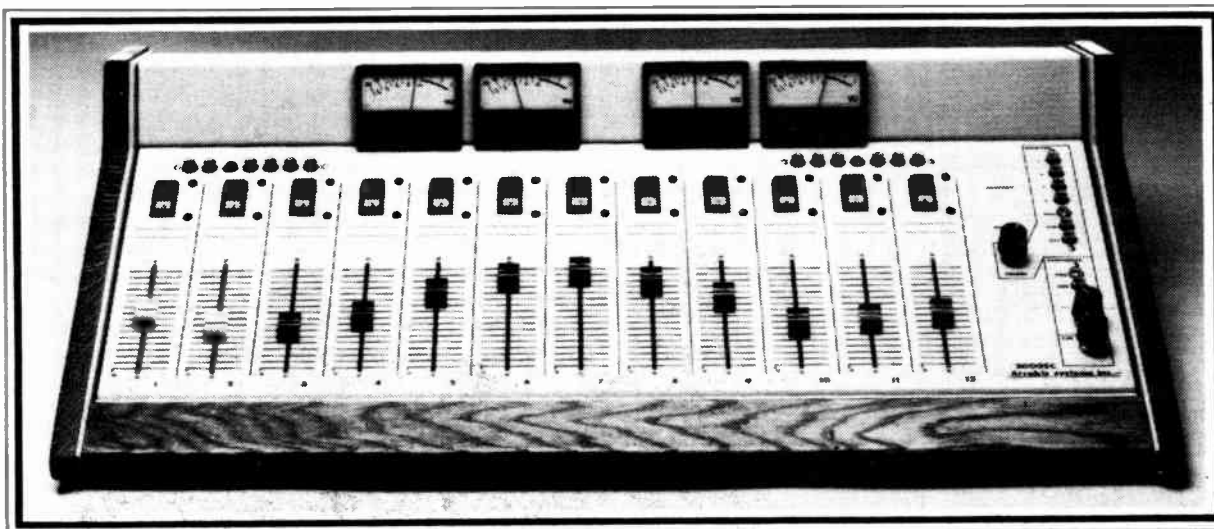


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Circle Reader Service 44 on Page 26

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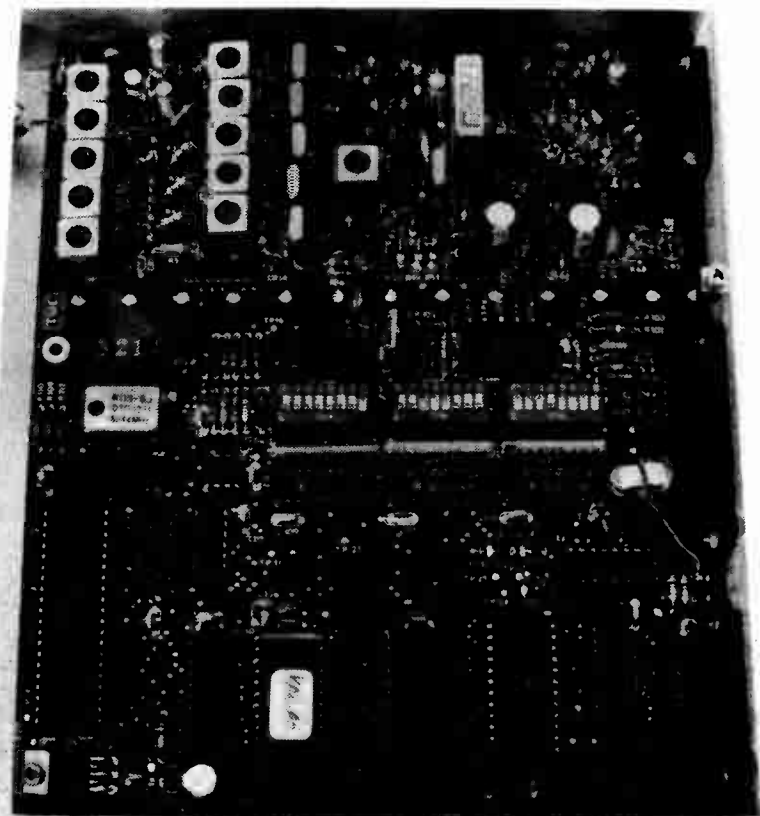
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R-DAT May Be Radio's Future

by Alex Zavistovich

Dallas TX ... The rotating head digital audio tape (R-DAT) recording format, considered by some industry insiders as future competition for compact discs in consumer audio, may also be a successor to NAB cartridges in AM and FM broadcasting.

Sony VP/Product Operations Peter Dare, in a presentation on R-DAT technology held during the technical sessions of the NAB convention, maintained the format will enter the professional industry "in the very near future."

Dare suggested R-DAT "offers the consumer and professional industry a giant step forward in recording technology and performance."

DAT technology allows the recording of several hours of digital stereo sound on an approximately 4mm wide tape. Two different recording systems have been developed—R-DAT and S (stationary)-DAT, and each has its own supporters.

Sony has long been a proponent of R-DAT technology, showing a prototype R-DAT in a private suite demo during the 1986 NAB convention. But the original machine suffered from a number of problems, including prohibitive costs.

Effectiveness improved

Since the introduction of that original unit, the technology's effectiveness has been improved, Dare said, by the development of very large scale integrated circuits (VLSI).

Because both consumer and professional R-DAT machines will use the same

VLSIs, the "economics of producing R-DAT are extremely attractive," he added.

In addition, Dare said, the R-DAT format "has been agreed to by over 80 companies working together to define the format, the cassette and the error correction and concealment scheme necessary in digital recording."

A number of R-DAT operating specifications were detailed by Dare during the

“ “

R-DAT is likely to replace the NAB cassettes currently in use in AM and FM stations.

” ”

presentation. The format's recording procedure is "very similar to a video tape format," he said.

Tape speed of the format is 8.15 mm/S, with a 48 kHz sampling frequency. The number of channels to be recorded, he said, varies from 2 to 4, and cassette playing time varies from 120 to 240 minutes.

The R-DAT system produces "an extremely flat frequency response, no wow or flutter and almost unmeasurable crosstalk." The systems are also able to search to a specific point at extremely high speeds, which Dare said makes the format ideal for automation systems and

"any application requiring 2 channels of high quality audio."

End of the cassette

Dare told the audience, "I strongly suspect that we will see the end of the current NAB cassette being used in studio applications."

"These (studio) applications can be more than adequately addressed with the R-DAT format with performance, quality and economics that the broadcasting industry will undoubtedly adopt," he said.

Sony showed its commitment to the technology at this year's NAB show by introducing a prototype professional portable recorder, the TCX-663. According to Dare, the unit has a search and shuttle speed approximately 200 times the normal playback speed, and a selectable 48 or 44.1 kHz sampling frequency.

Dare told RW in early March, "R-DAT is likely to replace the NAB cassettes currently in use in AM and FM stations." The technology, he said, "will probably lead to FM stations using R-DAT instead of reel-to-reel tapes."

R-DAT is the "first significant change in broadcast audio after about 20 years of cassette and reel-to-reel analog recording," Dare commented. The process affords "fantastic (recording) quality with low maintenance," he added.

Need Good AM Radios

(continued from page 5)

shopping for any kind of receiver (portable, home, car).

The decent AM receiver does not exist, and the stores could care less. And, it won't matter how much noise is made about NRSC if your better fidelity cannot be heard.

It seems to be clearly in the lap of the receiver manufacturers now. We all (or most of us) are doing our part to make the transmission end of things clean and bright.

Now we are waiting for a good (available) receiver. Who will provide it?

A few years ago I spent \$700 on a good communications receiver with selectable bandwidth. It has been discontinued with a new model with less bandwidth taking its place.

All of the AM stations in this country will lose unless receiver manufacturers are forced to upgrade AM radios by law or market pressure. I bet it won't be the latter.

On a related subject, the only radio I can receive at night at home is skywave AM (or shortwave). It is becoming impossible to listen to the clears without interference from the little guys (not to mention the big guns in Cuba).

I guess with urban populations making up the majority of listeners, we in rural America will have to find other means of staying informed.

Too bad that we in the less populated regions of this country are being ignored. The reason for the clear channels was to serve us, remember? I can still listen to the Opry, and the big guns from Cincinnati and Atlanta, but who knows for how long.

Don Mussell, Consulting Engineer
Mouth of Wilson, VA

Ampex Sold For \$479 Million

by David Hughes

Redwood City CA ... Lanesborough Corporation, a privately held chemical manufacturer, will purchase Ampex Corporation from Allied-Signal, the companies announced 6 April.

The purchase price is \$479 million, "plus the assumption of certain liabilities," according to Ampex.

The transaction is expected to be completed by late May, pending regulatory approvals.

Debt financing

New York City-based Lanesborough will "finance the transaction through a combination of its own equity and an offering of debt or equity securities," Ampex said.

"In the interim, Lanesborough has arranged for credit facilities with commitments of up to \$475 million from a major New York commercial bank."

Edward Bramson, president and CEO of Lanesborough, said his firm will "make sure that Ampex has the financial and other resources to continue investing in its future."

He added: "Ampex is a strong company with outstanding capabilities. We think the company's prospects for growth are excellent."

New subsidiary

The Lanesborough/Allied-Signal agreement calls for Ampex to be acquired by a newly formed subsidiary of Lanesborough, which indicated that it will keep Ampex's present management and organizational structure intact.

Allied-Signal Chairman and CEO Edward Hennessy, Jr., said the transaction "will be beneficial" to all three parties. "We are extremely pleased," he said.

Ampex President and CEO Charles Steinberg said he was "especially excited that Ampex will again be operated as a stand-alone corporation."

Allied-Signal announced last December that it would sell Redwood City, CA-based Ampex, which posted 1986 sales of more than \$500 million.

Aside from the manufacture of audio-video equipment, systems and magnetic tape for the broadcast industry, Ampex also supplies tape, instrumentation recorders and core memory systems to the government and aerospace industry.

Allied-Signal said it will also sell six other units in its "electronics and instrumentation sector"—including Sigma Instruments, Amphenol Products, Linotype Group, MPB Corporation, Neptune International and Revere Corporation—to concentrate more on its aerospace, automotive and engineered materials businesses.

For more information contact David Jansen at Ampex, 415-367-4150, Michael Ascolese at Allied-Signal, 201-455-4674, or Edward Bramson at Lanesborough, 212-759-6301.

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AM Dominates NAB Show

by David Hughes

Dallas TX ... The FCC came close to endorsing a single AM stereo standard at the 65th Annual NAB Convention, held 27 to 31 March at the Dallas Convention Center, as broadcasters began rallying around the new NRSC pre/de-emphasis standard.

FM was not to be left out, as the FMX stereo extension system received a major boost with new data revealed at the show that indicated the system's multipath problems had been reduced and with the start of a new development campaign.

Despite unexpected snow and cold winds that blew into Dallas, by the official count 40,388 people—about 1,000 more than last year—took in the product exhibits, sessions and assorted social events associated with the show.

Exhibitors reported heavy booth traffic and brisk sales during the four full days the exhibit floor was open (as opposed to 3½ days last year). While crowds seemed to slacken off a bit towards the end of the show, the general consensus was that things went well.

Attendance at the sessions also seemed strong, particularly at the Friday engineering sessions, which were held a day before the exhibit opened.

NAB Engineer Ed Williams, who organized the sessions, said the NAB's decision to start the engineering sessions a day earlier than in previous years, on a Friday, was successful. "We had blockbuster attendance at the sessions on Friday," he said.

While he admitted that session attendance figures slid a bit on the following days, with added competition from the exhibit floor and the myriad of other activities at the show, he said he was very pleased.

AM stereo

Apart from more details about the campaign to implement the new NRSC pre/de-emphasis curves, which received wide support at the show, the major news development at this year's show centered on AM stereo.

While there was no indication that the FCC would abandon its controversial "marketplace decision," there was definitely good news for Motorola's C-QUAM system.

Only days after Canada formally approved C-QUAM as its national standard, FCC Mass Media Bureau Chief Jim McKinney came as close as the Commission has come to officially endorsing C-QUAM as a de facto US standard.

In a management session, McKinney, while sidestepping any outright endorsement of C-QUAM, said that with the current situation in which all AM stereo receivers receive C-QUAM and only about 3% receive the Kahn system, "if I were a broadcaster, I would not have any trouble determining which one had already won."

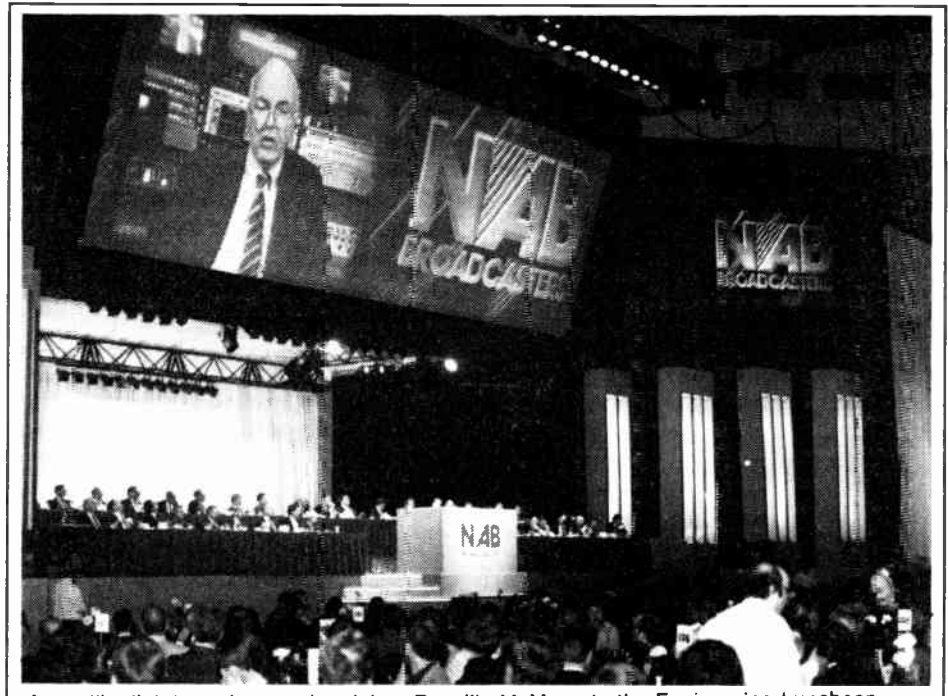
During the radio engineering session on AM improvement, McKinney also said that broadcasters should install AM stereo now, and not "wait until more studies are made," in an apparent reference to the study the NTIA is now conducting on multimode technology.

Commissioners James Quello and Mimi Dawson, during a panel discussion at the show, remarked that the FCC had made a mistake when it left the AM stereo standard to the marketplace.

Addressing the NAB Engineering Luncheon, Rep. Don Ritter (R-PA) argued for a change in antitrust laws that would allow "organizations like the NAB (to be) free to act in the best interest of their members," on such issues as AM stereo.

"Right now, technology may provide the answer via new IC chips that can receive both the Motorola and Kahn AM transmissions," he said.

"The NTIA is doing a study on the viability of such chips. If they work, the problem is on its way to solution but, if not, the industry, hopefully standard driven by the market, not the NTIA and the NAB, should once and for all get together on a single standard," Ritter maintained.



A satellite link brought award recipient Renville McMann to the Engineering Luncheon.

On the FM side, the resurrection of the FMX stereo extension system was big news.

FMX co-developer Emil Torick detailed recent improvements to the system that

reduce multimode-type interference discovered in on-air tests last year.

Torick also announced that two firms, Sprague and Sanyo, would produce *(continued on page 13)*

Digital Cart Machine Unveiled

by Barry Mishkind

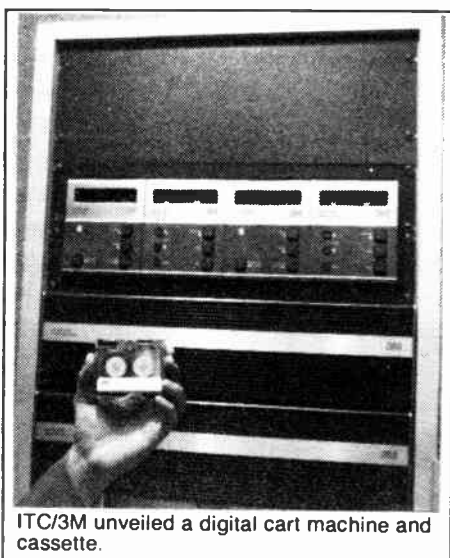
Dallas TX ... The 1987 NAB Convention once again featured many new answers from manufacturers sensitive to broadcasters' desires to achieve ever cleaner audio in the studio.

While there were relatively few brand new machines shown this year, several exhibitors did create some excitement.

The digital cart arrives

One obvious highlight had to be the unveiling of the ITC/3M digital cart machine.

The HCDA-3000 is, in short, a major attempt to push back the technical limits that separate the higher quality cartridge machines from the CD players that seem



ITC/3M unveiled a digital cart machine and cassette.

to be proliferating in the nation's control rooms.

According to the published specifications, ITC has developed a cart deck that should be truly transparent in the audio chain, pushing back, as it has, the residual noise levels down to the immeasurable.

While not in production until the end of the year, this machine will likely find a place in those stations that are seeking to obtain the highest SNR from source to antenna.

It is a bit pricey at \$13,500 for the recorder, and there are some operational compromises as yet, but this machine shows ITC/3M's commitment to future technology.

Interestingly, ITC/3M states that it feels analog cart decks will still be important for at least another 10-15 years.

New life for analog

Another path towards a similar goal of better dynamic range and improved SNR was tested by Pacific Recorders & Engineering. The company had a demonstration in its booth of the new Dolby SR audio processing.

Listening to a third generation tape recording using the SR technology, it was virtually impossible to hear tape hiss at any level, microphone preamp noise being readily identifiable.

The lack of tape overload and other recording effects was impressive, giving new meaning to the phrase "see if you can tell the difference between cart and CD."



Pacific Recorders & Engineering demonstrated Dolby SR with a Tomcat cart machine.

At an estimated cost of over \$2000 extra per machine, though, SR audio processing is still in the testing stages, with PR&E collecting input as to whether the marketplace is ready for it.

Also on view in the Pacific Recorders booth was the new Micromax recorder. It features the company's Maxtrax half-track tape format heads or NAB format quarter-track as an option.

Built-in phase correction

Over at Broadcast Electronics, another new cart machine was creating excitement.

(continued on page 10)

NAB Equipment Report

Digital Day Dawns For AM Transmitter

by Tom Osenkowsky

Dallas TX . . . Every year it seems NAB is described as the "biggest and best ever." Well, 1987 was no exception.

A myriad of products made their debut, and in every category, new and exciting products emerged.

There were some real innovations in transmission gear on the exhibit floor.

Most notable of the new transmitters was the Harris DX-10, a 100% solid state digitally modulated AM transmitter, operating up to 10 kW, with higher powers planned for the future.

An industry first

An overall efficiency of over 80% represents an industry breakthrough, with Harris maintaining that the new design

An overall efficiency of over 80% represents an industry breakthrough.

can save broadcasters thousands of dollars in electric power costs.

Digital modulation is an industry first. Twelve years ago, Harris debuted the world's first solid state 1 kW transmitter, the MW-1.

Now in '87, the company showed the trendsetter of the future: digital modulation with the DX-10.

Harris also introduced its FM-35K, 35 kW transmitter. Complete diagnostics, easy component access, broadband cavity and the ability to instantly "patch around" a problem in the RF chain are featured in the FM-35K, the new 25 kW FM 25K-1 and FM 5K-1 transmitters.

For the transmitter plant, Harris has introduced the Sentinel 48, a CRT touch-operated system featuring user-friendly prompts for status, commands, options and readings.

Both the Sentinel 16 and 48 may be complimented with newly introduced Potomac antenna monitor interface software. This allows automatic tower selection and reading without operator intervention.

Solid state introductions

Continental debuted its solid-state AM 1 kW transmitter, the 314F.

Featuring plug-in modules, full circuit and VSWR protection, the 314F is stereo ready via easy interface and ease of servicing is enabled by plug-in modules.

Another exciting first is the 100% solid state FM 3800 W 814C Continental

Tom Osenkowsky, a regular RW columnist, is a radio engineering consultant and president of MASTER Software. He can be reached at 203-775-3060.

transmitter. Plug-in modules, single phase AC power, and VSWR protection are features sure to get the attention of any engineer, plus 3800 W of solid state FM!

Broadcast Electronics proudly displayed its FM-35A, 35 kW transmitter in actual operation.

Easily operating at a cool 38.5 kW, the FM 35A is fully metered, and with optional CRT displayed diagnostics, represents fine engineering with field-proven reliability.

STLs and other gear

Moseley Associates introduced its PCL-600 STL which replaces the well-known PCL-505. A sleek front panel and exceptional specs make the PCL-600 a sure winner.

Another new Moseley product is the CL-100 TSL. This transmitter studio link eliminates the need for costly phone lines for return telemetry of remote control systems.

Moseley has enhanced the industry-standard MRC-1600 by offering digitally-synthesized voice announcements via telephone link. Alarms, voltages and status are instantly available from any touchtone telephone . . . anywhere.

CCA Electronics introduced two new rack-mount transmitters/exciters for FM broadcasters. The FM-100G is 100% solid state, 100 W rated. The FM-500G is single-tube 500 W rated.

Transmitters often require dummy loads. Altronic Research, based in Ar-



Harris Broadcast's digital AM transmitter is an industry first.

kansas, offered two new dummy loads using heat exchanger technology. These are ideal for situations where a constant water supply is unavailable.

The Omegaline 5800 series features two models, a 25 kW and a 50 kW, both rated for continuous duty.

New wave of antennas

Pinzone introduced a new anti-sky-wave antenna for AM. Although it was not actually at the booth, the CPG antenna features a lower profile and offers a 6 to 10 dB gain over the standard quarter-wave antenna.

Broadcasters in need of towers are advised to check out the new Central Tower line of self-supporting and guyed towers.

Featuring complete computer analysis to meet exact needs and backed by a 10-year guarantee, CTI has introduced an economical tower package deserving of the broadcaster's attention.

Tennaplex introduced an extensive, customized FM and TV panel-type antenna line, specially engineered to meet the market needs of the broadcaster.

Shively's new, larger booth was always full of attendees looking over their extensive line of antennas and diplexers.

FM broadcasters should take note of Kintronics Labs new FM antenna repair service. Any brand or model of FM antenna is readily repaired and retuned in a professional, timely fashion by experienced Kintronics engineers.

And would-be broadcasters, consulting engineers and station chiefs will be impressed with Dataworld's new line of on-line database and service oriented computer access. The newest additions include AM groundwave calculations and FCC-scan specialized searches.

The list of fine products, new and existing, is endless. A "maximum effort" was clearly the key to a very successful exhibition.

New Life for Cart Machine at Show

(continued from page 9)

The Phase Trak 90 not only has circuitry that corrects phase errors on any cart played, it also has a front panel LED display to indicate the amount of correction, thus identifying carts that have problems, even as it makes the corrections.

The new cart machine has a built-in non-encoding patent-pending phase-correction system. The phase relationship between left and right channels is continuously checked while the cart is being played.

The phase correcting is done without

encoding or signal matrixing, so an out-of-phase cart will always be played with the phase corrected, no matter where or how it was originally recorded.

Elsewhere, Fidelipac introduced its new dark grey Dynamax carts to the show. The cobalt oxide tape permits even higher recording levels than hot tape.

The cart body has also been improved, as Fidelipac and other manufacturers like Capitol Magnetics try to deal with the "sticktion" problem that has cropped up in some of the hotter tape formulations and cart decks.

Engineers have reported that as more and more magnetism is placed in some carts, there is a tendency for the tape to cling to itself, which can cause carts to jam.

Also at the Fidelipac booth was the new three-stack Dynamax CTR30 reproducer with built in record amplifier, standard.

More digital inroads

Besides its new cart machine, Otari had its full line of analog reel-to-reels on display, and also showed the new DTR-900 1" 32 channel digital ATR in the PD format also supported by Mitsubishi and AEG.

Also in the reel-to-reel category, one noteworthy product shown by AEG is the Magnetophon 21, a two-track stereo recorder with many interesting features including an LED readout to help in set-



Broadcast Electronics unveiled the Phase Trak 90 phase-correcting cart machine.

ting up the machine and running tests.

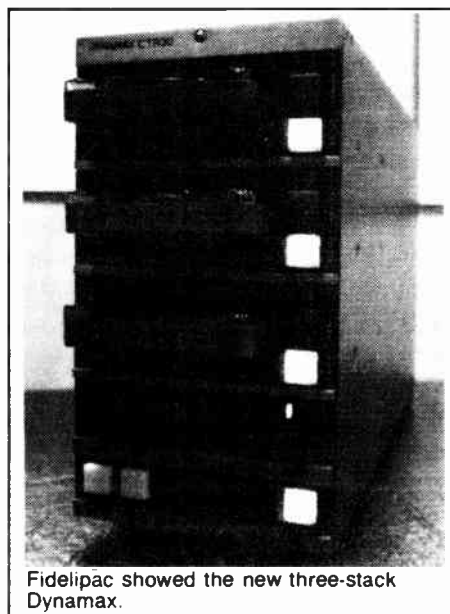
Tascam and Studer also displayed several high quality units. New at Studer's booth was the A820 24-track which also features built-in Dolby SR.

Digital reel-to-reel recorders can no longer be considered a curiosity, although they are still a bit pricey for many stations.

Mitsubishi Pro-Audio had its PD format machines on display, and Sony, of course had its DASH format recorders.

All in all, this year's convention gave evidence that the audio industry is not stagnating, but continually striving for a cleaner audio chain.

Barry Mishkind, a regular RW columnist, is a consultant and contract engineer in Tucson. He has been the cornerstone of RW's NAB convention coverage for many years, and can be reached at 602-296-3797.



Fidelipac showed the new three-stack Dynamax.

NAB Equipment Report

Sessions Stress Improvements

by Alex Zavistovich

Dallas TX ... AM improvement, radio broadcast engineering and the work of the NAB FM Transmission Subcommittee were among the hot engineering-related topics addressed during conference sessions of the NAB convention.

Other items of interest covered during the four-day engineering conference included presentations on RF radiation exposure, FM allocations and management of PCB's in broadcast facilities.

Overmodulation and splatter

In the opening technical session at the convention, a number of papers were presented which covered aspects of AM improvement.

Harrison Klein, of the San Francisco-based engineering firm Hammett & Edison, presented his paper on overmodulation and occupied bandwidth, and its relationship to splatter interference.

phase modulation occur when a transmitter is made to approach 100% negative modulation.

Continental Electronics' Grant Bingham presented a paper explaining modifications to a non-directional broadcast site which would produce a directional gain of 3 dB.

Bingham suggested that one of the antenna's guy wires be used as a "parasitic element," with all insulators on the wire shorted except those on the top and bottom. The guy wire can then be tuned at the base.

In some cases, the guy can be tuned by adjusting its active length, he suggested. After shorting the bottom guy insulator to ground, the desired pattern could be reached by shorting a certain number of upper insulators.

Hilmer Swanson and Robert Weirather of Harris Corporation described digital amplitude modulation, a medium wave technique which improves the efficiency and performance of AM transmitters.



The NAB demonstrated the NRSC pre/deemphasis standard with prototype receivers

dropping of 20 channel reservations would benefit "about 10% of the Class A stations," he noted that raising power may cause second adjacent problems.

"Possibly every application (to raise power) would be mutually exclusive," he speculated.

Other aspects of broadcast technology

were addressed in a separate radio broadcast engineering session, a session which also included a report on the formation of the NAB FM Transmission Subcommittee.

NewCity Communications' VP Engineering John Marino presented a paper

(continued on page 19)



A panel of receiver and processing manufacturers answered questions on the NRSC standard.

Klein studied splatter at the request of the subgroup working toward the NRSC standard, and his paper became an important part of the work which led to agreement on a preemphasis/deemphasis standard.

In the paper, Klein maintained that "the primary cause of splatter interference is not the disappearance of the carrier during overmodulation, but instead is the presence of excessive high-frequency content in the audio signal that modulates the transmitter."

Low-pass filters on the audio before modulation was suggested by Klein as a way to minimize splatter. Other methods included clippers in the processors or transmitter inputs and elimination of DC level shift in AM transmitters.

Klein also urged AM stations to evaluate regularly their modulation performance, and suggested that the AM broadcast industry develop a "high quality synchronous detector AM demodulator for accurate field modulation analysis."

During the same session, Kahn Communications President Leonard Kahn made a presentation on AM theory which took exception to the Klein paper. According to Kahn, "there is no practice that can, under normal conditions, cause more adjacent channel interference than overmodulation of a typical AM transmitter."

Problems of sharp negative peak clipping can occur when an audio signal level fed to an AM transmitter is raised "past a point where the transmitter's output will not decrease," Kahn maintained.

He added that problems of incidental

Digital amplitude modulation converts an input audio waveform to a series of 12 bit digital words by a high-speed analog-to-digital converter, they explained. A read-only memory then encodes the binary words into a form which can be used to switch the power amplifier circuitry.

In a 10 kW transmitter using the technology, overall efficiency was tested to 80%, 60 Hz AC in to RF power out, they said. Harris Broadcast introduced a prototype of just such a transmitter on the exhibit floor.

FM allocations

A presentation by John Furr, of the Texas-based ownership group Clear Channel Communications, proposed the increase of power of Class A FM stations.

According to Furr, research from 1983 to the present shows that such stations could increase their effective radiated power (ERP) from 3 kW to 6 kW, with "no adverse effects on the allocation spectrum."

The increase, Furr contended, would also improve the competitive situation in markets with mixed station classes, and would increase station coverage in rural areas without the need for capital investment and litigation.

Other benefits to be derived from increasing the ERP of Class A stations would be increased penetration of buildings in urban areas, and a minimization of "increased adjacent channel interference during periods of atmospheric inversions."

Although Furr noted that the FCC's

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NAB Equipment Report

Pro CD Players Now a Reality

by Lloyd Berg

Dallas TX . . . The fact that digital audio products were the big attraction at this year's NAB convention shouldn't surprise anyone.

What we all needed to find out was how many of the emerging digital technologies have become an operational and financial reality for the radio broadcaster this year.

CD hardware

Attracting almost as much attention as the ITC/3M digital cart machine (see related story on cart equipment, this issue) is an item that many broadcasters can put into use as soon as it becomes available.



CD "streamers" decorate Century 21's booth.

Denon introduced the DN-950F CD "cart" player. It's called a "cart" player because the CD is placed inside a 1/2" thick cartridge shell of the type used for CD-ROM applications.

Lloyd Berg is CE of WDAE-WUSA. He may be reached at 813-876-0455.

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Circle Reader Service 9 on Page 26

The shell protects the optical surface and allows stick-on labels to be applied. A shutter door opens when the cart is inserted into the player, and closes upon removal.

The player looks and acts like a conventional cart machine and was designed specifically for the broadcast control room (since KIIS/LA CE Mike Callaghan participated in the design).

The unit measures 5 1/4" tall and can be mounted three wide in a standard 19" rack.

The front panel controls consist of a very simple track selector and large stop and start buttons.

The digital counter on the front panel gives the jock the time remaining and a rear-mounted DIP switch programs a dry contact closure when a selected amount of time to the end of the cut is reached. Of course, remote start and tally is provided for.

Denon is presently selecting a US representative that will sell and provide 100% support for this unit. Cost will be about the same as a conventional cart machine.

At the Allied booth again this year, the Audiometrics CD "jukebox" was a featured item. The multi-disc player holds and plays any one of 100 internally stored CDs.

A few of these units could easily contain the total music library for an automated or live assist station.

Studer showed a new CD player this year. The A727 is an updated version of the A725, which, for awhile, was one of the few professional players on the market.

The A727 offers upgraded software, plus a cue-to-music feature.

Studer is also marketing the Philips CD player, as per an agreement announced at last year's NAB convention.

Two other new CD players offered to stations are from Tascam and Technics. Tascam is being low-key about its player, which resembles the ubiquitous Tascam 122 tape cassette deck.

The Technics SL-P1200, displayed as support equipment in many booths, is actually a consumer CD player with many professional features.

Straight Wire Audio offered an upgraded version of its CDQue. The CDQue II has improved features, and SWA is offering free upgrades to the original model.

Digital storage

Digital store and playback audio "computers" are still making a credible showing.

Another interesting item at the Allied booth was the Compusonics DSP-1000 digital disk recorder, also featured at Compusonics' booth.

Based on laser technology, the unit records and plays back audio from a 5" optical disk. Each disk can hold 72 minutes of full frequency stereo audio using 44.1 kHz, 16 bit sampling.

The unit's suggested price is \$6995, but the current cost of the blank disks is between \$99 and \$175 each.

Compusonics also showed the DSP-1500 floppy disk spot player which is meant as a replacement for cart

machines.

Broadcast Electronics showed, as a deliverable product this year, its Digitalk, the DV-2 solid state digital recorder. It stores audio on a RAM chip.

The 3 1/2" rack-mount unit can store six and a half minutes of 6.5 kHz mono audio with a 56 dB SNR.



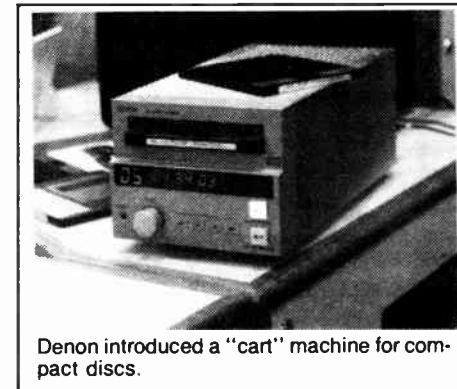
Allied Broadcast showed the Audiometrics CD "jukebox" controlled by the Media Touch Touchstone.

This time can be used to play from one to 99 different events, randomly accessible.

Obvious uses for the DV-2 are network news, actualities, control room jingles, logos or IDs, or to answer telephone calls, weather, sports or concert lines.

The DV-2 can be manually or computer controlled, and has an end-of-message signal that should work quite well with automation systems. The cost is under \$3000.

MEI—Microprobe Electronics Inc. again showed the DigiSound unit. It's



Denon introduced a "cart" machine for compact discs.

basically a rack-mount computer with 1 to 4 megabyte hard disks for audio storage and playback.

Each disk holds 65 minutes of 15 kHz mono audio, broken down into as many audio cuts as is possible.

The DigiSound is intended as a replacement for mechanical multi-cart automation units. But its pricey for the average radio station since it costs nearly \$30,000.

For-A was back again this year with its Sirius 100 hard disk store and playback system. It features up to 1000 minutes of audio storage, with access from eight user locations.

Otari unveiled a hard-disk audio machine as well. It's being marketed by Otari for another Japanese manufacturer. The AF 200 features 33 minutes of audio

per disk drive, and the system can be expanded to include four drives.

If you really would rather not have tape in the studio at all, and your pockets are deep, you might want to consider the DAS-2 digital audio system from Mitsubishi Pro Audio.

Capable of storing up to 28 hours of audio with a bandwidth of up to 20 kHz, and interfacing with the traffic computer, the DAS-2 starts at about \$60,000.

Music programming services are responding to the increased use of CDs at stations, now that there is hardware available in the form of players.

Last year there were production library offerings which this year were expanded to include actual music libraries.

One of the problems with CD libraries was the amount of time it took to press and deliver discs, which precluded their use by stations with current music formats. Another concern was precise cueing.

Century 21, in a booth decorated by "streamers" of CDs, has apparently solved those problems for its customers.

Oldies on CD

The company is currently offering six "oldies" formats: AC, mellow AC, optional AC, CHR and country.

In addition, beginning in July, Century 21 will provide a weekly CD "hits" service that will include all *Radio & Records* "adds," "most active," "breakers," and *Billboard's* "most added" in country, CHR and AC formats.

For cueing considerations, Century 21 is offering AutoSegue CD units which can work with CD players with gas fluorescent index displays.

The AutoSegue transforms CD players which lack remote start, end-of-message detectors and with high impedance -10 dB output into automatic sequencers like cart decks with tight cueing to audio, automatic start of the next event with end of message control and +4 dB output. It costs \$300.

Broadcasters now no longer have to wonder how soon the digital radio station will be available or technically possible.

The 1987 NAB convention provided at least some answers in the form of improved programming products and several pieces of practical and cost-effective hardware, with others clearly on the horizon.

NAB Equipment Report

Convention Zeroes in on AM

(continued from page 9)

FMX integrated circuit chips for receivers.

Just before the show, a new ownership structure, Broadcast Technology Partners (BTP), was formed to continue development of the system following the demise of the CBS Technology Center late last year.

In other FM news, John Furr, CE with Clear Channel Communications, delivered a paper that argued for a blanket power increase—from 3 kW to 6 kW—for Class A FMers.

He said that a plan his firm expects to file with the FCC in the near future will help "all 2,550 Class A stations increase their coverage 40% with diminimus of interference and minimum of capital and legal expenses."

Exhibit floor

In addition to the sessions, lots of new products were featured on the two exhibit floors—with a total of 300,000 square feet. Unlike last year's 3½ exhibit floor days, this year the floor was open a full four days.

R-DAT made its debut in prototype form at least. Sony showed a cassette recorder for the field and a high-speed duplicator using the rotary head digital technology which is starting to gain consumer acceptance.

Sony said that the products shown were aimed solely at the professional market, and predicted actual product availability for the first quarter of next year.

Other digital developments included the introduction of the first digital cart machine from ITC/3M, and several professional CD player offerings.

Also in the digital domain was the first digitally modulated AM transmitter, introduced by Harris Broadcast.

There was also an array of NRSC pre/deemphasis standard compatible gear. Orban featured upgrade kits for its Optimod-AM equipment, as well as the new 9100B Optimod-AM audio processing system. CRL featured new interface boxes, while Texar had a new AM modulation controller.

Serious questions

Despite the overall upbeat mood of exhibitors and heavy booth traffic, there were serious questions raised at the convention about the future of US technology.

In accepting an engineering award via satellite from Connecticut, Renville McMann, formerly with the now defunct CBS Technology Center criticized CBS' and GE/RCA's decisions to "divorce themselves from their labs."

He said that far too many corporate dollars are being used for "greenmail to prevent takeovers," while the firms cannot find even relatively "miniscule" amounts for research.

McMann advocated a spectrum fee to help fund research, and recommended that US equipment firms plow more money into R&D.

NAB President Edward Fritts, in an effort to reestablish US R&D advances, officially announced the creation of NAB Technologies, an NAB for-profit subsidiary that will form partnerships with

firms to foster technology. "This is a small beginning," he said, "but it will grow."

Fritts also said NAB was developing an "internal working group to develop a long-range plan which will lead ultimately to the creation of an NAB Technology Center" which would "have access to the technological enhancements that will keep us competitive."

FCC Chairman Mark Fowler bid farewell at the show; he was scheduled to turn over the reins of the FCC to Commissioner Dennis Patrick on 17 April.

Fowler highlighted his campaign to deregulate the broadcast industry.

While most of Fowler's efforts to deregulate basic technical issues have received overwhelming praise, he acknowledged that many of his efforts that touch on political or philosophical areas, such as ownership limits or cable TV must-carry, are still hot beds of controversy.

For example, Edward Markey, chairman of the House Subcommittee on Telecommunications and Finance, said at the show that "the Commission has

been engaged in a blindly ideological drive to open up the free market, and has been oblivious to the underlying public interest and public trust concepts which are the foundation of our nation's communications policy."

Fowler acknowledged the criticism: "I'm sure there were times some of you wished that, when Umpire Fowler called balls and strikes, I stood *between* the pitcher and the batter, not *behind* them."

However, he added that "what I was hearing was the American public out there in the bleachers—that's what guided my efforts."

Next year's NAB convention is scheduled to be held 9 to 12 April in Las Vegas, NV.



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NAB Equipment Report

"Dueling" Processors For FM

by Rob Meuser

Dallas TX ... Audio processing was as lively as ever at this year's NAB. There was a lot of excitement in addition to all the discussion centering on the NRSC standard for AM (see related story, this issue).

processor, which can store 32 different settings of EQ, compression and noise gating, as well as de-essing.

CRL was far from sleeping. Besides an emphasis on the NRSC standard, the company introduced virtually an entire new line of processing equipment.

The SGC 800 gain controller is a pre-

processor is now the SMP 850. It incorporates sound field enhancement and multi-band pre-emphasis limiting. Several versions of Dynafex noise reduction were also shown.

High quality striving

Dorrrough Electronics had a fully operational display of the digital DAP 610 coupled to the company's stereo generator. The pair was billed as a high quality approach to FM processing.

The Dorrrough Loudness Meter was also shown in many forms. This approach to metering is quite unique, compared to other forms of measurement.

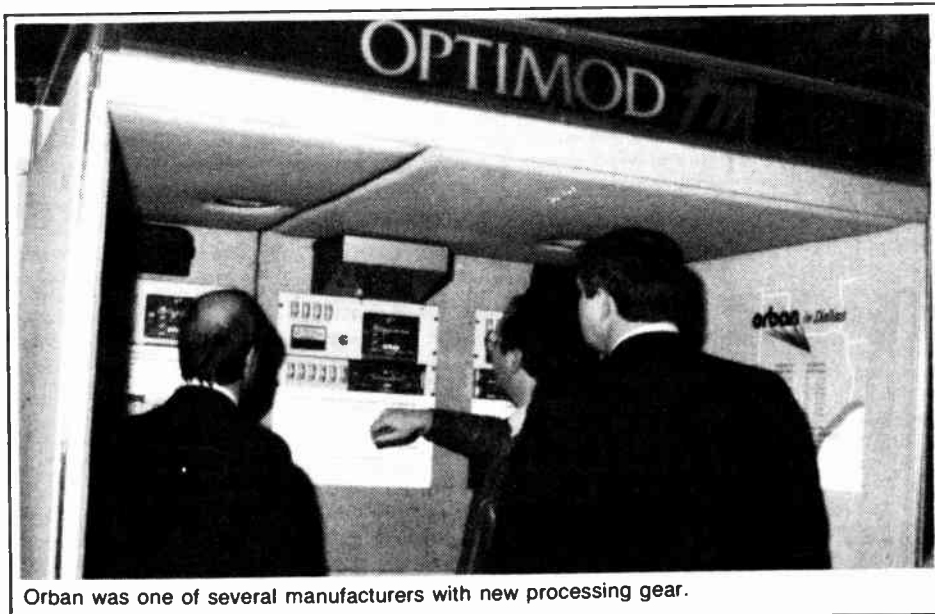
In case you haven't seen them yet, Dorrrough's loudness meters show both a weighted average level, based on both average level and frequency content, as well as a simultaneous peak measurement.

The object in using the meter is to maintain the same average loudness on all programming, without exceeding the peak level. Such operation gives the audio processor a signal that requires it to work least hard for your degree of desired loudness.

Aphex Systems showed the Compeller; an improved Aphex B Aural Exciter and the Dominator, now available as a full blown FM or AM limiter.

The next step in today's processing is stereo enhancement. Modulation Sciences has developed the StereoMaxx, a separation expander that does not use a matrix.

The unit provides automatic control of



Orban was one of several manufacturers with new processing gear.

A new form of entertainment has developed, watching Texar and Orban display each other's equipment.

In the case of Texar, the Audio Prism is often used with the Orban FM Optimod, and Texar even has a new replacement for Orban's Card 5 in the Optimod 8100.

The Audio Prism with Card 5 is said to be a hot item in competitive markets.

At the Orban booth, the new XT2 six band limiter chassis puts more sock into the Optimod 8100 as well.

The new unit has enhancements over earlier XTs including smoother high frequency limiting (some coupling is now used) and two pots that used to be internal adjustments are now on the front panel for presence and high frequency boost.

Orban also displayed the Texar Audio Prism so as to allow for comparison with the XT2 during the course of the show.

The Orban display was setup by Texar engineers, and Bob Orban tweaked up the XT2/Optimod setup at the Texar booth! Proponents of either system, though, all would swear that each proponent had his system set more favorably than was the competitor's.

In any event, they were both powerful and maybe next year the NAB can sell tickets to those who wish to view this high tech duel, with the funds used to defray inflated hotel bills for all.

Stereo introductions

At the Orban booth, sandwiched in between the NRSC battle zone and the Texar/XT2 shoot-out were two new stereo products.

The first was the Co-operator, a studio compressor, limiter, HF processor and clipper. The Co-operator's features and variations are numerous and there are many studio applications.

Also new was the programmable mic

aration processor which includes Dynafex noise reduction and either a pulsed or static noise calibration generator.

The second CRL processor unit is the upgraded SEC 800. It's a redesigned spectral processor with new packaging and a wideband coupling mode.

The former CRL FM modulation proc-

Carnival of Studio Essentials

by Randy Schell

Dallas TX ... It's been a number of years since I've been to Disneyland, and I was really surprised to see they had moved it to Dallas.

Wait a minute ... I know it doesn't snow on the Magic Kingdom. That must have been the NAB convention. That would explain why everyone was trying to sell me electronic equipment ... and why the rides were so slow.

Fortunately, the electronic equipment was great. Just like Disneyland, it's always getting better.

I was in search of "studio essentials," and found a lot of things I wanted to take home, including several items shown for the first time at this exhibition.

Mics for every need

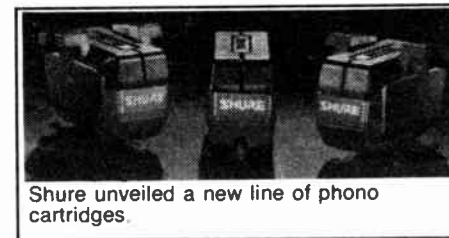
Shure Brothers had two new wireless microphone systems; the W1020 Non-Diversity Wireless System and the W1025 Diversity Wireless System.

The Shure W25DR Wireless receiver features new diversity technology called "phase diversity," and employs a special phase correcting circuit to keep the signals from the two antennas in phase at all times, greatly increasing the effective antenna gain.

Randy Schell, an occasional contributor to RW is president of Schelectronics, a firm which specializes in technical services. He can be reached at 713-558-5121.

User net price for the Shure W1020 System is \$1200; the W1025 Diversity System is \$1700.

Also new from Shure this year was the SM89 condenser shotgun microphone, designed especially for location use.



Shure unveiled a new line of phono cartridges.

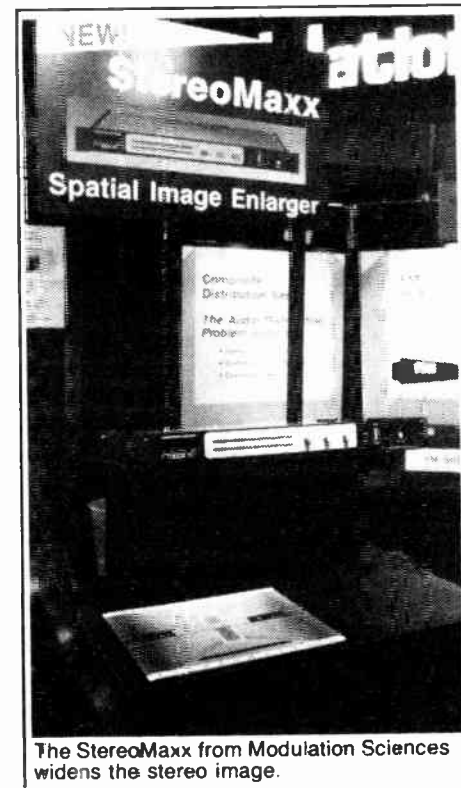
The SM89 has a highly directional polar pattern and fine-tuned frequency response that will discriminate at a distance in favor of desired dialogue or effects and against ambient noise.

It operates over a wide phantom voltage range (11-52 V); features a built-in windscreen for "pop" reduction in close-up use; and comes complete with foam windscreen and Cordura carrying case.

I was particularly pleased to see a new line of phono cartridges from Shure also; the BC70, BC80 and BC90.

According to the company, the new BC series sets a new standard of reliability and performance in phono cartridges, offering professional broadcasters both high fidelity sound reproduction and unparalleled ruggedness to withstand constant backcueing.

Prices on the BC series cartridges are:



The StereoMaxx from Modulation Sciences widens the stereo image.

that mind expanding effect where the stereo seems to come from the rear side windows of your car.

The unit seemed to administer its sonic impact with very few negative effects. A definite must for the engineer who wants to broaden his station's sonic horizons in a competitive market.

Effects of all kinds

Effects and reverb were as abundant as ever this year. AKG Acoustics (which bought Ursa Major last year) introduced the ADR 68K digital reverb.

(continued on page 16)

\$90 for the spherical stylus BC70, and \$126 for either the P-mount BC80 or the 1/2" mount BC90. Both of the latter have elliptical styli.

New amps and DAs

Benchmark Media Systems showed up with a really impressive pair of new audio cards. The DA-102 distribution amplifier is a dual channel device boasting a crosstalk spec of -100 dB at 2 kHz.

Both the left and right channels are switchable between a fixed unity gain and front panel gain control with a range from full off to +20 dB.

Five 60 ohm outputs per channel are driven from the four 10 W amplifiers. The 60 ohm output impedance allows much longer lines to be driven without high frequency loss.

Direct outputs from each amplifier allow build-out resistors to be added for up to 20 outputs per channel total, or they may be used for headphone drives where the lowest allowable load impedance is 30 ohms.

Excellent RF immunity, outstanding common mode rejection, distortion, bandwidth and transient response combine to make a very sweet and easy to listen to amplifier.

Benchmark also showed the MIA-4 microphone preamp card, with exceptional frequency response and distortion specifications.

(continued on next page)

Rob Meuser is TD of CHAM radio in Toronto. He can be reached at 416-526-8200.

NAB Equipment Report

Standard Boosts AM Processing

by Rob Meuser

Dallas TX ... After years of seeming stagnation, AM radio got at least its fair share of attention at the 1987 NAB trade show.

The catalyst for the focus was without a doubt the NRSC voluntary standard for pre-emphasis and filtering.

Receivers modified for the NRSC proposals were on display at the NAB advanced technology display.

A graphic demonstration of second adjacent channel interference with and without the NRSC filters was given. Listeners could sample the quality of both desired and undesired signals using the complete NRSC specification.

Real world hardware

CRL had several NRSC approaches. The company had its own NRSC demo, and showed an upgrade for the SMP 900A stereo matrix limiter, the SPF-300 at a cost of \$495.

There was also on display an adapter for the PMC 300 and 300A monaural limiters, new monaural and stereo limiters with NRSC built in, and the MDF

Rob Meuser is TD of CHAM radio, Toronto. He can be reached at 416-526-8200.

400/800 costing \$295 to \$395 for studio de-emphasis and filtering.

The SPF-300 was said to be usable with other non-CRL equipment.

Urban showed its latest AM entry, the Optimod 9100B/2 with all the toys needed for both NRSC and either Kahn or C-QUAM AM stereo.

There are also retrofit kits for both the 9100 and the older Optimod 9000. These kits ranged from \$395 to \$495, with a trade in program available for the 9100.

Texar introduced the Phoenix, a dedicated all-in-one AM processor with NRSC specifications.

The company also offered the AMC-2 as an upgrade to the existing AM Prism, and with a trade-in of an older AMC-1 the cost is \$200.

The new Phoenix is a complete system, including multiband processing for \$2745. The Super Eagle stand-alone limiter was also shown.

Inovonics had a stand-alone limiter that had pre-emphasis, high frequency limiting, peaking limiting and filtering according to NRSC all for \$520. They are also offering the features in the model 250 AM stereo processor.

Aphex Systems showed an AM version of the Dominator, with both NRSC pre-emphasis and a phase linear low

pass filter. The AM addition is \$600 over the base price for the Dominator (same as the FM addition to this device).

Delta Electronics presented the JSA tri-band processor with NRSC upgrade as well as an accessory unit, newly developed called the Eliminator.

A surprise entrant with an NRSC adapter was Energy-Onix with the AM enhancer-protector. At \$595 it offers pre-emphasis and filtering to connect to any

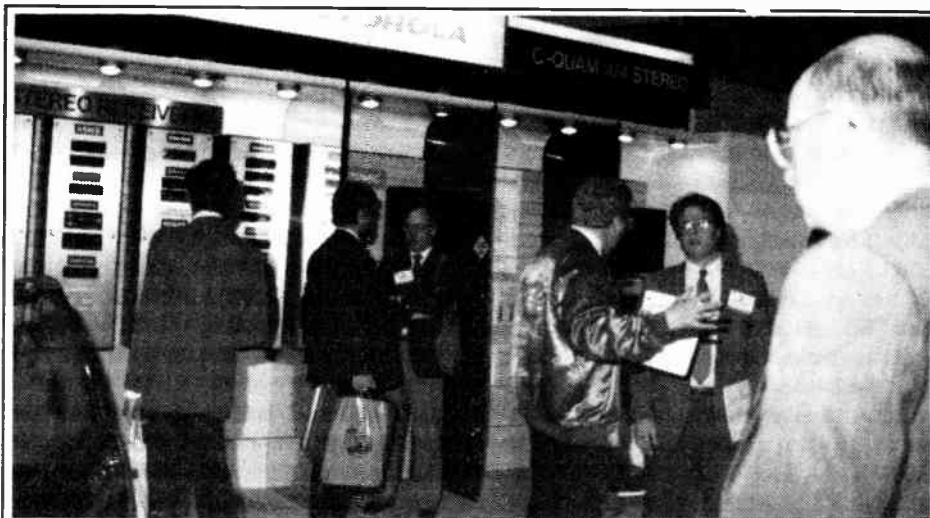
existing processor.

Only one well known audio processing manufacturer was heard as a dissident voice in the crowd. Mike Dorrough had some very strong and personal feelings about NRSC.

He said the old DAP 310 would sound okay on an NRSC de-emphasized radio, and would not (in his opinion) cause interference if adjusted according to his recommendations.

As for the 610, Dorrough was overheard explaining to a customer some filtering might be required and he would

(continued on page 18)



There were new products shown for AM stereo, which is still a hot topic.

Studio Gear Impressive

(continued from previous page)

Well, the guys at Beyer Dynamic haven't been sleeping much, lately. They've been up at night building gear to introduce at this convention. Take a deep breath. Here's what they came up with.

The MCE10 is reportedly the smallest hypercardioid mic there is. It's a condenser that runs on batteries or phantom power. A word of caution: I wouldn't drop this one in a thick carpet. It really is small.

The MC736PV and MC737PV are new, lightweight, very high gain condenser shotgun mics. The 736 is a short shotgun, and the 737 is a long one.

Also on the bill are a couple of new super cardioid vocal/speech mics; the M700 dynamic, and the MCEBO condenser. Both are internally shock-mounted to minimize handling noise, and have extra rugged brass grills.

Completing the list of new mics from Beyer is the M58, an omnidirectional, internally shock-mounted dynamic, designed primarily for ENG applications. This one's particularly well balanced, making it easy to handle for long periods of time.

Additionally from Beyer, and, my personal favorites, are two new pairs of headphones designed specifically for broadcast use.

The DT770's are closed ear construction and list for about \$175. The 990's are open ear, and are about \$10 more. Yes, they seem a bit pricy at first. But, that's before you hear them.

Other studio essentials

JBL brought a new mounting bracket for their 4408 monitor speakers.

It's a rack mount that allows vertical

swiveling. Also new for this year is the Control 1 "personal sized" monitor speaker system with an extremely versatile mounting bracket option.

The Control 1 is magnetically shielded so it can be placed adjacent to video monitors.

New from Crown are three lavalier condenser mics. The GLM-100/ENG and its dual element version, the GLM-100/D are omnidirectional, and the GLM-200/D is unidirectional.

The 100/ENG is battery or phantom powered, and all three have excellent frequency response curves.

Also in the Crown booth was the TEF acoustic measurement system, and, although it isn't a new item itself, there's new software that makes it much easier to operate. Oddly enough, they call it "Easy TEF"

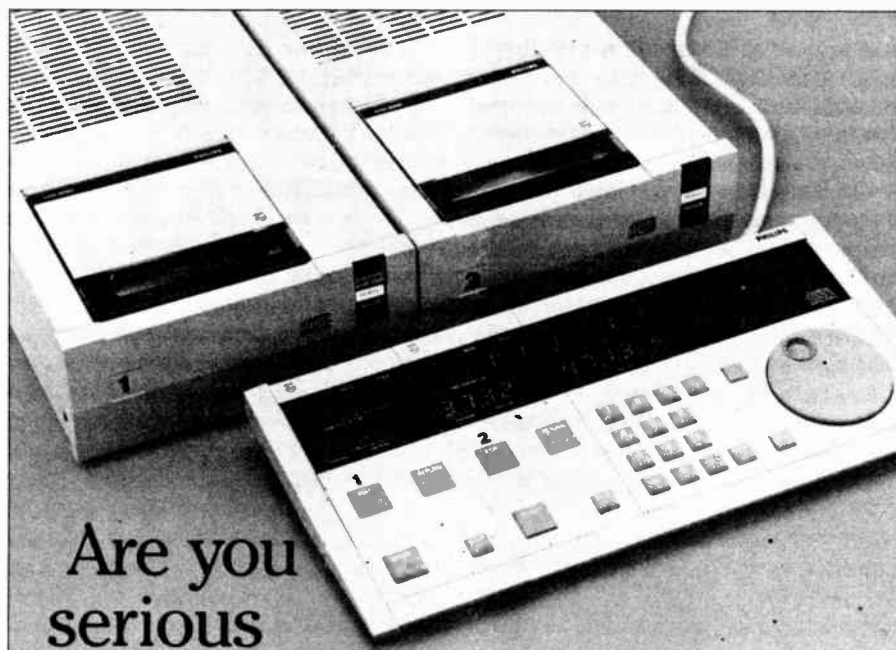
Another innovative piece of "test gear" shown by Crown was LEDR ... Listening Environment Diagnostic Recording. It's a tape used to make subjective evaluations of a monitoring environment.

By listening to sounds "travel" specific paths around the room, a determination can be made regarding at least the more serious reflections within the environment.

This one takes some practice to become proficient at it, but what doesn't? And, at about \$200, it's an extremely inexpensive way to get a look at your listening area.

Obviously, there was a lot more to write about than there is space to write it in. Personally, I loved the opportunity to actually touch all those things I see in my dreams, and lose five pounds doing it.

Oh, by the way, did I mention the talking Mickey Mouse?



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If you're serious about the CD, please call or write: Studer Revox America, 1425 Elm Hill Pike, Nashville, TN 37210; (615) 254-5651.

STUDER REVOX

NAB Equipment Report

Processors Unveiled

(continued from page 14)

Eventide showed a MIDI control interface for the SP2016 along with its established line of reverb, effects and digital delay products.

If you are really into wide stereo, you can now even expand your announcers! Although originally intended for TV, Gotham Audio showed the RSM 1901i stereo microphone. This stereo mic has both XY and MS capabilities.

In the MS mode the original stereo pickup actually leaves the mic in matrix form. You can then process the sum portion for uniform mono and have either natural or supernatural stereo via adjustment of the difference channel.

While not strictly audio processing, the Dolby SR system was back at the Dolby booth, as well as being demonstrated with other analog tape equipment.

There are cards available for Dolby A units, and others coming as replacements for other Dolby units. The aim of Dolby SR is to increase the performance of analog tape as the industry makes the transition from analog to digital.

The digital era has probably had the biggest impact on test equipment more than most other parts of radio broadcast-

ing to date. This year's NAB had its share of digital test wonders.

Audio Precision showed its System One. It's basically a collection of building block test devices that interface with any standard PC compatible computer.

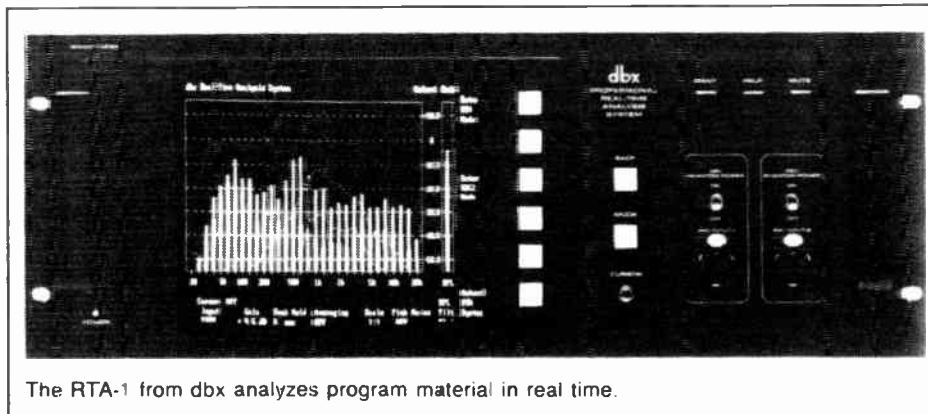
The fully implemented system is cost effective after you really study its various capabilities, which include full stereo test measurements, including input and output channel switching.

The system was programmed at the floor display to automatically adjust a Studer A810 tape machine for various tapes, then print out a complete graph of all measurements.

A similar device was a new unit from Amber Audio. The Amber unit also makes autorange measurements, but has its own LED read-outs (System One requires a computer).

The Amber system can be programmed via an IEEE interface; no software is offered, however.

In the same class of instruments, Rhode and Schwarz showed the UPA audio analyzer. It has a digital display, auto range, distortion measurements, wow and flutter and more. It can be computer controller via an IEC (European standard) parallel bus.



The RTA-1 from dbx analyzes program material in real time.

A totally different set of functions and implementation was found in the dbx RTA-1 real time audio analyzer. The RTA-1 stands alone and supports an IBM color monitor and graphics printer.

In this case the RTA-1 is the micro-computer, and the peripherals merely plug in this unit. The unit also interfaces to various computers via an RS 232 port.

The unit analyzes 10 octaves (20 Hz-20 kHz) in third octave bands.

After acquiring this sonic data, the built-in micro allows for various manipulations and display modifications of the data, including hardcopy print out.

Real-time analyzers are most useful in studio work and audio processing where either wideband response measurements are needed or actual program material needs to be spectrally observed.

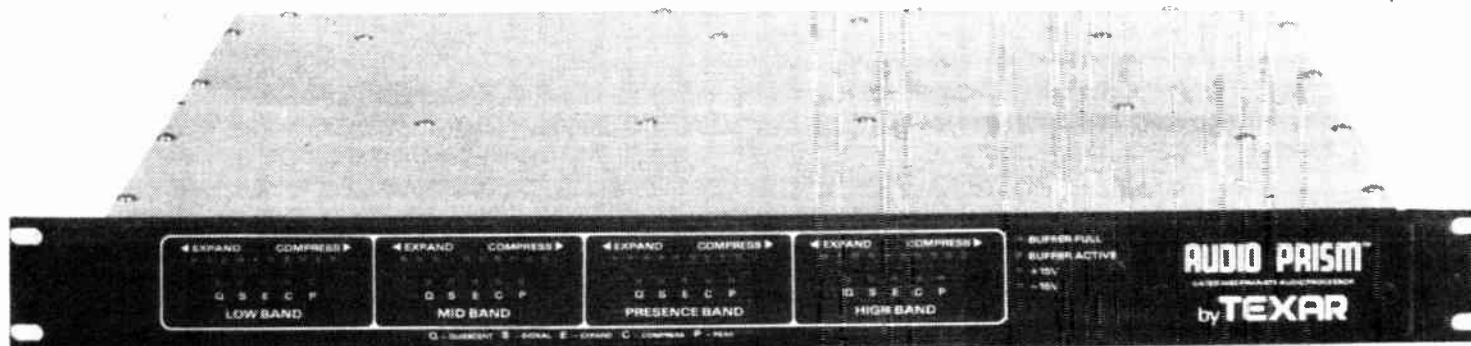
The dbx RTA-1 performs those functions and more with immense ease. A computer driven device will make a big difference on any job where many measurements must be made, or where time is of the essence.

In such instances, you set up the test, the machine does the rest and documents it, even when you're half asleep.

In the non-microcomputer world of measurements, the Potomac QA-1 Quantaural analyzer was again shown. This is an inexpensive highly functional tool for the engineer.

It contains some of the advantages of a real time analyzer and many other functions that don't show up on the more expensive digital units. This unit is as indispensable at the transmitter as the dbx RTA-1 might be in a studio.

STEP UP TO DIGITAL CONTROL.



Staying ahead of the guy next door gets harder and harder. With modulation levels approaching their theoretical limits, the line between competitive audio processing and fatiguing overprocessing becomes finer every day. What's a chief engineer to do?

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NAB Equipment Report

Few Innovations in Consoles

by Michael Callaghan

Dallas TX ... A review of the operating boards at NAB '87 revealed slow progress compared to the surge in TV and digital audio products.

Most of the changes were cosmetic and on the outside, hiding a lack of innovation on the inside.

The usual number of "me-too" consoles were announced, and the only real innovations were in the areas of digital control and the promise of some new editing systems.

Rack-mountable offerings

Pacific Recorders & Engineering introduced a new miniature version of its well-known BMX series console.

The Stereomixer is similar in concept to the company's Newsmixer, a mono board unveiled specifically for newscasts several NAB shows ago.

Designed to be rack-mountable, the Stereomixer will accommodate as many as eight plug-ins. These may be mic input, line input, tape in/out, line selector, EQ/processor, or telco input/mix-minus modules.

Miniature rotary pots take the place of sliders to accommodate the small size, but the unit uses the same control logic and many of the same internal parts as the larger BMX. The price ranges from \$3500 to \$6500 depending on the modules selected.

PR&E is not alone in bringing out a rack-mountable console. Broadcast Audio also introduced a 5 1/4" version for use in remote trucks and small studios.

It features full remote control, and will handle six modules, each with two inputs. The headphone and monitor amps are each fed through a separate selector switch.

Broadcast Audio has also provided some retrofittable upgrades for, and a new custom version of their Series 4 console.

The basic 16 pot on-air board sells for \$11,350, and an additional \$750 will provide a digital clock/up-down timer, headphone EQ, and an auxiliary send system for use in taking phone calls.

ADM introduced the RM1083 rack-mount modular 8x3 mixer with eight mic or line inputs.

New consoles

Dorough Electronics, which started out building custom consoles, has returned to the market with the introduction of the Model 700.

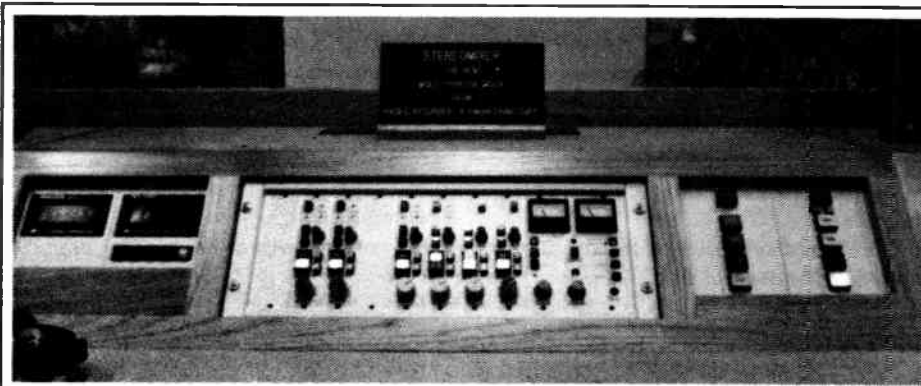
Contained in the board are true lever-type program/audition and mic select switches, a 10 W monitor amp and three mic preamps.

All ICs are socketed, and the unit will produce +26 dBm before clipping. This new board should find a home in smaller operations looking for a good reliable console at an entry level price.

Dorough's new offering follows simple lines, offering seven mono inputs for just \$2200. A stereo version will sell for \$3000.

The best way to successfully launch a new product is to fill a need that's not

Michael Callaghan is CE of KIIS AM/FM. He can be reached at 213-466-8381.



The Stereomixer is a new compact board from Pacific Recorders & Engineering.

being met.

McCurdy, after looking at the competition, has addressed just such a need with its new S series console.

The novelty of it is what it doesn't have, such as no A-B selectors on the input modules, no relays or Shadow-type switches.

There are also no transformers, no motherboard, no cue detent on the Pen-

ny & Giles slide pots, no edge-finger contacts on the circuit boards and no program assignment buttons.

Instead, the modules as supplied are meant for just one source, and the modules will always feed program when switched on. A post-fader audition feed is switched in and out with a separate button.

The console uses a three-input matrix

switcher, and internal switching power supply, and is available with enough options to arrive at just about any configuration imaginable.

I was impressed with the solid feel of the board, and the building-block concept. It means that you needn't buy more than you need to get started.

An example of the thought that went into the design are mid-path jumpers on the module PC boards. You needn't use external jumper plugs to complete the signal path when not using the mid-module in-out loops.

It carries a three-year warranty, which means it can be recommended for purchase without budgeting for parts for a long time. McCurdy Consoles are distributed by Ram Broadcast.

Enhancements, bells and whistles

LPB, meanwhile, showed an enhanced version of the Signature 3 series console with the addition of LEDs to show Audi-

(continued on page 18)

New Hybrids Solve Problems

Dallas TX ... Digital hasn't just become the catchword for audio recording and music playback. Telco equipment went digital this year as well.

Gentner Engineering introduced its Digital Hybrid telephone system at the show. Through the use of digital signal processing (DSP), the hybrid automatically nulls to a telco line on connection.

The DSP also continues to fine-tune the hybrid null during a call.

There are both digital and analog filters to remove line noise, and send and receive processors keep levels constant without AGC "pumping."

This feature helps eliminate one of the problems which has long plagued telephone equipment.

The hybrid is connected via modular jacks, and audio inputs and outputs are XLR connections. Full remote control is possible.

One-time adjustments for caller and send level and caller (reduction) control are behind a removable front panel. The Gentner Digital Hybrid lists for \$1950.

Software and firmware

Gentner also introduced several other products at the convention. The TERM software permits the use of Gentner's



Comrex expanded its line with the PLX micro.

VRC-1000 remote control unit through a personal computer.

The menu-driven software can program the PC to call the VRC-1000 at specific times, look for alarms or data and take desired action. The software is priced at \$195.

Also for the VRC-1000, Gentner unveiled new firmware which is being made available to existing users of the remote control unit through a field update program.

With the new firmware, the VRC-1000 setup can be altered remotely and several other functions can be programmed.

Also new from Gentner was the Tele-mix X, a multi-line on-air telephone system with modular design which allows the user to configure a custom system with off-the-shelf components.



Gentner introduced a digital hybrid.

Extender line extended

Comrex also introduced a new telephone hybrid, and offered upgrades of its frequency extender line.

The TH-1 and TH-2 are new basic and extender hybrid systems. The TH-1 features manual or automatic answering with fully remotable controls. Its price is \$795.

The TH-2 includes all the basic features and adds automatic line leveling and diverta-coupling to interface to any PABX. With a one-line frequency extender encoder and decoder, the extender/hybrid's cost is \$2495.

Comrex also expanded its frequency extender line with new single line (continued on page 20)

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NAB Equipment Report

Consoles Show Few New Tricks

(continued from page 17)

tion and Program feeds.

There are also remote start pushbuttons beneath each pot and a new VU select switch which provides for external metering outputs.

LPB prices are still basically in the same range as for its other established consoles.

Howe Technologies (nee Howe Audio)

provided input.

The ergonomics of the board have an immediate appeal. Curved recesses in the slider knobs provide an excellent feel, sealed spill-proof switches provide tactile feedback, and the color is easy on the eyes.

Two angled backplanes tilt the meter panels and optional equalizers for the best visibility.

console price.

It features full operational logic, two tally relays assignable to any number of functions, and frame and sheet metal work made to the customers' specifications.

Circuitry is state-of-the-art, and mic input transformers are a custom proprietary design.

Each channel includes equalizer and effects send capability that are options on other consoles, and the appearance and feel of the boards are distinctive.

The console is based on the company's proven SP-5 design, and should find popularity among stations that have budgeted for a new high class on-air boards, but would like full production capability as well.

A fully-loaded 18 input version of the SP-6, with 10 mic and eight line level inputs sells for \$22,000.

Other notables

Other console manufacturers showed established lines and offered upgraded versions or enhanced features.

ATI showed a the BC12DSL, a 12-mixer, dual stereo output version of its small board.

Auditronics introduced the 400 Series production console with 12, 18 or 24 inputs and four or eight outputs, plus stereo or mono capability.

Studer unveiled the C279, a compact, low-cost six-input production mixer, switchable to accept balanced mic or mono, or unbalanced stereo line inputs.

Arrakis showed their line of consoles, studio furniture and audio routing equipment.

And Radio Systems showed two new

lines of studio furniture, in operating studio set-ups.

The lack of innovations in console design this year seems to indicate that a majority of vendors seem content to wait for someone else to rock the boat before venturing into new waters.

The notable exception is the digital control concept built into the Radio Resources AllDesign and planned for the Howe Gazelle.

Both of these rely heavily on multiplexed microprocessors to control the audio. But how anxious we engineers will be to turn over our air studios to this technology remains to be seen.

Consoles of the future

One additional new area to watch is the "tapeless studio" concept shown by Lexicon, with its Opus and New England Digital with its Synclavier.

Both exhibit digital recording, mixing, editing and overlay techniques.

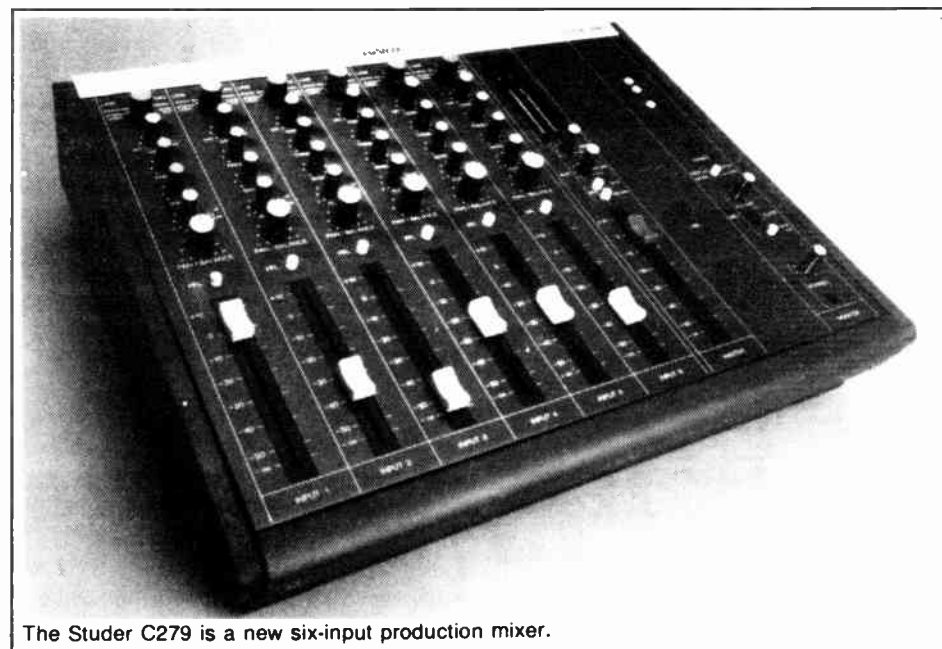
The possibilities of replacing a multitrack facility with a system of this sort is intriguing—no tape to edit, instant search, the ability to resolve to less than one thousandth of a second. We all know what word processors do for text.

Imagine a music or sound processor with the ability to cut and paste, block move, copy and delete, all controllable with mouse and keyboard.

Currently, however, the cost may cause engineers to think twice. The Synclavier starts in the \$50,000 range.

The Opus, which is designed to resemble a production console, will cost from \$130,000 to \$250,000 when a fully operational unit becomes available in November.

As these become more affordable, it's easy to envision our multitrack studios with no moving parts at all, just discs spinning in a closed rack.



The Studer C279 is a new six-input production mixer.

brought a clean sheet to the convention—literally. Literature for the company's new Gazelle console shows a photo of a white sheet.

Design of the new high-range console is currently being completed, and the purpose of the display shell at the show was to gather input from engineers about what features should be included.

But engineers haven't been the only participants in the design process. A number of design specialists have also

An optional liquid crystal display will carry external information, ranging from the weather to personal messages for the air personality.

Howe intends to provide a digital control interface between the console proper and the ancillary audio control chassis. This will use two CPUs in a fully redundant configuration.

Howe expects to integrate the input gathered from the show into the design and have a production version on display by September.

A fully equipped Gazelle will be priced in the upper end of the scale, ranging upwards from \$35,000. Stations interested in the latest audio and computer technology should definitely keep a close eye on this one.

Digital from down-under

In next door's booth, Radio Resources displayed a board made in Australia, called the AllDesign. It incorporates many of the features planned for Howe's new board.

Separate console and audio circuitry chassis are connected digitally, with substantial diagnostic aids included to help in troubleshooting.

Battery-backed power supplies prevent memory loss during brownouts or power failures.

An unusual digital clock indicates time as it would be read on the air. For example, 3:45 appears as "15 to 4." Separate up-timers for the mic and line level modules should help in keeping "talk-ups" tight.

The console will be manufactured in this country shortly. A fully equipped version with 16 inputs will sell for about \$20,000 with an optional readout panel costing an additional \$5000.

Wheatstone introduced the Model SP-6, a production console that features full eight-track performance at an on-air

NRSC Cards Introduced

(continued from page 15)

make it available if requested.

Dorrough (the father of multiband processing) felt very strongly that current problems were started by certain processing manufacturers and now they are restricting future AM radio to solve the problem they created.

His message is that good, clean and simple processing is all that is needed for good AM (or FM for that matter).

AM stereo products shown

While NRSC was seemingly everywhere, AM stereo became somewhat more mature, despite the NTIA recommendation of more multimode research.

Motorola announced a new series of C-QUAM chips, high performance, low voltage (for portable radios) aids to mechanically tuned radios, and a complete stereo IF sub-system on a chip.

The goal is good performance and low cost to manufacturers so as to compete with FM at the set manufacturing level (FM stereo costs 50¢ to implement).

Delta, TFT and BE showed their C-QUAM exciters. BE also showed its monitor, the only alternative to the Motorola design on the market.

Kahn Communications had no new specific AM stereo products, but is definitely buoyed by the NTIA's current study of multimode technology.

Kahn did show several other new

products.

Power Side is a new manifestation of single sideband AM, designed to make a Kahn AM stereo exciter produce a single sideband mono signal on either mono stations or for monaural programs on an otherwise stereo station.

Good and Loud is new packaging of the well known Symmetra-peak and the Non-Symmetra-mod; it creates a dynamically enhanced positive peak.

Also new from Kahn is the Flatterer, which takes either a stereo or mono AM signal (such as that from the sample transmitter from either a Kahn or Motorola type AM stereo exciter), and passes it through a series of RF networks that can alter the sideband structure.

The altered signal is fed to a unit that provides delay equalization, and then develops audio and PM signals which force the transmitter to function as a linear amplifier (via envelope restoration).

The resultant signal is thus designed to be pre-distorted counter to antenna roll-off characteristics.

AM radio was far from dead, at least technically at this year's show. Enough of what was shown was in the prototype stage, so we should look forward to another interesting show next year, by which time receiver manufacturers are expected to have NRSC radios beginning to hit the market.



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NAB Equipment Report

Exhibitors Applaud Changes

by Alex Zavistovich

Dallas TX ... Complaints from exhibitors at the 1986 NAB convention were apparently taken to heart by convention officials—this year's event was generally marked by exhibitor satisfaction with booth traffic and floor management.

Last year, a number of exhibitors listed complaints ranging from lack of air-conditioning service during booth set-up and tear-down to lax security, infrequent shuttle bus service between hotels and the convention center, poor condition of restrooms, and broken escalators.

Prior to this year's show, however, the NAB exhibitor's advisory committee and convention officials worked to remedy the problems, particularly in the set-up and tear-down of the exhibit area. Three or four floor managers were on hand at the exhibit area to address any difficulties arising in the process.

Irwin Ungerleider, the new chairman of the NAB exhibitor's advisory committee, said a committee meeting held on the morning of the convention's last day generated no negative comments from attendees.

Much of the meeting, he said, was devoted to paying tribute to the efforts of NAB Exhibits Director Ed Gayou, who has organized the association's spring convention for the past 30 years.

Earlier this year, Gayou made public his decision to retire following the spring convention. The NAB has appointed Richard Dobson to replace Gayou, and also plans to move its exhibits office from St. Louis to its Washington DC headquarters.

Ungerleider stressed that, although no one had any complaints about the exhibits during the advisory meeting, it did not necessarily mean that there were no problems.

At press time, the advisory committee was expected to make a formal announcement about the convention by mid-April.

Still, Ungerleider said, "at this time, it appears that all is well."

"Badge Police"

Not all of the problem points raised by exhibitors last year were completely remedied this year, however.

One exhibitor maintained that complaints about security during the 1986 convention led the NAB to overcompensate this year, instituting what he called the "badge police."

Security guards at the convention this year scrutinized the badges, he said, detaining attendees who placed their business cards inside the badge sleeve. Many were required to prove their identity before being allowed inside.

The exhibitor pointed out that comments about lax security last year were not leveled at who was allowed into the show, he said. Rather, exhibitors were concerned about unwanted hangers-on after the show closed each day.

Still, on the whole, most exhibitors seemed pleased by the booth traffic and interest generated by the exhibit.

CRL Sales Director Ray Updike's comments were typical. He said that, compared to last year, the 1987 NAB show was "an order of magnitude improved."

Traffic on the exhibit floor was "ex-

tremely good," he added, estimating that business this year was "ten times greater than it had been last year."

His company had no problems with booth set-up, tear-down, or security during the show, Updike said, although he too mentioned that the guards detained some visitors and, in one case, ejected an exhibitor guest from the show.

Great cooperation

Ampex Show Manager Bob Schwartz said his company got "great cooperation" from convention center personnel, and had neither problems nor setbacks on the floor.

After some initial difficulty "locating the perimeters of the booth," Schwartz maintained that set-up went smoothly. He said ground cable and carpeting were already laid down by the time Ampex was ready to bring in its display equipment.

Another Ampex spokesman, Dave Detmers, added that the company was "swamped" by booth traffic on all four show days.

"This was a record NAB (for Ampex)," Detmers said. He added that the company exceeded its last year's sales by over \$1 million.

Likewise, Harris Broadcast Group spokesperson Martha Rapp said her company's booth set-up was "smooth and on schedule," and Harris received

(continued on page 20)

Sessions Cover AM, FM

(continued from page 11)

on the formation and goals of the NAB FM Transmission Subcommittee. The group, he said, is striving to prevent the "AM-ization of our FM service," in particular, by minimizing interference problems.

FMX, a system designed to extend the stereo service area of an FM station, will be investigated by the committee, Marino said. Another research area will be the competitive positioning of Class A stations against Class B or C facilities.

Marino noted that a proposal to create a so-called "FM2 band" in the 200 MHz range will also be examined. According to its proponents, the new FM spectrum would enable AM daytimers to improve service to its listeners by moving to the band, he said.

The FM Transmission Subcommittee will also examine the use of directional FM broadcast antennas for added interference protection, Marino added.

Synchronous transmitters

Harris Corporation's Robert Weirather, who earlier presented a paper in the AM improvement session, also provided information on broadcast AM synchronous transmission, and described how the method used in the US is different from that used elsewhere.

A number of factors may prompt the use of synchronous transmitters, he said. These include natural or manmade obstructions, nulls in the antenna pattern and co-channel or adjacent channel interference.

Synchronous operation is made more complex when broadcasting in AM stereo, Weirather added, because both the ISB and C-QUAM methods use low frequency pilot tones for the stereo signal. The pilot tones may therefore also need to be synchronized.

Thomas Osenkowsky, a Connecticut-based engineering consultant, described in his paper the use of microcomputers in understanding array operation and improving directional antenna efficiency.

He presented BASIC language programs for computing alternative arrays, analyzing tee network parameters and

transmission line data, including phase shift.

James Paffenbarger, of the University of Michigan Public Radio Stations, outlined the use of SCA subcarriers as a means of minimizing FM stereo degradation.

Paffenbarger urged receiver manufacturers to "incorporate designs that optimize crosstalk performance throughout the 53-99 kHz baseband spectrum."

Environmental and health concerns in a broadcast situation were also discussed during the conference session.

Management of polychlorinated biphenyls (PCBs) was explained by Jack Pfrimmer, of General Electric. According to Pfrimmer, the Toxic Substance and Control Act charged the EPA with creating rules on the use and servicing of PCB transformers.

PCB transformers must be inspected quarterly for leaks, he warned. Repairs must be initiated within 48 hours, if a leak is discovered.

Equipment containing PCB material, including large, high-voltage capacitors, must carry an EPA-specified "large mark" warning, Pfrimmer warned. Disposal of the PCB equipment is best handled by licensed hazardous waste disposal companies, he added.

Thomas Vaughan of Micro Communications presented a paper on measurement of occupational RF radiation exposure on broadcast towers.

A number of problems are associated with making power density measurements, he said. Measurements are usually not made from any single radiating antenna, and equipment normally used measures the signal not only from the antenna, but from all other reflecting sources.

Vaughan also described the EPA's six minute time-averaged rule for RF exposure levels. The guide permits exposure of 1 mW/cm² over six minutes, or 6 mW/cm² for one minute.

If done within certain specified time limits, he said, the exposure standards would enable a tower rigger to climb through even a high RF region on the antenna.

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NAB Equipment Report

New Telco Hybrids Introduced

(continued from page 17)
systems.

The PLXmicro encoder is a one-line unit for news, battery operated, and small enough to fit into a briefcase or attach to a portable cellular phone. It has a built-in coupler and monitor jack, mic and tape outputs with AGC and optional AC power, and its price is \$995.

The Comrex BASICplus is similar to the frequency extender the company in-

troduced last year, but with a built-in telephone coupler and balanced input and output added. The LX-R plus encoder and decoder each cost \$595.

Another new telephone hybrid was introduced by Symetrix. The 109 auto-null hybrid is a single-line hybrid which is designed to interface audio equipment to two-wire telephones.

Advanced Micro-Dynamics showed its TC-8 remote control with full logging

capabilities. The full studio unit now has also added speech capabilities.

A synthesized voice gives readings and status. The speech option is an add-on being offered at the introductory price of \$395. The TC-8 also can be controlled through a personal computer.

Advanced Micro-Dynamics also introduced its composite FM DA. It features four totally isolated outputs which drive 100' of coax, and has extremely low

noise and distortion.

And an interesting product in the category of phone equipment was introduced by DSI Communications in the Ram Broadcast booth. It's an automatic contest answering device called the contest computer.

The winning caller number is pre-selected and programmed in with a front panel thumbwheel switch before the start of the contest. Once started, each call is answered with a computer-digitized human voice.

Non-winners are told "Sorry, you are caller number . . .". The voice advances the number for each answered call, and the computer keeps a tally on the front panel.

The winning call is automatically routed to a rear panel jack for connection to a standard phone or hybrid, and is treated like a regular call by the announcer.

There is a printer port for auto-logging of calls, and custom phrases are available as an answer option.

Praise From Exhibitors

(continued from page 19)

"good cooperation" from the convention center.

Booth traffic was higher than in previous years, Rapp pointed out, noting that exhibit attendees showed increased interest in new products this year.

Asaca Marketing Director Alan Davis also commented that booth traffic and sales were "very good." The company sold a cart system on the floor, he said.

Davis saw no problems on the show floor, noting that set-up and tear-down ran smoothly and was easier than last year. Union labor was efficient, he said, and Asaca's request for an extra line for power was answered by an electrician who arrived within five minutes of the request.

Although Davis said the Dallas convention center staff did a good job with the show, he added that he hoped the NAB would sign a permanent contract with the convention facility in Las Vegas.

"Hotels and restaurants are more accessible there," he said, "and the floor space is all on one level."

At least one other exhibitor was also looking ahead to Las Vegas as a future site for the NAB convention. According to ITC/3M Market Development Advanced Administrator Bill Parfitt, although booth traffic was "excellent," the size of the Dallas exhibit area was somewhat cramped.

"Our (ITC/3M) booth is designed for a space twice the size of what we had in Dallas," he said. ITC was unable, therefore, to increase the size of its display to highlight the new products it unveiled this year.

Parfitt commented that the problems of last year's show were overcome this year. His company is looking ahead to next year's convention in Las Vegas, but he declined to make comparisons.

"We don't know what's going to happen in Las Vegas next year," Parfitt said. "We're adopting a wait-and-see attitude."

For more for information about the exhibitor's advisory committee contact Irvin Ungerleider at Sony: 201-833-5200.

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Find Surprises Before Buying

by Tim McCartney

Boise ID . . . The product that was on display at the NAB does exactly what you need, its design is excellent, price is right, proprietary parts are minimal, and you have ordered it.

Your homework prior to ordering was appropriate, but not the full-blown level of research you would have preferred.

As you remove the product from its packaging, the real adventure begins and the inevitable surprises surface.

The book

The first surprise is that a technical manual does not come standard, but rather as a \$25 option.

While this is a disappointment, it's better than the other possible surprise at this point: schematics are not available at any price: the manufacturer's five-year replacement policy means your repairs in the field aren't needed (or allowed, under the terms of the warranty).

Regardless of whether the manual is for operating or technical functions, a possible "extra" is the multitude of languages provided including a poor English translation.

A detailed lesson in how to use the book may be needed if its writers have not heard of the modern concept of indexing.

An interesting point to check in the book is whether or not the company's phone number is provided.

When it is not, one cannot help but wonder what the underlying message may be. Do they move a lot? Are they listed in directory assistance? Do they hope we won't call?

The lesson here is that a preview of these manuals before buying is an effective way to learn a lot about the rest of the adventure to follow.

Testing: you or them

In the interest of economy, some firms increasingly allow product testing to be conducted in the field rather than by their own quality control departments.

It's hard to know if this practice is still spreading each year, but statistics compiled by KBSU point to a current typical situation.

KBSU spent many thousands of dollars on 77 individual pieces of broadcast equipment, each costing over \$50, from August 1986 through March 1987.

The items include an audio processing system, reel and cassette decks, portable recorders, satellite downlink system, studio timers, distribution amps, printers, CDs, receivers, amplifiers, speakers, microphones, mic mixers, headphones, intercom mic, telephone interfaces, turntable, turntable preamps, oscilloscope, oscillator, distortion analyzer, AC voltmeter, frequency counter, multimeters, electronic thermometer, printer and remote control system.

Of these 77 units, six arrived defective, three more needed repairs we could accomplish, and three more developed problems within a couple of months. That amounts to an 84% success rate overall—certainly a passing grade.

Tim McCartney, CE, KBSU, Boise State University, is a regular contributor to RW, an SBE Broadcast Engineer, has a masters degree in human resources development, and is a former GM. He can be reached at 208-385-3663.

The lesson here is that more information is needed about which manufacturers regularly make up those other 16% that allow us to do most of their field testing.

It may be difficult to obtain, but communication can certainly help.

Customer service

If the product is vital to the station, such as exciters and transmitters, a 24-hour "tech alert" service is essential.

Only in the middle of the night will we find out just how alert the service really is.

When repairs are needed, it's comforting to know that the firm is geared up to meet these problems. One concern is its policy on, and charges for, loaner units.

Then there's the question of paying for the repairs. Will the company insist on COD terms? Will they refuse university purchase orders numbers? Or, will they be fair and allow net 30 terms?

When the firm makes a mistake in its customer service, does it deal squarely and openly with the problem or, does it withdraw into a Water/Trangate coverup stance?

Can these problems be resolved by working with customer service personnel or does the CEO need to be contacted before any action begins?

And a thunderous, group-sponsored hip-hip-hooray is in order for those firms with toll-free phone numbers!

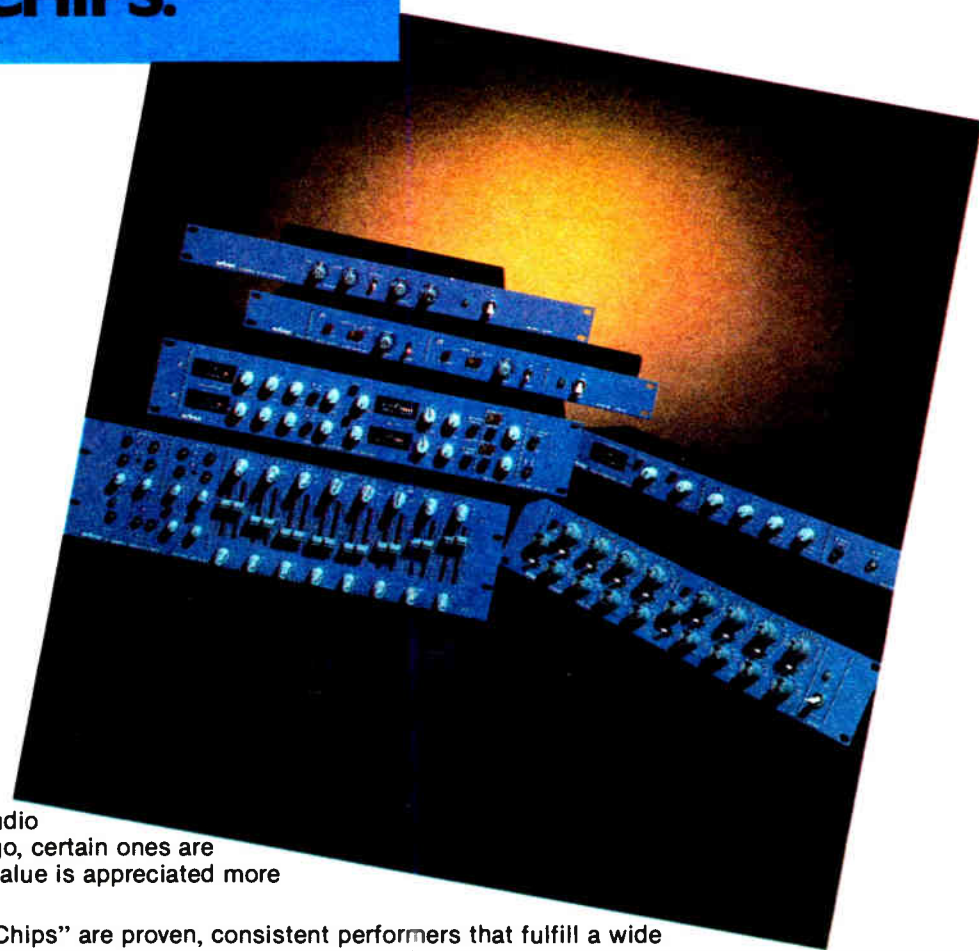
The lessons here are to at least consider each of these areas before buying.

It's also important to know what the warranty covers, does not cover, and for how long.

The firm's reputation for product reliability is essential. Reliability is a key issue with STLs and broadcast chain items; it needs to become more of a key issue with other products.

(continued on page 22)

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Circle Reader Service 40 on Page 26

Giving Yourself a Promotion

by John Q. Shepler

Rockford IL ... It's one of those gray days. You're down in the dumps again. Why? Oh, the usual. Too much grief and too little in return for it. People just don't seem to appreciate the effort.

Why, you busted your buns all night last Sunday and the front office staff even sneered when you checked in two hours late Monday morning.

Don't these jokers know how valuable you are and what would happen if you weren't around anymore?

Nope, they don't. And they probably won't either unless somebody makes sure they find out. That somebody will have to be you.

Bleak future?

Broadcast engineers are a misunderstood lot. At best, you're the guy in the back room who fixes the transmitter when it blows up. Good 'ole dependable so-and-so.

At worst, they think you're the nerd with the pocket full of screwdrivers who gets his jollies booby-trapping the equipment so that the guy on the air looks like a fool.

Often, it seems that the most appreciation you can expect is the privilege of getting to keep your job for another year.

If you've haven't hacked anybody off too badly and the corporation is still afloat, you might even get a few bucks more next year.

What a dismal prospect. Slog in, dodge the flak all day, and slog out at night. Day in—day out. Year in—year out.

What you need is something better. What you need is a promotion. Since nobody appears to be jumping up to give you one, I guess you'll just have to promote yourself.

What a promotion is

There are three types of promotions. The first type is the most familiar. This is the loud festive type whereby you are elevated to a higher position in the pecking order.

With a great deal of fuss and some embarrassment, you get a fancier title, a bump up in the paycheck, maybe a nicer office, and always a lot of sincere and semi-sincere compliments.

This is the type of promotion we all

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

crave. It is also the most difficult promotion to come by in broadcasting.

Let's face it. Where do you go after Chief Engineer? In most stations the next job up is General Manager.

Are you GM material? Would you even want to be?

The problem is the size of the companies. When you have only 25 or 50 people in an organization, there just aren't enough high-roller jobs to go around.

There is one potential opening. That is the position of Director of Engineering for a chain of stations. This may or may not be a good move depending on your interests.

Q-Tips

The negative aspect of having to travel away from home so often may counterbalance the extra income and status you'll receive.

More than one way to get promoted

The second type of promotion is one that you go out and make for yourself.

Through contacts or job ads, you locate another station that is willing to give you more money, better equipment, nicer people to work with, or whatever else you consider an improvement.

Then you shake hands with your new employer and consider yourself promoted.

There is a third and more subtle form of promotion that you control totally yourself, and which may even lead to one of the above types of promotions. In effect, you are promoting yourself.

This type of promotion is a do-it-yourself activity. You put as much or little effort into it as you care to. Your employer doesn't have to help or even know that you are doing this.

How to promote yourself

What you are going to do is to elevate yourself to a higher position without anybody else's permission.

Oh, you'll probably have to do most of the same things you're doing now in your job. There won't even be an immediate pay increase.

However, over time people are going to develop a new and higher opinion of you, to match your new position. That is when you'll reap the material rewards as well.

By the way, this promotion takes effect when you go into work tomorrow morn-

ing. At that time, you will no longer be the poor grunt that hauls equipment around.

You will have been promoted to the status of technical professional, business executive and industry leader. So, look and act the part.

Necessary changes

Here is a whole list of changes you'll want to make as the result of your new promotion:

•**Attitude.** Since you have just been promoted, obviously you are doing a great job.

You don't have to resort to small minded verbal abuse and back-stabbing like those who don't qualify to move up. You're above that. You are now in a position to ignore the jerks.

•**Office and Shop.** Someone of your stature can no longer tolerate a disorganized work area. Books, parts and tools will be filed away neatly. Only the equipment you need for the job at hand need be out in the open.

When others come to visit, they will wonder who gave you such a nice place to work while they still have to struggle in a mess. They may even accuse the GM of favoritism.

•**Quality of Work.** Only the best is now good enough. Professionals like yourself don't have to kludge junk together. They do neat and thorough work that will hold up for years.

They refuse to be pressured into doing a sloppy job by someone who is obviously of a lower calibre.

•**Equipment Purchases.** Since you are now a business executive as well as a technical expert, you're in an excellent position to choose the best equipment for the job.

The best is not always the most expensive, but it certainly isn't always the cheapest either.

Of course, you're easily able to make a case for better equipment by showing on paper how the right equipment will pay for itself by lasting longer and needing fewer repairs.

You can talk business terms such as amortization and return on investment to convince other executives that you have done your homework.

•**Professional Credentials.** Ever look at the walls in a doctor's or lawyer's office? They're always plastered with diplomas and certificates of accomplishment.

If clients start to wonder about the professional's qualifications, all that fancy paperwork puts their fears to rest.

Your credentials should also be displayed prominently on your office wall.

These may include a lifetime FCC license, SBE and NARTE certification, two or four year college degrees, an amateur radio license, commendations for civic projects, copies of articles published, and certificates from seminars and short courses.

•**High Visibility.** As a member of broadcasting's elite, you'll be a lot more visible in the industry. Certainly, you'll attend conventions and regional conferences to keep up on what is new.

You may chair discussion panels at some of these conventions or present a paper you have written. When you come up with a better circuit or technique for accomplishing some task, you'll get national recognition by writing a short article for publication.

If you are part of a group of stations, take the lead by sending copies of your ideas to the other engineers and asking for their input.

You can expand your visibility by speaking at club or professional society meetings. Join a local chapter of the SBE or start an informal discussion group with engineers at other stations.

You may even want to teach an electronics course at a community college or vocational school.

Visibility is valuable because people start thinking of you as better than average, perhaps even a "guru." It also gives potential employers a chance to see you in action.

•**Establish Contacts.** You'll want to get together with other professionals to share ideas and keep each other pumped up. Identify the top rate engineers in your area and make a point to visit them or have lunch occasionally.

Maintain relationships with engineers and other broadcasters who have moved on to greener pastures. You'll be flattered and happy to help them when you can, and someday they'll return the favors.

Promotions are great

The best thing about getting a promotion is that you feel so great about it. So, why stop at just one? Promote yourself again when you feel ready.

The irony in this is that by promoting yourself, you'll make yourself promotable. Getting that self-promotion gives you the excuse to have things better, which is what you really wanted all along.

Nobody has to give that to you. You can give it to yourself. What somebody else will do is come along and give you the bigger paycheck that you will then certainly be worth.

Knowing Before Buying

(continued from page 21)

We need to know if a firm is likely to still be in business in 1992 in order that it may service its five-year warranty.

This gets us into the big company vs. little company discussion.

Company size

If we go with the giant, surprises such as RCA's decision to abandon the radio transmitter line are possible. If we go with smaller firms, are they likely to survive the competitive market?

American business typically takes a conservative posture on this question. Most businesses sat on the sidelines waiting for an IBM to enter the already growing computer market—they wanted

to be sure before buying.

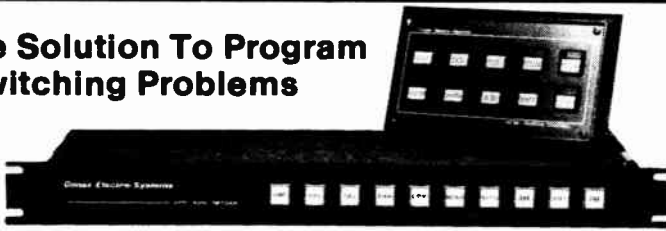
The choice here is difficult, since premium prices are often charged for the industry giants' products. But, it needs to at least be considered.

The lessons, again, are that we need more of that hard-to-get information. More discussion. More phone calls to the authors of RW user reports. More note comparing. More phone calls to our peers. More local meetings with other engineers. More, more, more.

While every firm has its weak points, it is fair to say that the weak do not rule our industry. We need to improve on the typical 84% success rate by never ordering from the weak companies in the first place.

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Overwater STLs Are Problem

by W.C. Alexander

Dallas TX . . . Overwater STL paths have long been a problem for broadcasters in coastal regions where all or part of the STL path is over water. Instances where the mid-path area is over water are particularly troublesome.

Microwave signals (including 950 MHz) leave the transmit antenna and travel in a straight line to the receive antenna. Well, not exactly.

Actually, microwaves are always being bent, to some degree, toward the earth. This is due to the prismatic effect caused by the changing dielectric constant of the atmosphere.

Since the pressure and hence density of the atmosphere surrounding the earth generally decreases as height above sea level increases, the atmosphere's dielectric constant also decreases with height, causing a prismatic effect on microwaves.

Because this bending is normally less than the curvature of the earth, microwave signals will, as a rule, travel farther than the visible horizon.

K factor

The ratio of effective earth (the way a microwave signal sees it) to the true curvature of the earth is called the "K" Factor.

The K Factor is assumed to be approximately 4/3 or 1.33 most of the time (and thus the scale on 4/3 paper or true earth paper used to calculate path clearances). However, in some instances, K can be as low as 0.45, causing considerable bending of microwaves.

In overwater situations, the K Factor can often vary considerably from the norm.

This sometimes happens very quickly, and is most prevalent when an inversion layer is present, caused by cooler air near the surface of the water underlying warmer air above.

When such conditions exist, it is likely that a particular STL path will become unusable, due largely to signals arriving out of phase at the receive antenna, caused by multipath resulting from the inversion conditions.

One station's solution

At station KBRT (formerly KBIG) in Los Angeles, the transmitter site is located on Santa Catalina Island, 26 miles from the nearest point on the mainland.

STL troubles had plagued the station dating back to the time when it started keeping records.

Days and even weeks had gone by when the STL system was unusable, and due to the unavailability of equalized, dedicated circuits to the island, it was frequently necessary to resort to the use of regular telephone lines for the program feed.

We at the station had noticed diversity antennas in place on Pacific Bell's microwave tower on the island. This gave us an idea for a possible solution.

We ordered equipment right away, purchasing two Mark Products 8' grid antennas, two runs of 7/8" foam line, two TFT 7707 receivers, and an automatic changeover panel.

W.C. Alexander is Director of Engineering for Crawford Broadcasting Company, and an aspiring horror-fiction novelist. He can be reached at 214-445-1713.

The only question that remained was what the proper spacing for the antennas should be. Calls were made and questions were asked of scores of people in the field, yet no one seemed to be able to tell us what formula to use.

Finally, we adopted a trial and error method, and the two grid antennas were mounted on the center tower of the three tower directional array, spaced 8' apart vertically (feedhorn to feedhorn).

The individual antenna lines were connected through isocouplers to separate receivers, and the changeover panel, which selects the best signal based on AGC voltage, was installed between them.

This was all done in April of last year,

traditionally the worst time of the year for STL trouble at the station (several outages had occurred already that month).

Immediate results were apparent—all outages ceased.

First-time success

Initially we had planned to use a two-channel strip chart recorder on a timer to record the AGC voltages of the two receivers, and based on a comparison of the findings, adjust the antenna spacing until simultaneous signal dips no longer occurred.

However, as it happened, we must have hit it right the first time. Happily, KBRT has not experienced a single STL

outage caused by loss of signal in a year.

Diversity reception could provide the answer for other stations experiencing similar problems. The receiver and antenna manufacturers were most helpful in tailoring the equipment to our specific needs.

While we were fortunate to have hit the spacing right on the first try, this probably will not be the case everywhere.

I suggest the use of a two channel strip chart recorder connected to the receiver AGC voltages. (If a TFT receiver is in use, this is brought out on pins 1-2 of the rear connector, J2.)

Leave enough loop in one of the transmission lines so that the antenna can be moved several feet vertically.

Ideally, antenna spacing should be adjusted so that, over a period of time, **(continued on page 26)**

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Tomorrow's Audio Processing

by Fred Baumgartner

Part IV of IV

Englewood CO ... In my last three articles, I've argued in favor of a different perspective on audio processing, based on an understanding of goals and new technology.

While I sincerely doubt that the goals will change in the near future, I believe that technology is changing even as I write. Let's look at several trends.

Key developments

The first is digital—the central movement in electronics these last few years. In general, if digital can do it, it can do it better than analog.

The second is smarter processing, which has to do with equipment "seeing" larger chunks of time (more information) and having more options of what to do to it.

Third is that audio processing for broadcasters is, even in sum total, small business. The monies for a dedicated digital technology do not exist. Thus it must be built on technology that has broader applications.

Fourth is the advent of both long and short term cost effective storage of the rather large amount of data necessary for digital audio. These include the "laser" discs and, to a lesser degree, high data density magnetic discs and RAM.

Fifth, less important but also a driving force, is cost effective short-and long-haul fiber optics and national networks built with them. Also, the availability of wide bandwidths on cost effective microwave channels and satellites.

And sixth, are low-cost microprocessors and fast mini computers.

Knowing all of this, I think I can tell you what the digital processor of the fu-

Frederick Baumgartner, assistant CE at KWGN-TV and former CE of WIBA, Madison, WI, is a frequent contributor to RW. He can be reached at 303-740-2883.

ture will be. But first I can tell you what it is not.

Even now there are "digital" processors available. By and large this title is somewhat misleading.

The use of TTL gates and microprocessors to control the front panel lights or even the audio control do not constitute true digital devices in the sense of a fully digital processor.

Digital processor of the future

Figure 1 is a block diagram of a digital processor. The first item is the input block. The output of the block is a digital audio signal.

The inputs to the block are more dependent on individual application. The input block is a very impressive item in itself. In the analog world its equivalent would be the mixer.

Well into the future, analog devices will exist and flourish. I don't expect to see a microphone or turntable cartridge with ribbon connector or fiber optic port for some time.

These analog items need to be converted to digital, and the sooner the better. Further, it is unlikely that digital devices will all have the same digital output format any more than analog devices do today.

Because most devices will be made to conform to some internal industrial standard and most will be designed to deliver analog signals primarily anyway, there will not be a major move to standardize the world any more than in the analog world.

In the analog world, amplifiers, pads and the like transform any audio standard to any other with relative ease.

In the digital world, it is a complex problem on the design level to convert formats, but for the end user it is just a black box with a micro.

The component cost of digital standards converters are not out of line with the devices we now use to convert analog audio standards.

The input block takes the various ana-

log and digital (even fiber optics) sources and adds them per instruction to produce a digital audio output.

The first generation will be little more than an A to D converter while later generations will surely tie to cross point switchers (analog at first, digital with time) and source equipment directly.

For the continued life of cart machines, tape decks, LPs and other non-digital sources, the input block can have circuitry for phase error correction, noise reduction, scratch elimination, etc.

The input block feeds two devices, a time delay line and an analyzer. The de-

price is well outside the \$20,000 maximum price for an audio processing system as it requires much R&D and specific function elements.

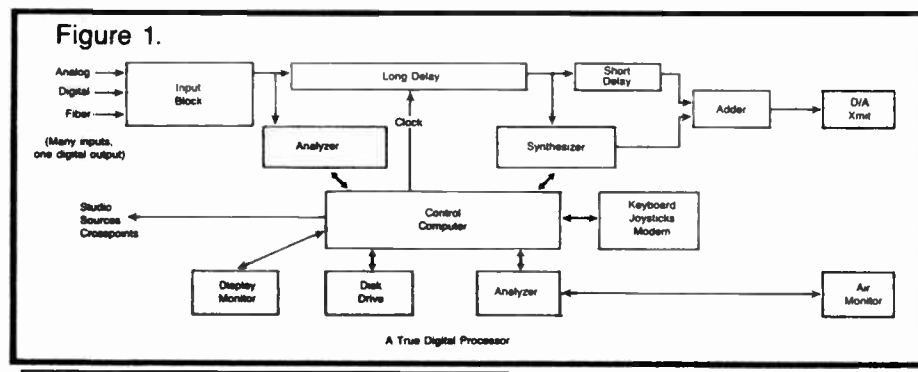
Further, the amount of control to be gained by this "brute force" approach is marginal.

So the analyzer block is there to reduce the mass of digital audio to information about its characteristics.

Smart processor

Each part of the analyzer relates a different parameter and its location in time. For example, one block might detect average program level, another peak levels, another individual peaks, spectral content, noise level, etc.

The assignable units could be config-



lay line is the basis for most of the advantages of the digital processor.

In an analog processor, the process decisions are made based on what has just occurred and what is present now. The gate is an example of an analog system's ability to deal with what is there now.

The gate waits before increasing gain so a pause is not mistaken for a change in program level. Of course the gate doesn't know what is next, so it never knows if it is correct to wait.

It is however a safer bet to wait to increase gain and immediately decrease gain than the alternative. Let us assume our digital processor has a seven-second delay.

The processor knows what has occurred, what is happening now and what is going to happen. It knows the difference between a pause and a radical change in program level.

Separate analyzer circuit

The other digital feed from the input block goes to the analyzer block. It is a block because it is a series of separate analyzers. Some are fixed purpose, others are definable.

It would seem at first that the logical approach would be to feed the entire digital audio to the computer and then work a number of complex mathematical functions designed to provide a transmitter ready output.

In a sense this approach would be the ideal. But there are a few reasons why it is not practical.

To begin with, the amount of data required to be stored for the seven seconds of audio alone is pretty massive.

For example, a 44 kHz sample would require 300K, and assuming a 16-bit word length the result would be 5 megabits (625K in 8 bit words).

This is no problem for a dedicated delay, but for an off-the-shelf computer which must also then carry an operating system, it's a lot.

Then there is the problem of speed. Assuming a simple processing program that would require a loop of a 1000 clock cycles for each audio "word," the computer's clock speed must be in the 50 MHz range.

Now this can be done, however the

ured to arrange digital filters, sampling, etc. to look for information relevant to a particular source or condition.

The computer spends most of its time taking data from the analyzer and feeding commands to the synthesizer. Just as important (even though there is very little data being sent to and fro) is the computer talking to the source/input block, keyboard and the monitor.

The computer talks to the source/input block so that it knows what is coming in and thus can compensate for the particular source.

The computer recognizes a particular DJ and calls up a routine to tailor his/her voice. It knows the call is on line five, and (while the computer doesn't care) knows that you and Ma Bell never did get the buzz out of it and notches it.

Or it knows the source is a record and configures its analyzers to look for scratches and mistracking, and calls up the correction routine.

Or it knows that you just went to the night pattern or the auxiliary transmitter or both and calls up the file to feed it precorrected audio. And so on, for each source.

Operational feedback

The computer also talks to the monitor. The monitor tells the computer when it is off the air. The computer doesn't know that ice on the antenna is messing with the common point but it knows how to correct the audio and tell you something is wrong.

The transmitter "gracefully degrades" and it tells you while it corrects. The computer has mapped out each transmitter's faults and tells you if they change.

The proof of performance as we know it makes little sense in this digital world, yet the analog transmitters still need attention as do the pre-digital signals.

The feedback loop allows the computer to perform very sophisticated tests on the transmission system even while it is on the air. The system test generator completes the function.

Ask it for a full proof and it may do it under full program, taking noise measurements in short pauses it creates and

(continued on page 26)

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Detuning For AM Interference

by Lawrence Behr and Ronald C. Chaffee

Greenville NC ... Interference between new FM or TV towers and AM radio antenna systems is becoming increasingly common.

The solution to these problems is often complex, and FM and TV technical personnel are often not conversant with the demands of lower frequency AM technology.

In the AM broadcast band, stations are licensed to maintain very specific radiated field intensities from their antenna systems in both directional and non-directional systems.

The extensive interference range of AM stations, coupled with crowded band conditions, make the AM allocation problem a complex one.

Very tight radiation pattern tolerances on the order of 0.5 dB are not uncommon. The extensive near field of an AM antenna further complicates the problem.

Near field effects may extend to two miles or more, compared to only dozens of feet at VHF, and measurements used to determine the station antenna pattern may extend out as far as 20 miles.

To compound matters, tower heights typically used in the other broadcast bands may be a significant portion of a typical AM broadcast wavelength. Unfortunately, they are all too frequently ex-

Detuning is the technique of adjusting current flow on a reradiating object to a minimum.

cellent reradiators of an AM signal. Recognizing this potential for problems, the FCC normally sets conditions on construction permits proposing new towers within two miles of an AM station to make certain that there is no interference to the AM station.

The FCC takes the attitude that the first station in is to be protected. This places the burden on the new licensee to solve any interaction problem with an AM broadcast station.

The adjustment and maintenance of an AM broadcast directional antenna system is a complex and costly thing. The cost of initial adjustments may range from \$20,000 to \$100,000 or more.

For this and other reasons, it is rarely economically feasible for the owner of an interfering tower to solve a reradiation problem by adjusting the station's antenna pattern.

Much more feasible is the installation of a device on the new tower to "detune" it.

Detuning is the technique of adjusting

Lawrence Behr has been involved in broadcast and communications engineering for more than 25 years. He is president of the consulting engineering firm of Lawrence Behr Associates, Inc., and also heads LBA Technology, Inc. Ron Chaffee is sales manager of LBA Technology, Inc. He can be reached at at (919) 758-4509.

current flow on a reradiating object to a minimum, thus reducing or eliminating its effect on an AM station.

By incorporating an appropriate detuning device during tower construction, costs are typically only a few thousand dollars, and future licensing delays and expenses can be avoided.

How may detuning be accomplished? Several approaches are available.

If the offending tower is short with respect to the AM frequency (generally under 1/4 wavelength) any guy wires should be insulated, and the tower base put on an insulator.

This breaks the current flow in the tower so that it is not a significant rera-

diating object. However, all lighting conduits, transmission lines and other conductive paths leading to the tower must be isolated at the AM broadcast frequency.

This approach is generally cumbersome, as it requires lighting chokes and isocouplers, introduces added loss in communications systems, and is quite conducive to lightning damage to attached equipment.

If the tower is tall at the AM frequency, then special problems are presented.

It becomes not only necessary to isolate the base of the tower, but it may be necessary to install insulators at various levels on the tower in order to "sectional-

ize" it, and to install special tuning networks controlling each of those sections.

The required insulation may be cost-prohibitive for large self-supporting towers.

While tower sectionalization techniques will always work (given enough budget), a far less cumbersome and expensive alternative is available for most situations.

There is a technique which makes use of the current control capabilities of wire skirts attached to towers. In AM broadcast parlance, when used for transmitting, these configurations are known as "folded unipoles."

A conventional broadcast tower, with insulated guy wires, is used in this approach. No base or sectionalizing insulators are required.

(continued on page 26)

Q

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The New Reliables



Circle Reader Service 39 on Page 26

Methods for Detuning Towers

(continued from page 25)

The bottom of the tower is grounded, and all feedlines and lighting conduits are attached to the tower in a normal manner. An array of vertical wires is then arranged symmetrically about the tower, a few feet off the tower face.

At appropriate points, insulators and tuning arrangements are installed in the vertical downloads.

The number and spacing of these downloads, the location of any insulated segments and the configuration of tuning components are chosen by the designer to provide the desired attenuation to AM signal reradiation from

the tower.

A typical two-section commercial implementation of this approach is embodied in LBA Technology, Inc.'s "Folded Detunipole"®.

Adjustments to systems utilizing the Folded Detunipole approach are usually straightforward.

Immediately prior to tower construction, field intensity measurements are made on the AM station at appropriate locations chosen to be indicative of normal performance.

The detuning system is then installed. Its components are adjusted as recommended by the manufacturer, while ob-

serving resulting field intensities at the reference points measured prior to construction.

Adjustments to detuning components and foldwire configurations are made until measurements indicate that the tower has no significant effect on the AM pattern.

Progress in these adjustments is conveniently observed by monitoring AM current flow at suitable points on the tower being detuned.

Whatever approach is used, some general comments on detuning are in order.

In particular, the importance of stability cannot be overemphasized. Once the tower is detuned, you want it to stay that way!

Reaching that happy state requires a number of measures that are not normally encountered in typical tower installations.

To avoid inadequate bonding of tower structure on welded towers, each joint between sections on one leg from top to bottom should be tack welded.

On field assembled towers, all joints should be solid metal-to-metal, no paint, with one leg spot welded all the way down.

Inadequate grounding can cause problems. Typically, a 12x12' ground mesh with driven ground rods on its edges and corners should be placed directly under the tower. The tower should be bonded to this with copper strap at least 2" wide.

Everything that goes on the tower must be securely and frequently bonded to it. Grounding kits should be used to establish metal-to-metal bonds from all transmission lines and conduits to the tower at least every 75'.

The same high standards pointed out above must be observed whenever equipment is added to or deleted from the tower. It is possible for a single sloppily installed transmission line run to create more AM interference than the tower alone.

Lastly, don't neglect maintenance. Periodic checks of the detuning system are

necessary. Windstorms can break the connections, and lightning fries components.

Detuning carries with it some other paybacks. The bonding and grounding techniques required will reduce lightning damage incidents, and may well eliminate some land mobile intermodulation problems in the cases where the tower has two-way antennas installed.

Good practices and records will also keep relations with the AM station in good stead, and keep you out of the fray if the station has subsequent pattern problems.

For many operators, outside assistance from a consultant may be necessary in identifying and resolving AM reradiation problems.

AM broadcast practices and FCC regulation are quite different from those familiar to most FM and TV technical people. As pointed out above, errors can be very costly.

You will of course want to consult your tower manufacturer for advice on any structural aspects of interfacing detuning equipment with the tower structure.

So, if you suddenly spot an FCC condition on your new construction permit, or spot an AM broadcast tower near your new tower site, don't despair. There is a lot of help available to solve your problem.

Answer for STL Paths

(continued from page 23) when one receiver loses signal due to a fade, the other does not.

I have found that TFT's transfer panel switches quickly and silently, and switching is not noticeable on the air. I am sure that other manufacturers have panels of similar quality.

Time will tell just how successful we were at KBRT, but I believe the diversity system to be a complete success. For the first time since the station has been fed programming from the mainland, it has had a year of uninterrupted program feeds.

Audio Processing Trends

(continued from page 24)

running frequency sweeps so low as not to be heard and filtering out the test tone to measure it.

And then, sending the results to the transmitter shouldn't be an analog process. In most modern AM transmitters, pulse width modulation techniques are used.

It is easier to generate PWM from digital information than analog. Likewise modulation techniques in FM can directly interface to digital information. The audio need not become analog audio until the receiver's demodulator.

The same processor works on all formats, transmitters, etc. Only the programming changes.

Making the station "sound" means loading a base program and with joystick and keyboard in hand in the listening room, telling the computer what to do where.

The final product

When all of this is done, we must return to Figure 1 and the last part of the true digital processor, the synthesizer and adder.

In the classical sense this is the only part that actively changes anything. The audio leaving the delay is exactly without any change or degradation than what came out of the source.

If that is a digital format source, then it is exactly and perfectly what was laid

down in the studio, only seven seconds later.

Of course the computer has been spending the last seven seconds measuring the signal, looking at the program to see how to make it come out of the receiver just the way you want it to, and thinking about what needs to be sent to the synthesizer.

The synthesizer takes the output of the delay and generates a correction signal. This is added to the output of the stereo short delays (these are used for phase and other time based correction) and our processed signal is done.

Shape of things to come

There are a few other innovations I think we'll be seeing in the not-too-distant future.

Someone is going to invent bigger and faster computers that will be placed on top of the entire transmission system and generate very complex and elaborate programs that to the absolute limit of mathematics correct for any fault in the system.

And eventually, through the use of a modem, setup need not happen in the transmitter building, but in any good listening room with a phone line—even a car with a cellular phone.

In any case, I would be very surprised if a digital audio processor isn't sitting on someone's bench now (if I wasn't on a limited budget, it would be on mine).

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Diplexer for AM Transmitters

by Ron Nott

Farmington NM ... Diplexing two transmitters together is not a common practice in the US and as a consequence, the technology and advantages are not commonly known in the industry.

The most obvious advantage is that of automatic redundancy in the event of a transmitter failure.

If one of the two transmitters being diplexed should fail, the other continues to broadcast without so much as a second of dead air.

The device used to combine the power of the two transmitters is known as a diplexer, of which there are several schemes.

The requirements for a diplexer are:

- 1) To maintain the proper impedance to the output of each transmitter, regardless of conditions. Most transmitters require $50+j0$ within fairly narrow limits.
- Over 20 years ago, the FCC began requiring a high degree of harmonic attenuation within the transmitter, and because of this, the load must be maintained within a narrow range of resistance and reactance. If one transmitter fails, the other one must continue to see a load of the same impedance.
- 2) If one transmitter fails, RF power from the other one must be prevented from entering its output terminal.
- 3) The outputs must be in phase and of equal amplitude.
- 4) Both transmitters must be modulated in audio phase.

Ron Nott is the president of Cortana Corp. He can be reached at 505-325-5336.

5) In order to repair the failed transmitter while allowing the other one to continue broadcasting, switching should be incorporated to isolate it completely. This is done by RF contactors, as will be explained.

Diplexer scheme components

Only one of the diplexing schemes will be described, that of the hybrid diplexer, but the advantages and requirements will be the same for any of them.

As shown in Figure 1, the essential components are four phase shift networks and the reject load.

The reject load is a resistor with a dissipation capacity of at least half the power of one transmitter including modulation.

Ideally, it should have the capacity to handle one transmitter including modulation, so that it may function as a dummy load for troubleshooting and tuning.

Note that three of the phase shift networks have a positive shift while the other has a negative shift. These phase shift networks consist of LC networks designed to provide a shift of 90° and have an impedance of the transmitter output impedance times the square root of two.

Since the output impedance of 50 ohms has been adopted for virtually all transmitters, this means that the networks have an impedance of 70.7 ohms.

Designing to these values means that the transmitters will see an output impedance of nearly 50 ohms and zero reactance under any conditions.

Assuming normal conditions, when both transmitters are of equal power out-

put and are precisely in phase, the power from TX 1 through network A and the power from TX 2 through network B will arrive at output terminal 0 in phase and will add directly and be conducted to the ATU or phasor as one signal.

The power from TX 1 through network C (of -90°) and the power from TX 2 through network D (of $+90^\circ$) will be 180° out of phase and no power will flow into the reject load R.

If no power is entering the reject load, just what is the darn thing for? Read on and it will become obvious.

When a failure occurs

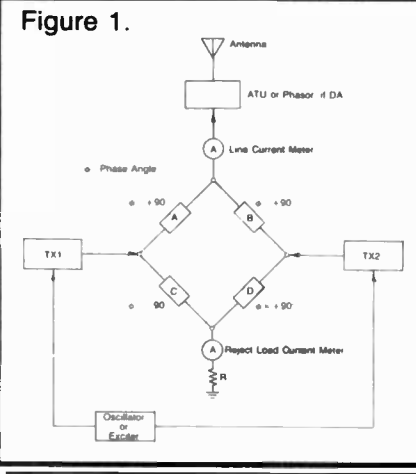
So much for normal conditions. Now assume that everything is chugging away just fine and one transmitter just decides to quit. What happens?

If TX 2 dies, TX 1 continues to feed power through network A to the antenna but it also feeds power through network C. Since the power from TX 2 is no longer arriving, 180° out of phase to cancel at the input of load R, power begins to enter it and dissipate as heat.

Because the resistance of R is the same as the impedance seen at output terminal 0, (usually $50+j0$) the power divides equally, half going to the antenna system and half to the reject load R.

The power to the antenna is now one fourth of that when the two transmitters were being combined for a field strength loss of 6 dB.

Requirement 2, above, stated that no power should enter the output terminal of the dead transmitter. Referring again



to Figure 1, the power from TX 1 travels in two paths to get to TX 2.

Through networks A and B, a $+180^\circ$ phase shift occurs. Through networks C and D, since one network is -90° and the other is $+90^\circ$, the net phase shift is zero.

The RF energy from the two paths is 180° out of phase and (theoretically, at least) no energy from TX 1 enters the output of TX 2.

The station could continue to transmit for an indefinite period like this at quarter power and the name of the survival game in broadcasting is *no dead air*. Run whatever power you can, but stay on the air!

Sometime soon, however, the boss is going to want the station to quit wasting power in the reject load and get as much as possible into the antenna. This is where the switching mentioned previously comes into play.

Since one of the design goals is to make all terminal impedances the same, preferably $50+j0$, it is simply a matter of installing RF contactors to break into the **(continued on page 31)**

Run Tapeless!

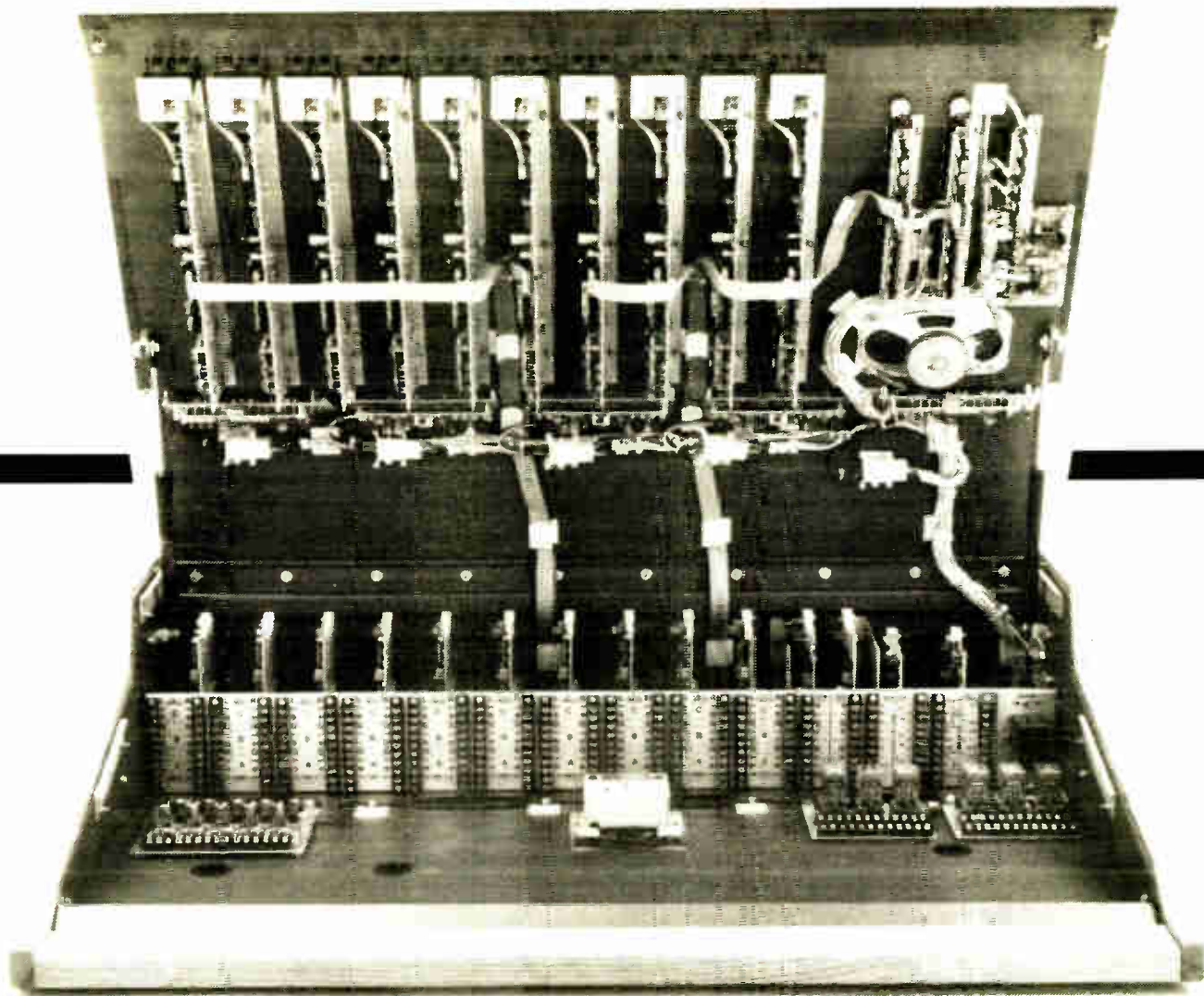
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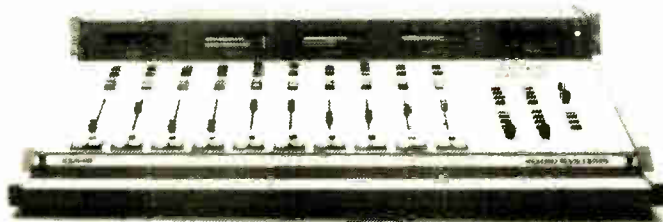
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Compute Field Intensity

by Ronald F. Balonis

Wilkes-Barre PA ... The practice and procedure of propagation prediction makes it a rather occult and mysterious activity.

The use of light boxes and queer-looking graphs with strange wiggly lines on them give its practioners a mystical, Merlin-like aura when divining over the glowing box to predict a signal's field intensity for a location or distance.

In the real world, however, radio signal field intensity prediction and measurement is an objective science, and must be treated as such.

Contrary to some forewarnings, computers have not, for some of us anyhow, made life more complex. They actually have immensely simplified it.

And with the program I present here (GWFLD.BA), AM groundwave field intensity calculations are in reach of your computer's keyboard.

Before FM, when the only radio there was was AM, the NAB, the IRE, and the FCC issued reports defining the field intensity necessary for reliable AM broadcast service.

Then, for a business city area, to override high interfering electrical noise and overshadowing effects of large buildings, it was a field intensity of from 10 to 50 mV/m.

For residential districts, it was 2 to 10 mV/m. And, for rural areas, 0.1 to 0.5 mV/m were considered sufficient.

That, however, was then, with AM radios capable of quality, hi-fi reception. Then—when the urban sprawl with its accompanying electrified web-like grid of noisy powerlines was not yet a reality.

Things change, as they must, so too the listening environment for AM. It makes the need to understand or know a station's coverage very important.

In AM radio, groundwave propagation is the mode and vertical is the polarization.

The term that defines coverage is field intensity (or field strength) stated in units of so many millivolts per meter at such and such distance.

And, the number of millivolts needed to qualify or quantify a distance or location for good reception depends on many things: antenna, frequency, power, location, conductivity and the radio itself.

The values (circa 1940-1950) I mentioned serve only as guide for relating the signal coverage to the mechanisms of groundwave propagation and field intensity measurements or predictions.

The field intensity of the vertically polarized groundwave is inversely proportional to distance from the source.

Doubling distance halves the field intensity, because the wave's energy has to distribute itself over a greater area.

This "inverse-distance law" is the ideal

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

```

0 'GWFLD.BA --GROUNDWAVE FIELD AT A DISTANCE--
5 'BY R.F.BALONIS 5/2/86 BASED ON FCC/OCE RS79-91
10 PI=4*ATN(1):I=0:IC=0:II=0:F=0:A=0
20 FD=0:Z=0:P=0:B=0:R=0:X=0:RA=0:XA=0
30 DIM R(50),X(50):K0=2.71828183:KM=1.609344
50 TLES=" ** GROUNDWAVE FIELD AT A DISTANCE ***
85 '--DEFAULTS
90 FX=100.0:FRQ=1.6:MI=1:E=15.0:K=10.0:DS="MI"
100 CLS:PRINT TLES:MI$=""
105 PRINT FX, "=Field (mv/m) =?";INPUT FX
110 IF FX=0 THEN STOP:"--- 0 TO QUIT
115 PRINT FRQ, "=Freq. (mhz) =?";INPUT FRQ
120 PRINT E, "=Dielectric K.=?";INPUT E
125 PRINT K, "=Conductivity =?";INPUT K
130 PRINT MI, "=Distance (";DS;")=?";INPUT MI$
140 IF VAL(MI$)>0 THEN MI=VAL(MI$):MI$=RIGHT$(MI$,2)
145 IF MI$="MI" OR MI$="KM" THEN DS=MI$
150 IF DS="MI" THEN KM=1.6093
155 IF DS="KM" THEN KM=1
200 DIST=MI*KM
210 X=17.9731*K/FRQ:B1=ATN((E-1)/X):B2=ATN(E/X)
220 P=PI*(DIST/(.299776/FRQ))*COS(B2)^2/(X*COS(B1))
230 B=2*B2-B1:FAR=(80.467/FRQ^(1/3))/KM
250 PRINT"*** TOO FAR DISTANCE (";DS;") =?";
260 PRINT INT(FAR*100)/100;"****";
300 GOSUB 1000:FIELD=A*KM*FX/DIST:"--GROUNDWAVE-
400 PRINT"GW FIELD =";INT(FIELD*.000)/1000;
410 PRINT"mv/m ";:INPUT " <ENTER>"; X:GOTO 100
500 STOP
1000 '--COMPUTE SURFACE WAVE ATTENUATION-----
1010 IF P>10.0 THEN 1500
1200 '--FOR P LESS THAN OR EQUAL TO 10-----
1210 R=(1/K0*(P*COS(B)))**SIN(P*SIN(B)-B/2)
1220 X=(1/K0*(P*COS(B)))**COS(P*SIN(B)-B/2)
1230 R=1+R*SQR(P*PI):X=X*SQR(P*PI):IC=0:F=1
1240 FOR I=1 TO 101 STEP 2
1250 II=IC:IC=IC+1:FD=-((2*P)^IC
1260 IF (IC MOD 2)=0 THEN FD=-FD
1270 F=F*I:A=B*IC
1280 R=R+(FD*COS(A))/F:X=X+(FD*SIN(A))/F
1290 R(IC)=R:X(IC)=X:IF IC=1 THEN 1330
1300 RA=ABS((R(IC)/R(I))-1.0)
1310 XA=ABS((X(IC)/X(I))-1.0)
1320 IF RA<.001 AND XA<.001 THEN 1350
1330 NEXT I
1340 PRINT"*** P DID NOT CONVERGE ***":A=0:RETURN
1350 I=101:NEXT I:A=SQR(R^2+X^2):RETURN
1400 '
1500 '--FOR P GREATER THAN 10.0-----
1510 P=SQR(P):B=B/2:A=B-PI/2
1520 RA=P*COS(A):XA=P*SIN(A):R=25+RA:X=XA
1530 Z=SQR(R^2+X^2):A=ATN(X/R)
1540 FOR I=50 TO 2 STEP-1
1550 F=(I/2-.5)/Z:R=F*COS(-A)+RA:X=F*SIN(-A)+XA
1560 Z=SQR(R^2+X^2):A=ATN(X/R)
1570 NEXT I
1580 F=P*(1/Z):R=1+F*COS(B+PI/2-A):X=F*SIN(B+PI/2-A)
1590 A=SQR(R^2+X^2):RETURN:"-----PROGRAM END
    
```

though; in the real world it's always something less than that.

How much less depends on the ground it passes over. As the groundwave passes over the ground, it induces charges in the earth and creates an earth current.

For the wave and its earth current the earth behaves like a leaky capacitor and can be represented as a resistance shunted by a capacitive reactance.

And, the earth, for the purposes of radio wave propagation, is described in terms of its conductivity and dielectric constant—its ground constants.

The attenuation that the groundwave experiences results from the loss over this leaky "earth capacitor" and the the inverse-distance free space loss.

The groundwave has the least attenuation over salt (sea) water, the most over dry, sandy soil.

The losses, however, are not just resistive. Due to the capacitive effect, they are reactive as well, and as the frequency increases so do the losses.

It limits the usefulness of the groundwave, regardless of ground losses, to frequencies of less than 2 MHz.

A standard and accurate way of predicting or computing field intensity is a necessary part of an efficient allocation process.

Charts 1-19 of section 73.184 groundwave field intensity curves represent the FCC's solution to the fuzzy radio world of propagation, field intensity calculations and predictions.

To calculate groundwave field intensity several types of data are needed: 1) The effective "radiated field" for the power and the antenna, the ground con-

stants of 2) dielectric and 3) conductivity, and 4) the distance.

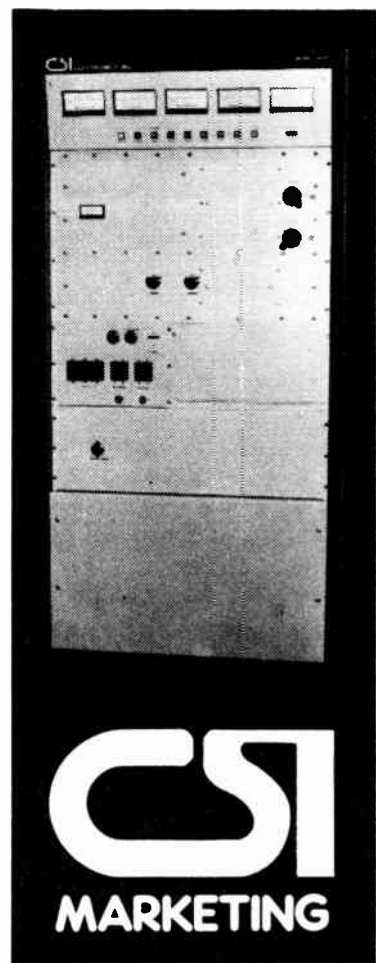
Figure 1 shows the relationship between power, antenna height, and effective field in millivolts per meter (mV/m).

It is based on Figure 8 of 73.190 and has lines for effective field at one mile and at one kilometer (depending on

which way you still think).

As used here and by the FCC, effective field (effective field strength) is the root-mean-square (RMS) value of the inverse distance fields at a distance of 1 kilometer (or miles in the olden times) from the antenna in all directions in the

(continued on page 30)



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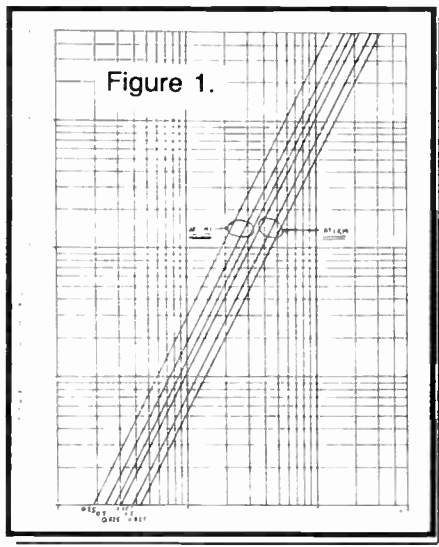
(continued from page 29)

horizontal plane.

And, the terms "field strength" and "field intensity" are synonyms for each other.

Charts 1-20 are drawn for a standard reference effective field of 100 mV/m with mathematical or mechanical ratio adjustments used to find field intensities for other effective fields.

Table 1 lists the range of conductivity



and dielectric constants according to the types of terrain and soil.

The earth constants listed in the table were compiled as a consensus from various sources and vary greatly with conditions and method of measurement.

The table illustrates that propagation prediction is not an exact science in a real world. The charts were drawn with a dielectric constant of 15 and with lines representing conductivities of 0.1 to 40.

The effective values of ground constants depend on frequency, lateral spread of the wave and the geological structure of the ground.

Moisture content is the major influencing factor for conductivity. For example, rich loamy soil normally has a conductivity of 10 mmho/m, but when dried it exhibits a conductivity of 0.1 mmho/m, the same as granite.

The attenuation of the groundwave is determined by the depth to which the ground currents penetrate.

The depth ranges from a few feet to perhaps a hundred and depends on the frequency, dielectric constant and the conductivity.

And the actual values of the ground constants tend to be determined more by the subsurface conditions than by the

Table 1.

Typical Values of Ground Constants
(compiled as a consensus of various sources)

Ground Type	Dielectric Constant	Conductivity millimho/m
Average	15	.5 to 5.0
Very moist	20 to 30	5 to 15
Dry	4	10
Thin soil over rock	7	1 to 1.5
Very dry	4	1
Sea water	80	4,500-5000
Fresh water	80	10
Hills of rich soil	20	10
Hills of forestation	13	5
Rocky soil	10	2
City or industrial area	5	1
Rich damp soil	22	15
Dry sandy soil	15	1

surface ones.

The values for ground constants result from several types of measurement.

It is measured by resistance and reactance of a capacitor having soil samples as its dielectric; by resistance between probes driven into the ground; by wave-tilt of the wave over the ground; and by the actual measurement of the groundwave attenuation.

The general lack of homogeneity for the over land propagation paths compounds the problem of determining the value of effective ground constants.

Efforts to correlate the constants in detail with geological soil types have not been too successful.

So, for conformity of groundwave calculations and allocation practice the FCC rules specify in the form of a map (73.190 Figure R3) the estimated effective ground conductivity for all of the United States.

The program GWFLD.BA calculates groundwave field intensity by the method given by A. Sommerfeld (1909, 1930) and K. A. Norton (1936).

Theirs assumes a flat, plane earth and is described in the FCC Rules in section 73.184 (e) using Graph 20, "Ground Wave Field Intensity versus Numerical Distance over a Plane Earth."

Graph 20 also lists all of the method's necessary formulas, and the coding of the program's variables follows the formulas as literally as possible, lines 210 to 300.

According to Fredrick E. Terman, the effect of the earth's curvature is negligible up to a distance determined by the equation: distance=50/(MHz) \times (1/3).

And it actually does not introduce a serious error until the distance exceeds twice that value.

That is where the reduction in field strength tends to be caused more by the curvature of the earth than by ground losses. The program displays this distance as "**** TOO FAR DISTANCE= "

When using the program, make note of it, it means what it says.

Neglecting the effects of earth curvature and accepting calculated field intensity estimates within a few percent simplifies the computer program.

That's how GWFLD.BA does field intensity calculations with only one page of program code while using a little less than 2,000 bytes of memory.

It's a calculator type program: enter data to get results. It supports multiple calculations by keeping the last set of data as defaults.

A null enter (just enter) repeats the previous value for a new calculation. And it calculates distances in either miles

or kilometers.

To use it just enter the data in sequence: effective radiated field in mV/m at one mile or one kilometer, frequency in MHz, dielectric constant, conductivity in mmho/m, and distance in miles (MI) or kilometers (KM).

Be sure to follow the distance entry by either KM or MI to tell the program of the type of distance units your using.

To quit the program, just enter 0 at the effective field prompt.

It is possible to compute field intensity to the same accuracy as the groundwave field intensity charts. The FCC has, in fact, done it, and the latest metric curves are the result.

They made two computer programing efforts (that I am aware of anyway).

One was by the FCC's Office of Chief Engineer in January 1979 called "Investigation of Methods for Converting the FCC Ground Wave Field Intensity Curves to the Metric system" (FCC/OCE RS79-01) by John H. McMahon.

The second was by the FCC's Office and Engineering Technology section in February 1986 called "Modern Methods for Calculating Ground-wave Field Strength Over a Smooth Spherical Earth" (FCC/OET R86-1) by Robert P. Eckert.

Both programs are in Fortran, which can be a something of problem if you or your computer do not speak Fortran.

The size of them can also be a problem. The first, written in a standard Fortran dialect consists of a program listing 17 pages long.

The second, also written in Fortran, but with a dialect that supports complex math functions, consists of a program listing 20 pages long.

That's why I chose, for my purposes, to leave the exact and much more complex methods and programs to the professionals.

Needless to say, GWFLD.BA was derived from these Fortran programs, especially the algorithm to calculate (to approximate) the value for the A loss factor for given values of numerical distance P, lines 1000-1590 of the program.

And, once again, I reiterate that the program is designed as a simple way to compute estimates of AM field strengths.

Its purpose and intended use is solely for armchair engineering, the what-if this or that kind, not for formal engineering filings.

Consider any correlations between actual calculated values from formal methods and the program's as mere accident and coincidence.

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Diplexer for AM Redundancy

(continued from page 27)

output of a transmitter and the input to the antenna system and bypass the diplexer completely.

Because the output impedance of the transmitters is the same as the input impedance to the antenna system, no further matching is required. The contactors may be locally and/or remotely controlled.

And by a little further designing, the disabled transmitter may be likewise connected to the reject load for testing when it has been repaired. When it's back up to snuff, push the button switching the diplexer back in and you're at full power again.

Problems, problems

The theory is great, but as in any device of any complexity, there are always pitfalls that are unforeseen.

Requirement 3 states that the outputs of both transmitters must be in phase and of equal amplitude. If this is not fulfilled, power will be wasted in the reject load rather than going to the antenna to be radiated.

The RF ammeter at the input to the load will indicate this. How can this problem be avoided?

Ideally, the transmitters should be identical. Same make, same model, same tuning. Tuning? Yes.

Phase shift comes from reactances and any inductance or capacitance that is different can introduce a few degrees of phase shift. Knowledge of this effect can

be utilized in tuning the system.

The goal is minimum power into the reject load and any reactance from oscillator through output network contributes phase shift.

If a small amount of power is indicated in the reject load, it may be decreased (or increased) by tuning the PA plate or loading, changing a tap on a coil, tuning the IPA stage, etc.

The coax lengths from exciter to transmitter inputs should be the same or perhaps an adjustable phase shifter could be designed into one line.

However it is done, the output phases (and don't forget amplitudes) must be precisely the same to get zero or near zero power into the reject load.

So much for the RF. The audio is easy. Just hook up the wires and go, right? Wrong! As will be described in a field experience, you must be careful here also.

In the field

Back in the '60s, Collins Radio sold several 20 kW transmitters into South America and Mexico by making use of two 10 kW transmitters and a hybrid diplexer.

Although the 820-F transmitter was not popular, I thought it was an excellent unit and when two were combined with this diplexer, it became an outstanding bit of electronic engineering.

However, when it broke down, hardly anyone could fix it using those terrible military type instruction manuals—thick impressive books with lots of printing

and pictures, but little information of practical value.

As a field engineer with Collins, I was sent out on a brand new 20 kW transmitter in Lima, Peru that was putting 12 kW into the antenna and 8 kW into the reject load!

Armed with a new Hewlett-Packard vector impedance meter, I began measuring the phase shift networks. The second one was some 4,000 ohms.

Careful inspection revealed that the lug had separated from the coil metal of a large inductor. This was a result of a severe jolt during shipping.

Resoldering fixed it, but of course, every crank had been turned and it took awhile to get back to zero power in the load and 20 kW in the antenna.

Exploding capacitors

About a year later, I went to the same station because of a more mysterious problem.

The modulation had greatly decreased and was distorted, and modulation transformer blocking capacitors were exploding!

These capacitors were originally tall and square in shape, but would explode into a rough looking football, leaking PCB oil all over the place.

Finding the problem took a bit of detective work, but in the end, it all became obvious.

When Collins designed this transmitter, the engineers elected to use a resistive splitter for the audio which would

modulate the two transmitters in phase from one audio source.

Since each transmitter required about +8 dBm and there was loss in the splitter, something like +24 dBm was required to fully modulate the diplexed transmitter.

The station limiter would not deliver this, so the local engineer did something that sounds good, but inadvertently created the problem.

He acquired a dual output Altec-Lansing amplifier and eliminated the splitter. However, he routed the two outputs through a patch panel for convenience in testing the transmitters separately.

Everything worked fine for a year and then one day someone turned over the patch cord. This caused the transmitters to be modulated 180° out of phase.

When one reached a positive peak, the other did a negative, cancelling at the output of the diplexer.

Transients must have been reflected back, causing voltage spikes in excess of what the capacitors could handle, so they blew up.

There are several methods of diplexing two transmitters and only the hybrid has been described. In cases where shortcuts have been taken to reduce costs, and they only serve to confirm the time honored adage, "You get what you pay for."

If you're going to diplex for the advantages it offers, shop for quality rather than price and you won't be disappointed. If minimum lost air time is really important to your station, diplexing can cut it to a minimum, but it ain't cheap!



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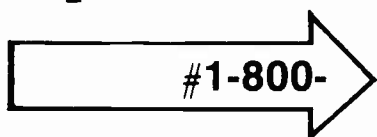
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Want to Sell

Elec Navigation Indus 310L w/meter, 250 kHz, 110 MHz, 50 dB RF power amp, 10 W output, \$600. M Rakoff, WQVM, 114-41 Queens Blvd #148, Forest Hills NY 11375. 718-591-0002.

Collins 356H-1 TT preamps & phone EQ. L Wilson, 409 Hillaire Dr, Hopkinsville KY 42404. 502-886-1678.

Gates Courier 70 2 chan remote amps w/power supply & schematics, needs work, less VU meters. L Wilson, 409 Hillaire Dr, Hopkinsville KY 42440. 502-886-1678.

RCA TT preamps (4). J Lies, WTRC, POB 699, Elkhart IN 46515. 219-293-5611.

Utility tower, 274' w/18" face, gd cond, on ground. M McKenzie, KALL, 312 S East Temple, Salt Lake City UT 84111. 801-364-3561.

Acoustic 260 amp, built-in reverb, fuzz, tremolo & tuning fork. BO. S Russell, Russell Music, 60410 Klett Dr, Decatur MI 49045. 616-782-9258.

Ecor HA-100 8 chan headphone amp, new w/rk mts, \$1300. M Fiedler, Mahoney Fiedler Prods, 5346 Dupont Ave S, Minneapolis MN 55419. 612-822-0013.

UREI 6250, \$500. M Fiedler, Mahoney Fiedler Prods, 5346 Dupont Ave S, Minneapolis MN 55419. 612-822-0013.

Langevin WE clones, #AM-101-D 50 W tube, \$275; AM-128XZ 25 W tube, \$125; also SS & tube power supplies, amps, preamps, line amps & mixers by WE, Langevin, RCA, ADC, Altec, Ampex, call for list. R Van Dyke, Van Dyke Inc, Squires Ave, E Quogue NY 11942. 516-728-1327.

Altec 1570B tube power amp 165 W very clean, \$280 for pair. W Busseti, Lizard Stds, 1124 W 2nd St, Florence CO 81226. 303-784-3540.

Langevin AM-16 preamp; AM17 program amp; EQ251-A EQ's; PS221 power supplies; mounting trays of instruction books, excel cond. B Anderson, Anderson Prods, 1157 Sunshine Terr, Studio City CA 91604. 818-769-6569.

ITC WRA stereo record amp, \$900. D Gowens, WESE, POB 660, Greenville SC 29602. 803-242-4660.

Russco mono TT preamps w/PS (2), \$50 ea. N Allebaugh, WICE, 100 John St, Cumberland RI 02864. 401-725-9000.

Shure FP11 & FP12 mic to line & head phone amp, \$99 ea. C Butler, Butler Eng, 8709 Pinon Dr, Jacksonville FL 32221. 904-786-6363.

Phase Linear 400, excel, \$300. B Laughlin, KDCV, 2636 N 56, Lincoln NE 68504. 402-466-8670.

Crown PSA-Z w/balanced input module, mint, \$1300. C Osgood, Ct Recording Std, 1122 Main, Bridgeport CT 06604. 203-366-9168.

Rust 150-3 FM RF amp, \$30. M Persons, KASM, Hwy 52 W, Albany MN 56307. 218-829-1326.

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McIntosh MC-50 (2) & (2) McIntosh MC-30 power amps. JP Robillard, 1803 N 1st East St, Haynesville LA 71038. 318-624-0105.

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, 10919 Oasis, Houston TX 77096. 713-723-5281.

Marantz & McIntosh tube & solid state. C Dripps, Kurloff Entr, 818-444-7079. 800-334-8223 CA only.

RCA BA73 program amp, any cond. T Vernon, WHGB, 900 Market, Harrisburg PA 17101. 717-249-1230.

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Andrew air dist manifold w/4 valves & 4 gauges, \$160. S Hasskamt, KDLH, 425 W Superior St, Duluth MN 55820. 218-527-8911.

Cablewave FLC78-50J, 7/8" foam, 250' unused on spool, \$795 & frt. G Thomas, KELL, POB 3834, San Angelo TX 76902. 915-655-9879.

Cablewave FLC158-50J 1-5/8" foam, 110' unused, not on spool, \$875 & frt. G Thomas, KELL, POB 3834, San Angelo TX 76902. 915-655-9879.

Collins 37CP 8 bay, 97.9 MHz, mounted on tower, BO. J Banoczi, KNOB, POB 3159, Anaheim CA 92803. 714-772-5662.

Collins 637D-1 HF antenna, high power broadband, 2-30 MHz w/50-650 Ohm balon, termination resistors & paperwork, new in large box, 120' x 120' when erected, installation avail, serious offers. Z Smith, Airwaves Comm's, 4801 Lamar Ave, Paris TX 75460. 214-785-8881.

Collins (ERI) G5CPS 4 bay antenna, \$2000. B Harlan, WFAH/WJQ, 393 Smyth Ave NE, Alliance OH 44601. 216-821-1112.

Stainless tower, 370', 320' Windcharger, 320' solid leg tower, last to be taken down. BO. J Tidwell, WAFT, Box 338, Valdosta GA 31603. 912-244-5180.

Fisher AM towers, (3), 330' high, 2' face, insulated, guyed, vgc, take all three & we'll dismantle, \$5000 ea, you transport. B Glasser, WHBC, POB 9917, Canton OH 44702. 216-456-7166.

ERI 403 isocoupler, 10 kW, 102.3 MHz. B Statham, WSTU, 1000 Alice, Stuart FL 33494. 305-892-1000.

Tower, used, heavy duty galvanized, on ground, will ship, you pay frt. J Pickett, ABC Ent, Rt 1, Sturgeon MO 65284. 314-687-3932.

Andrew LDF5-50, 120', 7/8" heliax trans cable, brand new never used, \$250 plus shp. B Mountjoy, Custom AV Svcs, Box G1240, Elizabethton TN 37644. 615-543-5849.

Bare copper wire, #No10, 150,000 + ft, 4/ft. W Blackwelder, KTBB, Box 7935, Tyler TX 75711. 214-581-0606.

Andrew 1920A air dehydrator, gd cond, \$700. S Hasskamt, KDLH, 425 W Superior St, Duluth MN 55820. 218-527-8911.

Andrew RG322 355', brand new on spool, flanged on both ends, \$4.5/ft. B Husband, 215 Taylorsville Rd, Yardley PA 19067. 215-493-4467.

Foam heliax xmission line, 288' 7/8" & 270' 7/8". M McKenzie, KALL, 312 S East Temple, Salt Lake City UT 84111. 801-364-3561.

Harris dual cycloid 12 bay CP FM antenna, BO; Gates AM antenna tuning unit w/RF relay for different patterns. BO. P Shirley, Lafayette Bdcg, POB 52046, Lafayette LA 70505. 318-233-7003.

Delta TCT-1 torroids (2). M McKenzie, KALL, 312 S East Temple, Salt Lake City UT 84111. 801-364-3561.

Cablewave HCC50J 3-1/8" air dielectric coaxial cable, approx 450', as is. BO. P Shirley, Lafayette Bdcg, POB 52046, Lafayette LA 70505. 318-233-7003.

Phelps Dodge CPFM-8 8 bay CP, tuned 101.1 MHz, BO. R Goodman, WCKN, POB 650, Anderson SC 29621. 803-226-1511.

Rigid coax, 20 sections of 3-1/8", 20' length, w/bullets & non insulated hangars, BO. R Goodman, WCKN, POB 650, Anderson SC 29621. 803-226-1511.

Cablewave FCC-38-50J sampling lines, 335' lengths (2). M McKenzie, KALL, 312 S East Temple, Salt Lake City UT 84111. 801-364-3561.

Phasor & LTU's for 2-tower array. M McKenzie, KALL, 312 S East Temple, Salt Lake City UT 84111. 801-364-3561.

Stainless 1" guy wire, 3000' on reels of 1000', approx 2 yrs old, BO. R Goodman, WCKN, POB 650, Anderson SC 29621. 803-226-1511.

Kintronics LTU-5B antenna tuning unit, w/remote sensor AM-1 & chokes LC-3, like new, \$950. AH Bolt, BHP Inc, 340 S 24th St, Quincy IL 62301. 217-224-1076.

CSI VSWR alarm panel, BO/trade. R Hahn, KDCR, Dordt College Campus, Sioux Center IA 51250. 712-722-0885.

RCA BFC 5 bay w/heaters tuned to 93.9 MHz. J Brown, WZZU, POB 33396, Raleigh NC 27606. 919-782-4709.

315' 3-1/2 Heliax w/connectors, excel cond. J Brown, WZZU, POB 33396, Raleigh NC 27606. 919-782-4709.

50 ohm EIA 90° elbow, 1-5/8", \$30. J Cunningham, KEOR, Rt 2 Box 113B, Stonewall OK 74871. 405-265-4496.

Cablewave 3-1/8" air hardline HCC-300-50J w/EIA flanges, 7 spools of 200', any or all, BO. B Brown, Brown Co, POB 59204, Birmingham AL 35259. 205-879-1621.

Scala FMO-4 4 bay omni directional antenna tuned to 95.3, only used 4 mos, \$700 plus ship. R Phipps, KHLK, 998 A Sidney Baker So, Kerrville TX 78028. 512-257-7711.

Transmission equip in excel cond, BO, write for list. R Bishop, Unwest, POB 3115, Cooper Mountain CO 80443.

HCC300-50J hard line coax 3-1/8" diameter, 200' lengths, 1400' total, EIA fittings. B Brown, Brown Co, POB 59204, Birmingham AL 35259. 205-879-1621.

Kintronics 7.5 kHz isocoupler, can be returned, never used, \$800/trade for stereo console. B Hoisington, WTCG, POB 1776, Andalusia AL 36420. 205-222-8849.

Tower 60', 12" base, 7 sections, \$600/BO. D Hubbard, KKRE, Box 1385, Monument CO 80132. 303-481-4700.

CP 4 bay FM antenna. S Lawson, KAK FM, 928 Hyland, Santa Rosa CA 95404. 707-528-4055 (eves).

Want to Buy

FM antennas, 2-4 bay, 1-10 kW tuned to 91.7. E Goetsch, WXPB, 303 W Prospect, Rhinelander WI 54501. 715-362-6000.

Tower light beacon. R Wright, WLLX, Box 156, Lawrenceburg TN 38464. 615-762-2916.

Any 4 bay FM antenna, 107.1 MHz; also any 360' tower. E Kazmark, KAZZ, Box 1369, Deerpark WA 99006. 509-276-8816.

CP antenna, 10 bay, 96.5 MHz. B Oliphant, KDZN, Glendive MT. 406-365-6996.

FM 8-12 bay CP, 105.7 MHz. B Dodge, Harvest Bdcg, POB 105FM, Hinsdale NH 03451. 802-254-2560.

Foam heliax, 200', 7/8", plug connectors. A Bowab, WDLT, 2402 Wolf Ridge Rd, Mobile AL 36618. 205-344-3698.

FM 2-3 bay CP, 96.3 MHz, w/deicers or radomes. B Dodge, Harvest Bdcg, POB 105FM, Hinsdale NH 03451. 802-254-2560.

Tower, 500' w/top mounted pole for FM 4-bay antenna. J Stitt, WLLT, 250 W Court Ste 300E, Cincinnati OH 45202. 513-241-9500.

6-bays on or close to 105.9 MHz. M McKenzie, KALL, 312 S East Temple, Salt Lake City UT 84111. 801-364-3561.

Tower, wind load B, 1200' & 500' tower, wind load B. F Hinds, WJIZ, POB 5226, Albany GA 31706. 912-432-7447.

AUDIO PRODUCTION (OTHER)

Want to Sell

Shure M-625 Voicegate, \$100. W Brown, KVNI, Coeur d'Alene ID. 208-664-9271.

Studio Tech AN-2 stereo simulator, 1 yr old, just taken out of service. L Davis, WKOV, 287 E Main, Jackson OH 45640. 614-286-3023.

Studio package: 16 input console, 2 trk Scully, 8 trk cart machines, D150 Crown amp, Russco turntable, 2 Altec limiters, 1 Fairchild limiter, 2 Mix down speakers, 8 mic booms, cassette recorder, Sony & AKG mics, all for \$7000. B Burchett, Bur-K Inc., 842 Bellefont Princess Rd, Ashland KY 41101. 606-324-8812.

Fostex 3180 2 chan spring reverb, new cond, BO. R Schumacher, KENO, 4660 S Decatur Blvd, Las Vegas NV 89103. 702-363-1808.

Castle dual phaser 3, (2) complete in 2 rack spaces, very low hrs, 4-16 stage phasing, \$325. R McMillen, 13515 SW 72nd, Tigard OR 97223. 503-684-1973.

RCA BA-43 program amps, rack mount w/VU meter (2), \$75 ea. S Porter, WNOE, 529 Bienville St, New Orleans LA 70130. 504-529-1212.

Eventide digital delays, 3.5 sec unit & 7 sec unit. M McKenzie, KALL, 312 S East Temple, Salt Lake City UT 84111. 801-364-3561.

dbx 142 encoder/decoder (4), \$175 ea; dbx 148 decoder only (6) w/408 mod's, \$50 ea. G Faltus, WKGR, 600 Atlantic Ave, Ft Pierce FL 33450. 305-461-0099.

Timestar 2400C prototype timer, programmable, will give station ID's at top of hour, \$2700. E Moore, 1102 N 31st Ave, Omaha NE 68131. 402-556-4999.

Garron STE-100, stereo phase enhancer, \$150. S Pctner, WNOE, 529 Bienville St, New Orleans LA 70130. 504-529-1212.

Eventide FL201 flanger, excel cond w/manual, bal in/out, \$450. C Cooper, Admix Bdcg Svcs, 960 Woodward Dr, Charleston WV 25312. 304-744-0022.

UREI 565 filter set w/manual, \$280. N Allebaugh, WICE, 100 John St, Cumberland RI 02864. 401-725-9000.

Symetrix 108 System, 8 line phone system, 6 mos old, used 2 mos, excel cond, w/extra control box for screening, \$1600. S Bush, KTKK, 3595 S 1300 W, Salt Lake City UT 84119. 801-264-8250.

Shure M268 neatly modified for mic or line input, rack mt, new cond, \$179. C Butler, Butler Eng, 8709 Pinon Dr, Jacksonville FL 32221. 904-786-6363.

Studio equip in mint cond, little use in low demand situation, write for list, BO. R Bishop, Unwest, POB 3115, Cooper Mountain CO 80443.

Custom built mobile studio, newly painted, new glass, Dodge frame & engine, elec or gen operated & air conditioning, BO. B Klaus, WNIR, POB 629, Kent OH 44240. 216-673-2323.

ADC SA-1 spectrum analyzer, 10-band, like new, \$100. B Laughlin, KDCV, 2636 N 56, Lincoln NE 68504. 402-466-8670.

ADC SA-1 spectrum analyzer, 10-band, like new, \$100. B Laughlin, KDCV, 2636 N 56, Lincoln NE 68504. 402-466-8670.

ADC SA-1 spectrum analyzer, 10-band, like new, \$100. B Laughlin, KDCV, 2636 N 56, Lincoln NE 68504. 402-466-8670.

AUTOMATION EQUIP.

Want to Sell

SMC 521 mono dual play on pull out drawer w/aux cards, solid state, \$400. W Hoisington, WTCG, Andalusia AL 36420. 205-222-8849.

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SMC 521 mono dual play on pull out drawer w/aux cards, solid state, \$400. W Hoisington, WTCG, Andalusia AL 36420. 205-222-8849.

BE Control 16 system, auto logging, cart encoder, (3) CRTs, (2) control stations, battery backup & charger, (5) racks, (4) IGM Go-Carts, ITC 3D cart deck, (2) ITC 770 open reel decks, all stereo & operational when removed from service. G Capogna, WYBR, POB 7180, Rockford IL 61125. 815-874-7861.

Harris w/4 Sonomag Carousels, 4 Ampex R-R's, misc parts, call for details, BO. R Huggler, WSUL, 250 Broadway, Monticello NY 12701. 914-794-0242.

IGM Basic A complete 3K system, w/everything. P Soito, WBAZ, Box 1200, Southold NY 11971. 516-765-1017.

Microprobe Elec 100 programmer, rarely used, remote B machines, 24 events, \$2500. J Yinger, WBCM, 301 The Davidson Bldg, Boy City MI 48708. 517-894-4543.

IGM Instacart, 48 tray stereo, working when removed from service, \$3500. M Meyer, KLOP, POB 70, Madison MN 56256. 612-598-7301.

SMC TAC-1 time announce controller w/book & cables, cards all check, \$350. W Hoisington, WTCG, Andalusia AL 36420. 205-222-8849.

Schafer 8000 automation control system w/4 stacks of memory, BO. B Harlan, WFAH/WJQ, 393 Smyth Ave NE, Alliance OH 44601. 216-821-1112.

Schafer 7000 48 tray Audifile, 2 Otari R-R, 2 Carousels, 1 yr use, \$14,000. D Monce, WADNY, 129 Main, Danville NY 14437. 716-335-2273.



Broadcast Equipment Exchange

CAMERAS ... WTS

Cetec Beehive B100 CRT on-air automation, 4 stereo ITC PB machines, 4 stereo 24 cart SMC Carousel, extra source boards, call for price. E Stern, KSPL, POB 2150, San Marcos TX 78666. 512-396-3354.

Cetec 7000, 4 Otari ARS 1000, 2 Go-Cart 24, 2 Audiofile 48 Carousel, encode terminal, remote terminal. BO. S Scott, KEED, 1330 Day Island Rd, Eugene OR 97401. 503-686-9123.

Shafter 7000 automation system, used less than 1 yr, 3 racks, 2000 event memory, 48 tray Audiofile Carousel, (2) R-R Otari's, \$15,000. D Nance, WCDQ, 75 Main St, Sidney NY 13838. 716-335-2273.

SMC 92A R-R cart deck, \$500, (3) RCA 12" 3345 TTs, \$75; Collins ERI GSCPS 4 bay CP 92.5 MHz, \$2000; GE console 4BC1A1, BO; Shafter 8000 control, BO. B Harlan, WFAH/WJDQ, 393 Smith, Alliance OH 44601. 216-821-1111.

Harris Sono-Mag Carousels, Ampex R-R's, digital clock, tone sensor, Shafter racks, BO. R Huggler, WSUL, 250 Broadway, Monticello NY 12701. 914-794-0242.

SEI Set-master controller, (3) IGM Go-Carts, mono, rack mounted, wired & ready to run, \$12K/BO. E Fisher, WSDR, Box 399, Sterling IL 61061. 815-625-3400/1240/3540.

Control Design automation controller incl 12-source switcher, 2K-event memory, 10-event clock & power supply, all manuals & instructions, avail 2/23/87, \$4000. G Meloon, WDBA, 28 W Scribner, DuBois PA 15801. 814-371-1330.

CD-24R stereo random-access Cartel, w/manuals & interface cables, working well, \$1000 plus ship compromise. G Meloon, WDBA, 28 W Scribner, DuBois PA 15801. 814-371-1330.

CD-25S tone sensors (2), \$200 ea w/manuals; CD-60T time-announce controller, \$350. G Meloon, WDBA, 28 W Scribner, DuBois PA 15801. 814-371-1330.

IGM 200, (2) Instacarts, (2) Revox A77, spare brain w/manuals, \$12000. K Harnack, Harnack Engr, 1197 Gibbons, Memphis TN 38127. 901-353-4837.

ABC Q command decoder, never used, BO or trade. M Shannon, WAMJ, 1129 N Hickory Rd, South Bend IN 219-234-1580.

Audiophile IIA refurbished, tested w/warranty (2) rack included w/ea purchase of 2, \$2750 ea. JD Bela, WKOY, POB 800, Bluefield WV 24701. 304-327-6125.

SMC ESP1 automation system w/programmer, (7) 350 Carousels, logger, remote control & 450 10-1/2 min carts, BO. K Hollingsworth, WCSP, 214 E Georgetown St, Crystal Spring MS 39059. 601-892-3001.

SMC 25RS Carousel, \$500 ea. B Harlan, WFAH/WJDQ, 393 Smith, Alliance OH 44601. 216-821-1111.

Want to Buy

IGM 392 network switcher, w/all the relays, an earlier model. J Robinson, KOMW, Box 151, Omak WA 98841. 509-826-0100.

Carousels (3), programmer cables, used OK but must be working. D Carlisle, WTIP, 817 Suncrest Pl, Charleston WV 25330. 304-342-3136.

CAMERAS (VIDEO)

Want to Sell

RCA TK76 spare parts & assbly, also parts for TK86, TK760, TK761, TK781, TK86. T Smith, CCI Comm, 192 Lancaster Ave, Frazier PA 19355. 215-289-1725.

ITE P-5 w/H-2 head, perfect cond. T Smith, CCI Comm, 192 Lancaster Ave, Frazier PA 19185. 215-289-1725.

RCA lenses, TK-76-86-781-760 Fujinon, Schneider 17:1, 20:1, 30:1, 14:1, zoom lenses, BO. T Smith, CCI Comm, 192 Lancaster Ave, Frazier PA 19355. 215-289-1725.

Hitachi SK70 3 tube w/CCU, AC power supply, battery patch w/2 battery, 300' camera cable & shipping case, \$4500. J Workman, Maritz Comm, 600 W Lafayette Blvd, Detroit MI 48226. 313-963-1200 ext 501.

Hitachi FP40 3 tube saticon w/access, BO or trade. M Glaser, MRG Assoc, 679 Nassau Rd, Uniondale NY 11553. 516-489-1071.

Philips LDH-20 (2) w/CCU's, cable, hand controls, 12:1 Canon lenses, 1" plumb, ITE T10 tripod head & dolly, \$6000 for both. T Smith, CCI Comm, 192 Lancaster Ave, Frazier PA 19185. 215-289-1725.

Itegami HL79A w/Angenieux 95:126, AC adapter, batteries w/charger, shipping case, cables & more; Sony BVH 500 1" VTR w/case, batteries, charger, AC500 power supply, HT500A chroma stabilizer, assorted cables, will sell VTR separately, call for price. T Cereste, Lightscope Prod, 420 W 45th St 4th FL, NY NY 10036. 212-757-0204.

RCA pedestal, gd cond, BO. L Saldona, AV Prod, 1801 Nickerson St, Austin TX 78704. 512-444-3959.

RCA TK43 camera parts & access, BO. L Saldona, AV Prod, 1801 Nickerson St, Austin TX 78704. 512-444-3959.

Hitachi FP-10 w/1.5" viewfinder, 10X zoom lens, AC adapter, tripod adapter, carrying case, BO. J Johnson, Interland Corp, 3200 W Peterson, Chicago IL 60659. 312-478-1700.

Hitachi GP61 1 tube camera, \$400. C Kent, ACS Inc, 443 Elbert, Ramsey NJ 07446. 201-925-7807.

Hitachi FP40, 3 tube Saticon w/all access & travel case, low hrs on tubes, will trade for newer chip cam plus cash, \$3000/BO. M Glaser, C&G Ent, 679 Nassau Rd, Uniondale NY 11553. 516-489-1071.

ITC730 w/CCU, 1.5" viewfinder, Fujinon 1:1.6, 11-110mm zoom lens, tripod adapter & carrying case, ITC-62, BO. J Johnson, Interland Corp, 3200 W Peterson, Chicago IL 60659. 312-478-1700.

Sony DXC1610 camera & mate recorder, pkg or separate, BO. F Chlebowski, Ontario Recording Srvc, 45 Sobieski St, Rochester NY 14621. 716-342-5331.

JVC KY210 w/Fujinon 10:1 lens & access, excel cond, \$3195. D Brennan, Custom Video, POB 26126, Birmingham AL 35226. 205-823-0088.

Want to Buy

Sony SVP330 video camera, M Glaser, MRG Assoc, 679 Nassau Rd MS 25A, Uniondale NY 11553. 516-489-1071.

Viewfinder & trinicon tube for Sony DXC1210 camera, C Lunde, Cycle Sound & Video, 167 Madison St, Waterbury CT 06706. 203-756-7751.

Philips LDH1 & LDH20 w/ or w/o tubes, in any cond as long as complete. G Odell, TFG, Box 9, Wethersfield CT 06109. 203-527-2972.

CART MACHINES

Want to Sell

ITC mono PB (2) w/130 carts, excel cond, BO. J Griffin, Comm Services, 2900 E 6th St #75, Stillwater OK 74074. 405-377-3666.

Spotmaster 500 Series, \$325; Spotmaster 500 Series, \$200. J Emmel, Emke Media, POB 401, Olyphant PA 18447. 717-383-1118.

Scully 270 PB decks (3), \$700 ea; Gates Criterion R/P deck, \$350; Gates Criterion decks (2), \$200. B Harlan, WFAH/WJDQ, 393 Smyth Ave NE, Alliance OH 44601. 216-821-1112.

BE 4300 RPS excel cond, R/P stereo, \$950. B Anthony, Rt 3 Box 185, Cornelius OR 97113. 503-357-6120.

ITC PD2 R/P, new heads & motor, \$825. D Goerg, Creative Eng, 2680 Edgerton St, Little Canada MN 55117. 612-646-7683.

Ampro CT2500B PB stereo, 3 tone FF (2), \$400 ea. D Stebbins, KELK, 1800 Idaho, Elko NV 89801. 702-738-7118.

Harris R/P, as is, \$300. R Sanchez, Lincoln Fine Arts Radio, 3800 S 48th St, Lincoln NE 68506. 402-426-2520.

Ampro CT3500B R/P stereo, 3 tone FF, \$500. D Stebbins, KELK, 1800 Idaho, Elko NV 89801. 702-738-7118.

ITC RPPF R/P stereo 3 tone like new, \$2000. H Buttermore, WHYT, 2100 Fisher Bldg, Detroit MI 48202. 313-873-9821.

Tepecaster 700P mono PB, works gd, \$200/BO. S Streitenberger, WFCB, 45 W Main, Chillicothe OH 45601. 614-773-3000.

UMC Beaucart Type 20, 3-cue tones, motorized azimuth adjust, \$2500. S Portier, WNOE, 529 Bienville St, New Orleans LA 70130. 504-529-1212.

Tepecaster X700RP, \$250; X700P, \$200. M Gottesman, KAMP, POB 1018, El Centro CA 92244. 619-352-2277.

Audicord A-10 mono, PB (4), like new, \$350 ea; BE 3200 RP mono, excel cond, \$950. AH Bott, BHP Inc, 340 S 24th St, Quincy IL 62301. 217-224-1076.

Harris Criterion 90-2 stereo cart R/P w/all three tones, never out of original box, \$2100. J Newman, 143 WBUC Road, Buckhannon WV 26201. 304-472-3932.

ITC 3D matching WRA record head, mono 1 cue, 1 owner, unit has never seen bcdt use, factory rebuilt last year w/svc man & spares, \$2150. P Appleton, Appleton Sds, 1000 NW 159 Dr, Miami FL 33169. 305-625-4435.

RCA RT-7 cart deck, \$50; Sparta 300-CP cart deck, \$50. J Ross, NW Audio, 3880 Ritamarie, Columbus OH 43220. 614-458-4292.

Ramco ACL-25E cart loader, \$250. S Portier, WNOE, 529 Bienville St, New Orleans LA 70130. 504-529-1212.

ITC 3D stereo PB w/WRA record amp, \$1850. D Gowans, WESE, POB 680, Greenville SC 29602. 803-242-4880.

Collins 642A-1 rack mount, S Portier, WNOE, 529 Bienville St, New Orleans LA 70130. 504-529-1212.

Spotmaster PB in vgc, \$250; Spotmaster 405 R/P vgc, \$350. B Hoisington, WTCG, POB 1776, Andalusia AL 36420. 205-222-8848.

ATC mono cart machine, operating, \$480. P Wolf, Wolf Eng, 241 NE 10th Ave, Cape Coral FL 33909. 813-574-5548.

BE Spotmaster 500 (2) stereo PB, gd cond, \$300 ea. M Phillips, Phillips & Co, POB 985, Laurenburg NC 28352. 919-276-1306.

ATC stereo R/P, \$350. M Phillips, Phillips & Co, POB 985, Laurenburg NC 28352. 919-276-1306.

Gates Criterion stereo, R/P, needs repair, \$500. P Wolf, Wolf Eng, 241 NE 10th Ave, Cape Coral FL 33909. 813-574-5548.

ITC Delta stereo w/record unit, never used; Broadcaster Cartimer, 3 digits to 9:59 w/4 remote machine, start switches, new. M Sirkis, Peak Audio, 3107 Bedlington Pl, Holland PA 18966. 215-860-0303.

Contel 101P-B mono PB, \$150. M Gollub, WMJS, Box 547, Prince Frederick MD 20678. 301-535-2201.

Gates Criterion cart deck, \$350; (3) Scully 270 PB decks, \$200 ea. B Harlan, WFAH/WJDQ, 393 Smith, Alliance OH 44601. 216-821-1111.

Want to Buy

ITC SP, WP, RP, 3D, any cond. S Streitenberger, WFCB, 45 W Main, Chillicothe OH 45601. 614-773-3000.

BE 3006 & 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.

Cue cards, 150 Hz, for Collins 642 Twin Tape; also need unit for parts. B Hoisington, WTCG, POB 1776, Andalusia AL 36420. 205-222-8849.

CASSETTE & REEL-TO-REEL RECORDERS

Want to Sell

Telex Magnecord 1022 1/2 trk R-R, owners manual, schematics, recently totally serviced, \$450. S Campbell, Sound Crafters, 105 Cool View Dr, Seneca SC 29678. 803-882-2762.

STUDIO REVOX
FACTORY AUTHORIZED
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Swiss trained in servicing all A77, B77, A700, PA99, A67, B67, A810 tape recorders. Typical 48-72 hour service. 90 day warranty. Huge parts inventory. factory boxes, new and used machines for sale.

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1165 Tower Road
Schaumburg, IL 60195
(312) 843-7488

Tascam Pro Series 70, 1/2" 4 trk w/dbx in Scully roll-around, \$2000/BO. P Dickson, 3011 211th Ave NE, Redmond WA 98052. 206-868-4942.

Ampex 440C 2 trk has 2 new head stacks, excel cond, \$1750. P Dickson, 3011 211th Ave NE, Redmond WA 98052. 206-868-4942.

Otari 7800 1" 8 trk, less than 300 hrs, \$5K/BO. P Dickson, 3011 211th Ave NE, Redmond WA 98052. 206-868-4942.

Tascam 80-8 1981 w/dbx, low hrs. M Baykian, Granny's Kitchen, 4261 Iversness, Orchard Lake MI 48033. 313-626-4075.

Ampex AG600 (2), gd cond, \$300 ea. M McNally, WEKC, POB 1071, Williamsburg KY 40769. 404-943-3437.

Ampex 602 (2) FT, gd cond, \$250 ea. D Ibel, KICD, 2600 N Hwy Blvd, Spencer IA 51301. 712-262-1240.

Magnavox R-R duplicator, 1/4" audio duplicator w/5 slaves w/dual 1/2 trk heads w/FT heads, gd cond. S Evans, Imperial Int Learning, Box 548, Kankakee IL 60901. 815-833-7735.

Magnecord 1821 R-R, mono, solid state, working, \$350. K Trimble, Elizabethtown Bldg, Box L, Elizabethtown KY 42701. 502-788-1400.

Ampex 440C, (3) 2 trk stereo, excel cond, \$1700; FT mono, excel cond, \$1300; Ampex 440B, (3) 2 trk stereo, excel cond, \$1400; FT mono, \$1000; Ampex ATR700, (2) 2 trk stereo recorders, vgc, \$100 ea; Ampex AG360, 2 trk stereo, vgc, \$880; FT mono w/tonerics etc, \$700. S Streitenberger, WFCB, 45 W Main, Chillicothe OH 45601. 614-773-3000.

Ampex 357 FT, excel cond, new tonerics 370 elec, 9889. D Goerg, Creative Eng, 2889 Edgerton St, Little Canada MN 55117. 612-646-7883.

Ampex AG360, mono, \$400/BO. L Houck, Rollin Recdg, 210 Algett, San Antonio TX 78201. 512-738-5483.

Ampex and Scully Spare Parts, Accessories, Motor Remanufacturing.

VIF INTERNATIONAL
PO Box 1555
Mtn. View
CA 94042

Telephone Number
(408) 739-9740
Telex 62922869 ESL UD

Wollensak (5), needs work & heads: Magnecord 1021, bad switch bank; Ampex PR-10 for parts or repair, has tube type amp. L Wilson, 409 Hillaire Dr, Hopkinsville KY 42240. 502-886-1678.

Tascam 133 cassette w/cue chan, 2 speed 1-7/8, 3-3/4, Dolby rack mount included, excel cond, \$800 incl ship. A Nadav, Accusound, 50-46 207th St, Bayside NY 11364. 718-229-5805.

Otari MX9090 1/2 trk R-R, \$1250. D Weeks, Sharpe Bldg, 515 E Park Dr, Monroe NC 28110. 704-283-7085.

Otari MX5858-8SD 1/2" 8 trk excel cond, w/manual & custom roll-around, \$2850. D Weeks, Sharpe Bldg, 515 E Park Dr, Monroe NC 28110. 704-283-7085.

Ampex AG448, stereo RP 7.5-15 ips in roll console w/manual; ITC 750 stereo RP w/manual; Revox A77 w/wood carry cabinet. B Securo, WGLH, POB 2127, Chapel Hill NC 27514. 919-942-8765.

Otari 50548-8 trk, 8 chan, dbx 154 in walnut cabinet, gd cond, \$3000. B Castner, Castners Ltd, 747 W Maple, Birmingham MI 48104. 313-433-3530.

Tascam 234(5) cassette decks, 1 yr old, excel cond, \$400. A Werth, Faith Prod, 1441 Guthrie Dr, Cleveland TN 37311. 800-251-4024.

Crown SX81 w/FT mono heads, solid state mono electr, operating w/gd heads, \$250/BO. T Adams, Wisc Pub Radio, Box 5541, Madison WI 53705. 608-246-2052.

Sony TC755, 10-1/2" capacity, 7.5-3.75 ips, 1/4 trk stereo, excel cond, \$400/BO. R Wells, KREO, POB 1598, Santa Rosa CA 95402. 707-433-8895.

Ampex 440 FT mono, 7.5 & 15 ips, in Rustang roll-around cabinet, \$1100. D Flynn, Continental Recd, 102 South St, Boston MA 02111. 617-426-3131.

Tascam 38 8 trk R-R, 1 yr old, low hrs, \$1800. R Vise, Super Sound, 6300 Weddington Ct, Mobile AL 36609. 205-680-1400.

Scully 206-8 1" 8 trk, \$3750. C Neilson, West Bank Sound, 1413 Washington Ave S, Minneapolis MN 55454. 612-370-0098.

Ampex PR10, \$100/BO. L Houck, Rollin Recdg, 210 Algett, San Antonio TX 78201. 512-738-5483.

Otari MX9090 2 trk, \$1050. S Bogart, Bogart Prods, 9 Twin Lakes Court, Arlington TX 77016. 817-467-0158.

Ampex AG350 2 trk, gd cond, \$800/BO. L Houck, Rollin Recdg, 210 Algett, San Antonio TX 78201. 512-738-5483.

Ampex MM1000 16 trk, \$6500. Joe, River City Studios, 147 Goodrich SE, Grand Rapids MI 49503. 616-456-1404.

Crown SX822 stereo, 2.5 yrs in prod, manuals, rack mount w/record amps & hubs, \$390 ea. B Larson, KSOS, Layton Hills Mall, Layton UT 84041. 801-546-1722.

Two trk NAB head stack, 1/4 trk head stack in fair cond, svc man; (3) Panasonic RS1520 2 trk rack mt, bias & EQ, 2 yrs old, w/svc man. \$875/\$1300 pay freight \$2200 for 2, \$3300 for 3. P Appleton, Appleton Sds, 1000 NW 159 Dr, Miami FL 33169. 305-625-4435.

Studer Revox A780 used in gd cond, rebuilt per supply, \$1487. P Appleton, Appleton Sds, 1000 NW 159 Dr, Miami FL 33169. 305-625-4435.

Technics SP100 (3) VHS tape PCM processor combo, digital audio, solid state, \$1200 ea, pkg deal \$3800; Sony PCM 16 digital processor, no hrs, \$2300. J.A. Joffe, Joffe's Bldg, 322 Crooks, Green Bay WI 54301. 414-436-7307.

Ampex AG448 (7), some spare parts in, gd cond, BO. E Terry, WETA, 3700 S-Fair Mile Run Dr, Arlington VA 22206. 703-688-2788.

Telex Magnecord 1022 R/R, 1/2 trk, recently serviced, excel cond, \$295. S Campbell, Campbell Prods, 186 Cashiers Dr, Seneca SC 29678. 803-882-2762.

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Revox A77 not working, \$150. WB Welden, KVLG, POB 1276, Sealy TX 77474. 409-885-4778.

Amplex 440C excel cond, \$2500; Revox A cassette, \$500. L McElroy, 875 S Clarkson, Denver CO 80209. 303-722-1109.

Scully 270's (3) 1/4" reel, 2 trk stereo 7.5/15 ips, perf working cond, w/manuals, \$750 plus ship. J Hurray, Steiger Hurray & Assoc, 253 River Rd, Hinchley OH 44233. 216-278-2600.

Amplex 351 rack mount, mono, works, \$150. J Cunningham, YSDA Radio, Rt 2 Box 113B, Stonewall OK 74871. 405-265-4496.

Amplex 351 2 trk w/remote, overbridge, rollaround, tube elec, 1577.5 ips, gd heads, \$650. J Green, WHPC, Stewart Ave, Garden City NY 11530. 516-222-7438.

Vega 1/2" 4 trk in console, 7.5 & 15 ips, \$3100; Studer A62 1/4" 2 trk, 7.5 & 15 ips, \$1200; Amplex MM 1000 8 trk 1" R/P, excel cond, \$5000; Scully 280 2 SP-14 2 trk 1/4" in console, one w/remote, 7.5 & 15 ips, w/remote \$2100, w/o \$1850. Executive Recdg, 300 W 55th #4P, NY NY 10019. 212-247-7434.

Scully 280 1" 8 trk w/4 trk head, excel cond, \$3100. E Mauro, Nall Recdg Std, 3016 Greenmount, Baltimore MD 21218. 301-467-7900.

Pioneer RT2022 1/2 trk 10-1/2" reel w/TAU-11 elec, gd cond, new heads, BO. C Coxix, Rejouissance, 2820 Raymond Ct, Falls Church VA 22042. 703-237-2590.

Metrotech logger, 10.5" reels, \$1000/BO. L Houck, Rollin Recdg, 210 Altgelt Ave, San Antonio TX 78201. 512-736-5483.

Amplex 350 elec tube type. L Houck, Rollin Recdg, 210 Altgelt Ave, San Antonio TX 78201. 512-736-5483.

Pentagon cassette duplicators w/R-R & cassette masters, one 12-slave, one 4-slave system. Nigel, Technichrome, 1212 S Main St, Las Vegas NV 89104. 702-386-2844.

Scully 280-4 4 trk, rack mount, rolls tape & heads look gd, as is, \$995. R York, Jewel Records, POB 31078, Cincinnati OH 45231. 513-522-9336.

Amplex 351 2 trk in wooden custom console, vgc, excel heads, \$1100. R York, Jewel Records, POB 31078, Cincinnati OH 45231. 513-522-9336.

Sony 1/2 trk, 766-2, closed loop, dual capstan, 10-1/2", 7.5 & 15 ips, 4 head w/remote, gd cond, \$550. R York, Jewel Records, POB 31078, Cincinnati OH 45231. 513-522-9336.

Tascam 22-2, used twice, in new cond, orig box & manual, \$600/BO. K Demucco, Bethany Lutheran Church, 35 W Messenger St, Rice Lake WI 54868. 715-234-3177.

Teac X7R R-R, dual capstan, bi-directional record & play, excel cond, \$375. R York, Jewel Records, POB 31078, Cincinnati OH 45231. 513-522-9336.

Revox A77; Sony TC630, both excel cond. B Michaels, Tye Bldg, POB 5105, Abilene TX 79608. 915-695-7300.

Tascam 32 7.5 & 15 ips, \$575. J Englander, Prod Block Sids, 906 E 5th, Austin TX 78702. 512-474-6043.

Tascam 40-4 4 trk R/R w/dbx, excel cond, \$950. J Englander, Prod Block Sids, 906 E 5th, Austin TX 78702. 512-474-6043.

Metrotech 552A Series 500 logger elects & reel machine (2), \$250 ea. S Portier, WNOE, 529 Bienville St, New Orleans LA 70130. 504-529-1212.

Tascam 122 bal & unbal inputs & outputs, dual VU meters, \$575. S Portier, WNOE, 529 Bienville St, New Orleans LA 70130. 504-529-1212.

Amplex PR10, \$100/BO. L Houck, Rollin Recdg, 210 Altgelt Ave, San Antonio TX 78201. 512-736-5483.

Revox B225, CD player, \$1200. S Portier, WNOE, 529 Bienville St, New Orleans LA 70130. 504-529-1212.

Ruslang tape cabinet, roll-around, never used, \$150. J Green, WHPC, Stewart Ave, Garden City NY 11530. 516-222-7438.

Amplex AG351, FT, \$500. L Houck, Rollin Recdg, 210 Altgelt Ave, San Antonio TX 78201. 512-736-5483.

Amplex AG351 2 trk, gd cond, \$600. L Houck, Rollin Recdg, 210 Altgelt Ave, San Antonio TX 78201. 512-736-5483.

Scully 280, in floor cabinet, mono, BO. G Erway, KBOG, Rt 2 Box 26B, Cordell OK 73632. 405-832-5332.

Want to Buy

Capstan motor for Tascam 7030SL. C Lundie, Cycle Sound & Video, 167 Madison St, Waterbury CT 06706. 203-756-7751.

Technics RSM85 cassette in gd cond. R McDaniel, KJRG, Box 567, Newton KW 67114. 316-283-5150.

1/2" 2 trk, record, reproduce & erase heads. D Love, Coincidence Digital Recdgs, 3700 Wingate, Waco TX 76706. 817-662-2551.

Amplex 15/30 ips servo motor. D Love, Coincidence Digital Recdgs, 3700 Wingate, Waco TX 76706. 817-662-2551.

Elect for Amplex 351. D Love, Coincidence Digital Recdgs, 3700 Wingate, Waco TX 76706. 817-662-2551.

Sony JH110C-8 working, gd cond, w/locator & rollaround. J Barcroft, KGB, 7150 Engineer Rd, San Diego CA 92111. 619-292-1360.

CONSOLES

Want to Sell

McMartin B502 stereo, 5 chan, \$575. J Griffin, Comm Services, 2900 E 6th St #75, Stillwater OK 74074. 405-377-3666.

GE 4BC1A1, BO. B Harlan, WFAH/WDJQ, 393 Smyth Ave NE, Alliance OH 44601. 216-821-1112.

Sparta A-16R rack mountable console, 5 chan, 15 input, 2 chan output, \$850. W Brown, KVNI, Coeur d'Alene ID. 208-664-9271.

Shure Production Master sub-mixer, mates to M67/M267, \$150. W Brown, KVNI, Coeur d'Alene ID. 208-664-9271.

Harris Medalist 10 w/P&G linear faders, in service, fully operational, \$1750. M Golchert, WVBR, Box 298, Russellville KY 42276. 502-726-3555.

Harris Executive 10 chan w/integrated out-board elec, fully operational when taken out of service 12/86, \$1800/BO. K Gordon, Key Comm, 10622 SW 100th St, Miami FL 33176. 305-271-1671.

Automated Processes, 40 x 8 x 24 w/Optimix automation system, 550 & 554 EQ's, (4) cue mixes. R Robinson, TNA, 10 George St, Wallingford CT 06492. 203-269-4465.

Quantum 128, 12 in 8 out w/144 position tiny telephone patch bay, housed in walnut cabinetry, vgc, \$4100. B Castner, Castners Ltd, 747 W Maple, Birmingham MI. 313-433-3530.

RCA BC18-8, gd cond, \$800. P Nicholson, Hollis Bldg, POB 7008, Columbus GA 31908. 404-322-2220.

Tascam 8 x 4 mixer, \$800. D Weeks, Sharpe Bldg, 515 E Park Dr, Monroe NC 28110. 704-283-7085.

Gates Yard 8 ch mono, \$400 & frt. M McAnally, WEKC, POB 1071, Williamsburg KY 40769. 404-943-3437.

MCI JH618, fully automated, less than 200 hrs, w/12 phase meter, #7, #13, #21 options, phantom power, \$19,000. J Simons, EVS Fleetwood Sids, 321 Revere St, Revere MA 02151. 617-289-6305.

Apache 100 mono, gd for news, \$300. K Trimble, Elizabethtown Bldg, Box L, Elizabethtown KY 42701. 502-769-1400.

Tascam M-35, 8 in 4 out, talkback, effects, slate, cue, 8 band EQ, slate tone, volume for control room, studio, headphones, gd cond, \$1250. R York, Jewel Records, POB 31078, Cincinnati OH 45231. 513-522-9336.

Tascam 10 3 mainframes & over 50 modules, all for \$400. B Hildebrand, Hildebrand Comm, 1819 Beltway, St Louis MO 63114. 314-427-2727.

RCA BCTA w/7 extra chan, \$500. J Lies, WTRC, POB 699, Elkhart IN 46515. 219-293-5611.

Ramko DC38-8S stereo, 8 chan, 32 inputs, \$2900. S Streitenberger, WFCB, 45 W Main, Chillicothe OH 45601. 614-773-3000.

McMartin B802S 8 mixer, stereo, \$1100. AH Bott, BHP Inc, 340 S 24th St, Quincy IL 62301. 217-224-1076.

Spotmaster 4BEM50 4 chan mixer for cable/bdct news, gd cond, \$500. D Lilling, Lilling Assoc, 1301 20th St NW #202, Wash DC 20036. 202-667-3276.

Allen & Heath 16 in & 8 out, \$5000. Executive Recdg, 300 W 55th #4P, NY NY 10019. 212-247-7434.

Tascam 30 mixer, new cond, \$950. T Stoller, 2320 Eade Ave, Ft Wayne IN 46805. 219-484-4913.

Audiotronics 501, 10 x 10 x 2 & quad, \$4500; & Audiotronics 501, 26 x 16 x 26, \$15000. Joe, River City Studios, 147 Goodrich SE, Grand Rapids MI 49503. 616-456-1404.

RCA EC-6B (2), 1 clean & working, other for parts, \$400 for both. J Ross, NW Audio, 3860 Rittamarie, Columbus OH 43220. 614-459-4292.

Allen & Heath 168D 16 x 8 x 2 3 aux sends, new cond, \$2200; Kelsey Club 4, 16 chan, in case, \$650. E Glenn, Madison N Prods, 1 Williams Cross Rd, Stormville NY 12508. 914-831-3644.

Tascam 2A, 6 x 4 mixer, \$250. J Englander, Prod Block Sids, 906 E 5th, Austin TX 78702. 512-474-6043.

Altec 250T3 12 chan, solid state stereo, works but needs some repair, \$200 plus ship. R Larsen, WROP, 316 S Maple, Oak Park IL 60302. 312-848-3172.

RCA BC2B one needs work, one for parts, BO. L Houck, Rollin Recdg, 210 Altgelt Ave, San Antonio TX 78201. 512-736-5483.

BE 5S150stereo, \$1200. D Angrem, WTMX, 4210 Norrose Dr, Indianapolis IN 46226. 317-545-8100.

Collins 212G1 gd cond, recently recond w/solid state, VU meters replaced w/stereo equip, \$1000. J Tudor, WKGG, POB 1080, Lenoir NC 28645. 704-433-5713 aft 6PM.

MCI 416 24 chan frame 18 in by 16 out w/producers desk, API faders, \$10,500. C Osgood, Ct Recording Std, 1122 Main, Bridgeport CT 06604. 203-366-9168.

Shure M67, \$250. B Jeffreys, WKMQ, 1901 Reedfarm Rd, Rockford IL 61111. 815-877-3075.

DISCO & SOUND EQUIP.

Want to Sell

Orban 245F stereo synthesizer (2), new, \$340 ea. B Salzman, Stevens Comm, 2600 Lupino St, Unit F-5, Vail CO 81657. 303-476-6786 aft 6 PM MT.

Eventide instant phaser, gd cond, \$250; Orban 111B stereo reverb, excel cond, \$350. B Castner, Castners Ltd, 747 W Maple, Birmingham MI. 313-433-3530.

Travel rack case w/angled top & space below, 30 space, flash hardware, \$250. M Baykian, Granny's Kitchen, 4261 Iverness, Orchard Lake MI 48033. 313-626-4075.

Audio gear inc: Eventide 1745A, 2830; Ursa Major 323, SST282; Yamaha R1000; UREI 920-16, 964; Ursa Major 8X32; Lexicon 224, 1200B; Roland RE201; Lexicon 93, 95, 102S; Eventide PA101A, FL201A, 910-06; Countryman 968; dbx 216; EMT 251, call for details & prices. R Burton, Audio Rents Inc, 7237 Santa Monica Blvd, LA CA. 213-874-1000.

EMT 140-T plate reverb, mono, \$1500. D Flynn, Continental Recds, 102 South St, Boston MA 02111. 617-426-3131.

Fairchild 658 echo unit w/rack & remote, triple spring, \$100/BO. A Tucker, Foothill Prod, 70 W 83rd St, NY NY 10024. 212-877-0973.

Fairchild 359 reverb, \$295. D Flynn, Continental Recd, 102 South St, Boston MA 02111. 617-426-3131.

Ursa Major 323 digital reverb, 8 room, 320 ms delay, bal in/out, \$699. P Vredenburg, Braintown Recdg, 12 Taylor Ct, Beardstown IL 62618. 217-323-2208.

UREI direct boxes for instruments, new, \$180 ea. M Fiedler Prods, 5346 Dupont Ave S, Minneapolis MN 55419. 612-822-0013.

Eventide 1745M digital delay, mono, \$990. Executive Recdg, 300 W 55th #4P, NY NY 10019. 212-247-7434.

dbx 310D modules in 216 mainframe, 16 chan, as is, \$1600. R York, Jewel Records, POB 31078, Cincinnati OH 45231. 513-522-9336.

Sparta stereo remote unit, Russo TT & stereo preamps, comp rebuilt, \$1200. C Lawson, LB Engr: 106 Skyline Dr, Bristol TN 37620. 615-764-3625.

dbx 310D modules in 216 mainframe, 8 chan, works fine, \$1100. R York, Jewel Records, POB 31078, Cincinnati OH 45231. 513-522-9336.

dbx 310D module, 2 tks in custom power supply rack, 8 XLR connectors, gd cond, just recond by dbx, \$350. R York, Jewel Records, POB 31078, Cincinnati OH 45231. 513-522-9336.

Ceiling Star chase light system, Revox B77 half trk, 7.5 & 15 ips, very little use, \$300. C Lawson, LB Engr, 106 Skyline Dr, Bristol TN 37620. 615-764-3625.

E-V Sentry IV PA horns, 1823M or 1824M drivers w/horns. S Russell, Russell Music, 60410 Klett Dr, Decatur MI 49045. 616-782-9258.

Yamaha R1000 reverb, new cond, \$725. T Stoller, 2320 Eade Ave, Ft Wayne IN 46805. 219-484-4913.

Gollehon PA cabinet, unloaded spks to fit 2-15" spks. S Russell, Russell Music, 60410 Klett Dr, Decatur MI 49045. 616-782-9258.

Orban 622 EQ, 2 chan, \$400. M Fiedler, Mahoney Fiedler Prods, 5346 Dupont Ave S, Minneapolis MN 55419. 612-822-0013.

Want to Buy

Lyrec timer or other 1/4" tape timer, 7.5 or 15 ips OK. A Tucker, Foothill Prod, 70 W 83rd St, NY NY 10024. 212-877-0973.

LIMITERS

Want to Sell

Orban 9100A/XT for 8100A/1, \$1250. B Harlan, WFAH/WDJQ, 393 Smyth Ave NE, Alliance OH 44601. 216-821-1112.

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Orban Optimod 8100A, perfect cond, \$3750. Ken Stevens, KTUX, 318-635-9999.

UREI 1178 for stereo dual peak limiter, looks, works new, \$500. K Blevins, Snider Corp, 4021 W 8th, Little Rock AR 72204. 501-661-7590.

Harris MSP-90 stereo AGC limiter assem, tri-band, w/all extender cards, manuals & cords, \$990. K Blevins, Snider Corp, 4021 W 8th, Little Rock AR 72204. 501-661-7590.

Aphex Compellor, like new, just out of box, BO. J Saunders, WJLM, 45 Penna Ave, Patchoque NY 11772. 516-475-1580.

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Gates SA 39A, 20 yrs old; FM Audimax 4450A stereo; Volumax 411 peak controller stereo; AM 2 Volumax 400 peak controller; Audimax III level controller. L Wilson, 409 Hillaire Dr, Hopkinsville KY 42240. 502-886-1678.

Orban 8000A (2), \$2000 ea. S Streitenberger, WFCB, 45 W Main, Chillicothe OH 45601. 614-773-3000.

Gates Sta-Level M-5167 works fine, \$60. W Brown, KVNI, Coeur d'Alene ID. 208-664-9271.

Dorough DAP 310 AM, BO ASAP. J Coursole, Coursole Bldg, 609 Lome Ave, Waupun WI 53963. 414-324-4441.

dbx 903 module, brand new, for F900 mainframe, \$175. E O'Brien, Our House Recdgs, 3041 Crawford, Terre Haute IN 47803. 812-238-9312.

Allison Research Kepex 500's (4) & (4) Gain brains w/16 unit power supply rack, all in excel cond, \$1200. B Castner, Castners Ltd, 747 W Maple, Birmingham MI. 313-433-3530.

CRL stereo FM4G, SPP800, SEP800(20), SMP800, \$4000/BO. J Hawkins, KGGI, Box 1290, San Bendino CA 92404. 714-889-2651.

Gates SA-39A limiter, \$150. W Brown, KVNI, Coeur d'Alene ID. 208-664-9271.

Optimod 8000A recently taken out of service, \$1900. K Trimble, Elizabethtown Bldg, Box L, Elizabethtown KY 42701. 502-769-1400.

Symetrix 525 dual gated CL, BO or trade for LA4. R Wells, KREO, POB 1598, Santa Rosa CA 95402. 707-433-4895.

CBS stereo FM Volumax Mod 411, \$250. B Harlan, WFAH/WDJQ, 393 Smyth Ave NE, Alliance OH 44601. 216-821-1112.

Dorough 310 Processor, BO. Guy, KBOG, Rt 2 Box 26B, Cordell OK 73632. 405-832-5332.

UREI 535 dual graphic EQ, excel cond, \$350. R Wells, KREO, POB 1598, Santa Rosa CA 95402. 707-433-4895.

Kahn SP58-1A Symmetra-Peak, \$95. S Porter, WNOE, 529 Bienville St, New Orleans LA 70130. 504-529-1212.

Orban 9000A Optimod AM. M McKenzie, KALL, 312 S East Temple, Salt Lake City UT 84111. 801-364-3561.

DAP 310 (3), 4400 Audiomax, 4440 Audiomax, 4111 Volumax, call for price. D Groth, Radio Engineering Assoc, Box 416, Poughkeepsie NY 12602. 914-471-1500.

CBS 411 stereo peak controller; CBS 4450A stereo compressor; Collins 26U1 tube type compressor; Fairchild 206 stereo compressor, BO on each. P Shirley, Lafayette Bldg, POB 52046, Lafayette LA 70505. 318-233-7003.

Allison/Valley People Gain Brain (2) plus LX100 power supply, peak & RMS limiting, \$400 for all 3 items. Cascade Recg, 2115 N Vancouver Ave, Portland OR 97227. 503-287-1662.

Dorough 310 tri-band processor, gd cond, replaced w/stereo equip, BO. J Tudor, WKGX, POB 1080, Lenoir NC 28645. 704-433-5713 aft 6PM.

BE FM601 stereo AGC limiter, \$700. M Wilson, KNOE, 1400 Oliver Rd, Monroe LA 71201. 318-388-8888.

CBS 400 Volumax, older white face unit, working cond, \$200. J Tudor, WKGX, POB 1080, Lenoir NC 28645. 704-433-5713 aft 6PM.

Gates Solid Statesman IE-1, \$800. S Portier, WNOE, 529 Bienville St, New Orleans LA 70130. 504-529-1212.

UREI LA4 compressor/limiter, \$450. D Angrem, WTMX, 4210 Norrose Dr, Indianapolis IN 46226. 317-545-8100.

Dorough DAP 310 mono processor, \$900. AH Bott, BHP Inc, 340 S 24th St, Quincy IL 62301. 217-224-1076.

UREI 1178 stereo CL w/manual, \$500/BO; UREI BL40 CL, \$250/BO. WB Welden, KVLG, POB 1276, Sealy TX 77474. 409-885-4778.

CBS III Audimax, working cond, older white face unit, \$200. J Tudor, WKGX, POB 1080, Lenoir NC 28645. 704-433-5713 aft 6PM.

RCA BA-28A, tube type AGC program amps (2), \$95 ea. S Portier, WNOE, 529 Bienville St, New Orleans LA 70130. 504-529-1212.

Modulation Sciences composite clipper. M McKenzie, KALL, 312 S East Temple, Salt Lake City UT 84111. 801-364-3561.

Spectra-Sonics Compilimits (2). M McKenzie, KALL, 312 S East Temple, Salt Lake City UT 84111. 801-364-3561.

Want to Buy

Orban 8100A, used FM Optimod. B Ladd, WNRN, 108-1/2 E Main, Bellevue OH 44811. 419-483-2511.

Inovonics MAP II 230 audio processor. B Kramer, WQXO, POB 3176, Longwood FL 32779. 305-682-5463.

Orban 8100A FM or Texar Audio Prism, substitutions OK. J Stitt, WLLT, 250 W Court Ste 300E, Cincinnati OH 45202. 513-241-9500.

CBS Audimax 4450. D Davis, Davis Bldg, 1217 Valencia Dr NE, Albuquerque NM 87110. 505-255-2431.

CBS stereo Audimax in any cond, can repair. G Miller, PA Network, 260 S Broad St, Philadelphia PA 19102. 215-732-7100.

MICROPHONES

Want to Sell

Sennheiser binaural rec system, new, BO. R Sanchez, Lincoln Fine Arts Radio, 3800 S 48th St, Lincoln NE 68506. 402-426-2520.

AKG C12A variable pattern power supply, 65' cable, vgc (2), \$550 ea; AKG C60 w/power supply & 65' cable, excel cond, (2), \$290 ea. B Castner, Castners Ltd, 747 W Maple, Birmingham MI. 313-433-3630.

E-V 666, vgc, \$100 plus ship. J Emmel, Emke Media, POB 401, Olyphant PA 18447. 717-383-1118.

AKG 414EB 48 V phantom power, \$500. M Fiedler, Mahoney Fiedler Prods, 5346 Dupont Ave S, Minneapolis MN 55419. 612-822-0013.

WE 633A historic mic's from the UN, \$45; WE 24A desk stand for 633 or 639, \$45; E-V 635A, \$60; E-V EL-103, \$20; Luxo mic booms w/adpt for 635A, \$35; will trade for old mic's or parts. R Van Dyke, Van Dyke Inc, Squires Ave, E Quogue NY 11942. 516-728-1327.

Cerwin Vega B30's, mint cond, ideal for disco or vocal use, 15" x 3 way, carpeted, \$475. J Green, WHPC, Stewart Ave, Garden City NY 11530. 516-222-7438.

Crown PZM6LPB, PX-T, PZM3LVB, PZM30GPB; Shure SM57-CN, AM528, SM11-CN, SM81; E-V RG-11, BO. J Johnson, Interand Corp, 3200 W Peterson, Chicago IL 60659. 312-478-1700.

Sennheiser MD421U, less than 1 yr old, \$189 ea or \$369/both. C Butler, 8709 Pinon Dr, Jacksonville FL 32221. 904-786-6363.

Want to Buy

Shure SM5B mic or RE-20 in gd cond, reasonable. J Emmel, Emke Media, POB 401, Olyphant PA 18447. 717-383-1118.

Sennheiser MD421, 2 ea wanted. G Stafford, Capital Magnetics, 1030 E Hruard Rd, Burbank CA 91501. 818-843-7987.

MISCELLANEOUS

Want to Sell

Business telephones 1A2 type 6 & 10 button, ITT models, 564, 2564, 830, 2830, gd cond, \$35 & up plus ship. C Zalinski, Eds Comm Svcs, POB 92, Johnson City NY 13790. 607-798-7111.

Rebuilt tube sockets at considerable savings, SK1300 & SK1320 used in CCA, AEL, McMartin, Elcom etc, for 3CX10,000, 3CX15,000 & 3CX20,000 tubes, complete assemblies or individual collets. Goodrich Ent, 11435 Manderson, Omaha NE 68184. 402-493-1886.

Oak equip rack, 33" high 19" wide 16" deep w/casters, \$100. J Nigro, Negro Assoc, 25 Patton Ct, Wayne NJ 07470. 201-790-1415.

Timer, up or down, to 9 min 59 sec, presettable, home brew, momentary contact for remote, \$35. C Zalinski, Eds Comm Svcs, POB 92, Johnson City NY 13790. 607-798-7111.

Phone Mate 300S battery operated automatic telephone answering machine, very little use; (2) new Christmas tree terminal blocks, 80 & 78 terminals; (2) used 80 terminal blocks; (1) used 60 terminal block; (1) 30 terminal block, mounted on frame. L Wilson, 409 Hillaire Dr, Hopkinsville KY 42240. 502-886-1678.

Rainbow case 2'9" x 2' x 2" insert rack mount incl, \$300/BO. R Sanchez, Lincoln Fine Arts Radio, 3800 S 48th St, Lincoln NE 68506. 402-426-2520.

Plate transformer, 3 phase 220/4000 V at 1 A, never used, \$450. S Streitenberger, WFCB, 45 W Main, Chillicothe OH 45601. 614-773-3000.

Comp phone system inc 10 ITT 9 line phones, Sanbar KSU w/7 line cards w/intercom system, BO. R Wells, KREO, POB 1598, Santa Rosa CA 95402. 707-433-4895.

Beau motor (new) for Ampex 440 3 speed, 7.5-15 & 30 ips, \$295. D Flynn, Continental Recd, 102 South St, Boston MA 02111. 617-426-3131.

Record-A-Call 560 answering units, (2), not remoted, like new, \$60 ea plus ship. J Emmel, Emke Media, POB 401, Olyphant PA 18447. 717-383-1118.

ASR-33T send & rcv teletype, BO. J Emmel, Emke Media, POB 401, Olyphant PA 18447. 717-383-1118.

Antique radio parts: tubes, ballasts, transformer, speakers, etc, SASE for list. N Carlson, Mobile Sound Group, 721 W Melrose, Chicago IL 60657. 312-871-7459.

Tandy TRS-80 Mod II w/2 expansion drives, \$500. B Harlan, WFAH/WDJQ, 393 Smyth Ave NE, Alliance OH 44601. 216-821-1112.

Teletype 33 (2), ASR, w/punch & reader, w/ or w/o stands, take one or both, \$250 ea or BO & you pick-up; many 16mm projectors to sell; Fairchild Galaxy (rear screen) salesman's projector. DMT A/V, Box 9064-RW, Newark NJ 07104. 201-484-5291.

Copper wire, #10, more than 12,000', \$500 & frt. M McAnally, WEKC, POB 1071, Williamsburg KY 40769. 404-943-3437.

Coex 80/FT dot matrix printer, used once, no manual, \$75. J Martin, Box 160326, Mobile AL 36616. 205-460-2395.

Oak equip rack, 19" x 22 x 33 x 16.5" w/casters, \$100. J Nigro, 25 Patton Ct, Wayne NJ 07470. 201-790-1415.

FREE, about 50 copies of Radio & TV News & Radio Elect, dating back to 1952. J Mayeux, 313 N Kenmore St, Arlington VA 22201. 703-524-7651.

Bird 8931-115 10 kW load, new in box, \$2000. GV Bell, POB 11100, Truckee CA 95737. 916-562-1164.

Vacuum crystal, T-12A, 1590 kHz for Gates BC-1H, \$75. D Davis, Davis Bldg, 1217 Valencia Dr NE, Albuquerque NM 87110. 505-255-2431.

New tech manuals for Sparta Elect products, write for product. D Peluso, DGP Consult, 2900 E Charleston Blvd #197, Las Vegas NV 89104. 702-384-0081.

Want to Buy

Used equip for new AM, mod mon, EBS rcvr, console, EBS gen, AGC limiter, tape decks, automation system, etc. F Kavenik, WLMV, Box 187, Vernon Hills IL 60061. 312-680-7557.

Gates SA 10 tech manuals & ops manuals, negotiable. J Pounds, WVLI, POB 902, Lexington VA 24450. 703-463-2161.

Manual or schematics for Ampex SP300 multitrack data recorder. T Adams, Wisc Pub Radio, Box 5541, Madison WI 53705. 608-246-2052.

MONITORS

Want to Sell

Gates MO-2639 mod monitor, gd for parts. L Wilson, 409 Hillaire Dr, Hopkinsville KY 42240. 502-886-1678.

McMartin TBM 3500 FM mod monitor, just taken out of service, in working cond, \$100/BO plus ship. R Phipps, KHL, 998 A Sidney Baker So, Kerrville TX 78028. 512-257-7711.

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Phone 800-336-3045

Employment

To place ads in this section, use the Action-Gram form. To respond to box numbers, write Radio World, Box 1214, Falls Church VA 22041, Attn: _____

POSITIONS WANTED

Hard working, dedicated exp (18 yrs) morning man/news/prod/admin, married, stable, avail, gd voice, warm climates, medium/larger markets. L Kay, 203 Harvestview N, Mount Joy PA 17552. 717-653-2500.

Journeymen TV control engr seeks employment in any aspect of video, cable or commercial TV bdcgt in Denver area. Bldt major, AS-USNY, Marine radio FCC license, 4 yrs military TV prod/troubleshooting, 4 yrs civilian commercial TV prod. Contact Sharon Smith: 303-430-7159.

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Studer Revox seeks experienced Service and Quality Control Technicians for openings in both the Studer and Revox divisions. Thorough knowledge of recording systems is essential; experience with other audio components and microprocessor control systems preferred. Openings at Nashville headquarters. Excellent benefits, salary based on experience. Apply by written resumé only to:

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Studer Revox America
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Nashville, TN 37210

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Chief position, 30 yrs in radio-TV bldt maint, prefer West. Rick, 916-674-3532.

Seeking asst or CE position in central US, major market asst & CE exper, FM/AM/DA, studio/TX repair & maint exp. TS, N143 W6175 Pioneer Rd, Cedarburg WI 53012.

CE, radio, FCC gen'l lic, BS Engr, exp in FM, prod sound systems & computers (H/W & S/W). A Melnyk, 200 Stockbridge Rd, Lenox MA 01240. 413-637-0838, X105.

New eng looking for place to grow & learn, have some exp, want more, ready to go! M Forster, 702 S Cherry St, Hammond LA 70401. 504-345-8963.

Prof high energy DJ seeks PT position in upstate NY, have refs/exp. G Collette, 237 N Huelson Ave, Stillwater NY 12170. 518-664-5094.

Corp CE, hard working, self-starter, wanting FT position w/single or group owner stations, 10 yrs hands-on exper in AM/FM, for KS, CO, MO, NE, OK, TX, IA, IL, avail immed. L Timmons, RR 2 Box 41, Stockton KS 67669. 913-425-6509.

Tech person, 10 yrs exper video/film, elect & bdcgt. Seeks PT/FT work inhouse/location film/video, Gen FCC, SBE, SMPTE. H Gray, 408-246-5563/241-9637.

Young successful PD seeks OM/GM in small/medium market. AM or FM, challenge a must! B Jones, 870 Pike St, Wabash IN 48992. 219-563-8619.

Exp announcer seeks new position w/VA station, 5 yrs on-air, great prod, former MD. G Hale, POB 52, Pratts VA 22731. 703-786-3423 or 703-948-6459.

HELP WANTED

Chief Engineer good-sized market, in NW, gd maintenance skills required w/studios, directional AM stereo, Class C FM, E.O.E. Send resumé to: Radio World, POB 1214, Falls Church VA 22041. Attn: Box 5-1.

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Want To Sell It?



Broadcast Equipment Exchange

MONITORS . . . WTS

Want to Buy

Collins 900C-3 mod mon, schematics & oper info. H Schardin, 8639 178th Ave, Forest Lake MN 55025. 612-464-7587.

Belar RFA-1 FM RF amp, schematics & oper info. H Schardin, 8639 178th Ave, Forest Lake MN 55025. 612-464-7587.

Belar FMS1, gd cond. B Kramer, WQXO, POB 3176, Longwood FL 32779. 305-682-5463.

MOVIE PRODUCTIONS EQUIP.

Want to Sell

B&H 1590B 16mm projectors, like new, \$400 ea. A Wentt, Faith Prod, 1441 Guthrie Dr, Cleveland TN 37311. 800-251-4024.

Want to Buy

Auricon EIF-20 Finder #, automatic parallax viewfinder for Auricon 16mm pro camera. H Deans, Deans Prods, 170 Gran St, White Plains NY 10601. 914-949-5920 aft 6 PM EST.

High-speed 16mm film camera, pref inexpensive. G Ormrod, GFO Productions, 122 E 19th, Olympia WA 98501. 206-352-8028.

RECEIVERS & TRANSCEIVERS

Want to Sell

Hallcrafters SX111 ham receiver, mint, w/manual, \$150. D Stebbins, KELK, 1800 Idaho, Elko NV 89801. 702-738-7118.

McMartin TRE 6-B SCA receivers xtal controlled, all solid state, \$55 ea plus ship. P Lierman, KNIS, Box 1243, Dayton NV 89403. 702-883-5700.

GE lo-band xtal FM monitor mdl 4ER7B5 rack mount, tube type, \$50 ea. J Newman, 143 WBUC Road, Buckhannon WV 26201. 304-472-3932.

Walki-Talkies (5) police/ind type, gd working cond. D Pickett, KIBG, 5001 Lionel Ave, Texarkana TX 75503. 214-832-5410.

UHF portable transceiver/base station, \$100. D Pickett, KIBG, 5001 Lionel Ave, Texarkana TX 75503. 214-832-5410.

Kenwood KR-6170 AM/FM receiver, 60 W w/built-in reverb & synth, \$100. M Gottesman, KAMP, POB 1018, El Centro CA 92244. 619-352-2777.

Want to Buy

Bearcat BC101 scanner receiver. J Hurray, Steiger Hurray & Assoc, 6816 W View Dr, Cleveland OH 11441. 216-526-7187.

REMOTE & MICROWAVE EQUIP.

Want to Sell

Transtar Satcom rcvr for Transtar Adult Comp temp service, 6 mos old, mint cond, \$4000. R Kramer, WQXO, Box 100, Munising MI 49862. 906-387-4000.

Trade S-A DAT-32 7.5 kHz card for 15 kHz card. R Wright, WLLX, Box 156, Lawrenceburg TN 38464. 615-762-2916.

S-A digital receiver w/15 kHz demod. G Stockman, WMFG, 807 W 37th, Hibbing MN 55746. 218-263-7531.

Wegener Series 1600 SMN receiver w/25 Hz & 35 Hz tone detector boards & 1683 receive translator board, also have video receiver, \$2000. S Streitenberger, WFCB, 45 W Main, Chillicothe OH 45601. 614-773-3000.

Orban 8000A Optimod FM, great cond, \$2400. J Smith, WIXK, 125 East 3rd St, New Richmond WI 54017. 715-246-2254.

ABC net alert rack mount unit (2) w/digital readouts, \$250 ea/\$400 pr. B Mountjoy, Custom AV Svcs, Box G1240, Elizabethton TN 37644. 615-543-5849.

Moseley (2) for 2-way & Marti 150-174 MHz. B Statham, WSTU, 1000 Alice, Stuart FL 33494. 305-692-1000.

Marti RMC2 remote control system, gd cond, \$700. M Wilson, KNOE, 1400 Oliver Rd, Monroe LA 71201. 318-388-8888.

Collins MW318A transceiver, 6 GHz TV, \$1200; RCB TVA7, 6 GHz TV, \$300. G Bell, Bell & Assoc, POB 1762, San Mateo CA 94401. 916-562-1164.

Marti modulator & demod cards for RMC-15 to STL use tuned to 66 kHz, \$100/pair; Moseley DRS-1A 10 chan digital remote control, BO. P Keogh, WKFX, POB 11907, Green Bay WI 54307. 414-468-5445.

Misc older RPU gear, Marti, GE, Motorola. M McKenzie, KALL, 312 S East Temple, Salt Lake City UT 84111. 801-364-3561.

Misc STL equip, Marti preamp, iso-coupler. M McKenzie, KALL, 312 S East Temple, Salt Lake City UT 84111. 801-364-3561.

Gentner VCR 1000 remote control system, never used. C Harrison, KGEM, POB 5278, Boise ID 83705. 208-344-3511.

Arlxter Mark 4' grid dishes for 950 MHz STL (2), as is, working when removed, BO; Moseley PCL 505 composite audio STL system, BO; Moseley TRC 15AW radio remote control system, BO; Gates RDC200A wireline remote control, BO. P Shirley, Lafayette Bdcg, POB 52046, Lafayette LA 70505. 318-233-7003.

Want to Buy

Moseley TRC15 in gd cond, w/manuals pref, negotiable. F Kavenik, WLMV, Box 187, Vernon Hill IL 60061. 312-680-7557.

Moseley 303. T Driggers, Driggers Bdcg, 818 Quail Ct, Healdsburg CA 95448. 707-433-9370.

TV microwave system, short hop for LPTV. T Peiorbet, WMKE, POB 1844, Midland MI 48640. 517-631-5583.

Cheap, used tube microwave STL for col- or TV bandwidth. C Alexander, Four Seasons Bdcg Inc, Box 669, Cadillac MI 49601. 517-482-9695.

Moseley PCL806C STL & MRC1600 remote control or equiv. J Sitt, WLLT, 250 W Court Ste 300E, Cincinnati OH 45202. 513-241-9500.

Marti MR-30 rec. B ladd, WNRR, 108-1/2 E Main, Bellevue OH 44811. 419-483-2511.

Remote control w/26 kHz control & 67 MHz telemetry. B Murphy, KVRH, 7600 County Rd 120, Salida CO 81201. 303-539-2575.

Florida outskirts of Tallahassee, only station in county, 1 kW 130K clear channel pre sunset authorization. J Hyden, WMFL, 1275 S Jefferson St, Monticello FL. 904-997-3536.

S-A DAT32 satellite system 7.5 kHz audio decoder card. K Brooks, KREI, POB 461, Farmington MO 63640. 314-756-6476.

Digital satellite receivers, Fairchild, Dart or equal. A Bowab, WDLT, 2402 Wolf Ridge Rd, Mobile AL 36618. 205-344-3698.

STATIONS

Want to Sell

Class IV automated AM in Andalusia AL, positive cash flow, owner taking out \$30,000 per year, land & building avail, FM chan avail in area, positive growth area, \$165,000 terms. W Hoisington, WTCG, Andalusia AL 36420. 205-222-8849.

Danville VA, 1 kW day, 500 PSA, 330 PSSA, 970 kHz, \$35K & terms. J Clegg, Box 3325, Danville VA 24543. 804-836-9700.

Daytimer, 1 kW, 1580, Class A FM 105.5, 2800 sq ft 3 bdrm, std combo on 3 acres of land, in city limits, comp automated, loads of gd clean equip, clear title, pkg. \$350,000 neg. J Robillard, KLVU, 1803 N First East St, Haynesville LA 71038. 318-624-0105.

Want to Buy

Got an FM CP, about to run out of time to build, we may be interested, call or write. F Morton, KMGZ, POB 7953, Lawton OK 73506. 405-536-7953.

STEREO GENERATORS

Want to Sell

Moseley SCG8 & SCD8, both \$200. G Falus, WRGR, 600 Atlantic Ave, Ft Pierce FL 33450. 305-461-0099.

McMartin BFM-1521 latest model, factory tuned & tested. Goodrich Ent, 11435 Mander- son, Omaha NE 68164. 402-493-1896.

SWITCHER (VIDEO)

Want to Sell

Visual Elec 24-10 24 input, 7 buss prod switcher, just removed from service, \$1000/BO. B Ellis, KOZK, MPO Box 21, Springfield MO 65801. 417-865-2100.

TAPES, CARTS REELS

Want to Sell

Fidelipac 300 (200) almost all w/HOLN tape, 25' ea. M Golchert, WVBR, Box 298, Russelville KY 42276. 502-726-3555.

3M-Scotch 206, 208 & Ampex 632 1/4" on 5", 7" & 10 1/2" reels-repro. Also available Ampex 406, 456, 3M 250 & Agfa 469 2" audio tape w/no splices & with one splice. Also available Ampex 406 & 456 1" audio tape with no splices. Call for prices. Burlington Audio Tapes, 106 Mott St, Oceanside, NY 11572. 1-800-331-3191 or in NYS 516-678-4414.

Pre-recorded music tape, 14" reels, 2 trk stereo, 7.5 ips IGM music, easy listening. F Anderson, 38C1 5th Ave S, Great Fall MT 59405. 406-452-2810.

Audiopack AA3 carts, (650), excel cond, 2.5-10min, \$2.00 ea. B Anthony, Rt 3 Box 185, Cornelius OR 97113. 503-357-6120.

Seac radio transcription library, excellent, \$1000. R Bellarva, WSBC, 4949 W Belmont, Chicago IL 60641. 312-777-1700.

Large stock of 10-1/2" metal reels, all for 1/4" tape, all NAB hub, all guaranteed in excel cond w/uniform flanges, \$1.50 (1-10), \$1.25 (10-100), \$1.00 (100+). G. Falk, Falk Recdg, 7914 Fegenbush Ln, Louisville KY 40228. 502-238-1010.

Audiopack A2's, (1000) w/HOLN tape. J Lies, WTRC, POB 699, Elkhart IN 46515. 219-293-5611.

Audiopack AA3's, (150) various lengths, in gd cond, \$1 ea. T Ray, WKSS, 60 Washington St, Hartford CT 06106. 203-249-9577.

Aristocart carts, \$300 takes all. W Brown, KVNI, Coeur d'Alene ID 208-664-9271.

Fidelipac numerous sized & Aristocart in 8.5 min length, new, BO. J Emmel, Emke Media, POB 401, Olyphant PA 18447. 717-383-1118.

Recortech tape eval, 1", 2" & 3/4", several of each. Nigel, Technichrome, 1212 S Main, Las Vegas NV 89104. 702-386-2844.

Ampex 1/4" tape, 60 min, \$10. L McElroy, 875 S Clarkson, Denver CO 80209. 303-722-1109.

Fidelipac & Audiopack 20 sec to 4 min, like new, some unused (450), \$1.50 ea. AH Bott, BHP Inc, 340 S 24th St, Quincy IL 62301. 217-224-1076.

Memorex 360 2" quad tapes, properly stored, sealed, packaged w/precision aluminum take up reels, BO. A Wootner, 23A Locust Ave, Lark Spur CA 94939. 415-927-0865.

Audio tape, 5, 7, 10" reels, each quality checked, gd prices. J Newman, 143 WBUC Road, Buckhannon WV 26201. 304-472-3932.

Scotch 1/2 mil bdct quality automated tape in boxes, 900 reels avail, \$2 ea. J Geedy, Geedy Assoc, POB 1467, Wilmington NC 28402. 919-251-8800.

Want to Buy

Fidelipac Master Carts, red or gold, any length, need 2000. D Davis, Davis Bdcg, 1217 Valencia Dr NE, Albuquerque NM 87110. 505-255-2431.

TAX DEDUCTION EQUIP.

PA & 2-way radio comm equip needed, donations. G Mikkelsen, Deep-Portage Conservation Foundation. 612-338-6455.

Magruder HS, needs equip donations to start school radio station. S Scarfield, 32 Brian Ct, Gaithersburg MD 20877. 301-921-0427 aft 3 PM weekdays.

Non-profit hands-on museum for children needs donated on-air light & studio equipment. M Sherk, The Discovery Center, 164 Hawley St, Binghamton NY 13901. 607-773-8750.

High school tech video program in desperate need for 3 1/4" editing system & any A/V equip for our studio. C Burke, Matawan Aberdeon Chan 19, Atlantic Ave, Matawan NJ 07747. 201-290-2840.

TEST EQUIPMENT

Want to Sell

Tek RM-529, need repair (2), \$300 ea. T Smith, CCI Comm, 192 Lancaster Ave, Frazier PA 19185. 215-289-1725.

Hickok 288X signal gen; Eico 425 scope; Simpson 260 VOM, needs repair; BC221 freq meter, battery operated; Hallcrafters S76 receiver, 540 kHz to 34 MHz. L Wilson, 409 Hillaire Dr, Hopkinsville KY 42240. 502-886-1678.

Heathkit IO104 15 meg triggered sweep scope, needs a little work, \$200/BO. R Wells, KREO, POB 1598, Santa Rosa CA 95402. 707-433-4895.

Tek RM529 waveform monitor, new tube, \$450. H Donnell, Creative Video Prod, 211 Windsor St, Reading PA 19601. 215-378-0994.

Tek 7704A scope, incl: 7A26, 7A13, 7B85, 7B80, scope cart, excel cond, new CRT in 1985, \$8400/BO. T McConville, Complete Post, 6087 Sunset Blvd, Hollywood CA 90028. 213-467-1244.

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EMPLOYMENT SECTION:

Help Wanted

Any company or station can run "Help Wanted" ads at the flat rate of \$18 per listing per month (25 words max). Payment must accompany insert; there will be no invoicing. Blind box numbers will be provided at an extra charge of \$2. Responses will be forwarded to listee, unopened, upon receipt. Call 800-336-3045 for display rates.

Positions Wanted

Any individual can run a "Position Wanted" ad, FREE of charge (25 words max), and it will appear in the following 3 issues of Radio World. Contact information will be provided, but if a box number is required, there is a \$2 fee which must be paid with the listing (there will be NO invoicing). Responses will be forwarded to the listee, unopened.

Check as appropriate: Help Wanted With Box Number Positions Wanted Without Box Number

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Rw

Broadcast Equipment Exchange

TEST . . . WTS

Jasoni TAS-1000 audio tape analyzer, prototype, \$250. D Peluso, DGP Consult, 2900 E Charleston Blvd #197, Las Vegas NV 89104. 702-384-0081.

Yaesu Museu YC-355D, nixie-tube freq counter, 35 MHz/30-200MHz, \$125. S Portier, WNOE, 529 Bienville St, New Orleans LA 70130. 504-529-1212.

Tentel T2L20-A Tentelometer, never used, \$110. M Fiedler Prods, 5346 Dupont Ave S, Minneapolis MN 55419. 612-822-0013.

Waveforms 452A, transmission measuring set, \$100. S Portier, WNOE, 529 Bienville St, New Orleans LA 70130. 504-529-1212.

HP-332A dist analyzer; HP-202 osc, both for \$500. P Moore, WBBA, RR1, Pittsfield IL 62363. 217-285-2157.

RCA BI-11A, transmission measuring set, \$100. S Portier, WNOE, 529 Bienville St, New Orleans LA 70130. 504-529-1212.

HP audio gen & dist analyzer, tube types, M McKenzie, KALL, 312 S East Temple, Salt Lake City UT 84111. 801-364-3561.

Gates M3625, test set, \$95. S Portier, WNOE, 529 Bienville St, New Orleans LA 70130. 504-529-1212.

Amp-volt (roll) chart recorder, dual scale, model A601C, \$150. D Pickett, KIBG, 5001 Lionel Ave, Texarkana TX 75503. 214-832-5410.

Potomac AT51 test system. D Zimmerman, KCLD, POB 1458, St Cloud MN 56302. 612-251-1450.

Want to Buy

Delta in line bridge, Delta revr/gen. J Battison, 890 Clubview Blvd N, Columbus OH 43085. 614-888-3364.



15, 30 and 80 W excitors, 100, 200, 250, 400, 500 and 1000 W solid state amplifiers.

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739 Fifth Ave.
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619-239-8462
Telex 229882LJMUR

Field strength meter for AM, gd cond. V Baker, Box 889, Blacksburg VA 24060. 703-552-4252.

TRANSMITTERS

Want to Sell

RCA BTA-5F, 5 kW AM, vgc w/spares, 1480, off air, you dismantle, BO. B Glasser, WHBC, POB 9917, Canton OH 44702. 216-456-7166.

McMartin B-910 FM stereo exciter, tuned & tested to your frequency at factory, stereo or mono. Goodrich Ent, 11435 Manderson, Omaha NE 68164. 402-493-1886.

Harris BC10H AM, 10 kW, 1580, 5 kW cut-back, 1978 vintage, BO. J Saunders, WLLM, 45 Penna Ave, Patchogue NY 11772. 516-475-1580.

Versa Count V322 FM exciter, 10 W stereo, 87.9 MHz, fully programmable, \$850. M Rakoff, WQVM, 114-41 Queens Blvd #148, Forest Hills NY 11375. 718-591-0002.

Gates BC50C 50 kW AM stereo xmt (1966), Motorola AM stereo incl, avail June 1st. D Gehman, WASG, 1210 S Main, Altmore AL 36502. 205-368-2511.

Continental 802-A FM solid state exciter, gd as new, 2 yrs old, \$4000. R Goodman, WCKN, POB 650, Anderson SC 29621. 803-226-1511.

Harris FM5H3 5 kW FM, less exciter, as is, working when removed, BO. P Shirley, Lafayette Bdcg, POB 52046, Lafayette LA 70505. 318-233-7003.

Collins 830D 1 kW FM 3 kW class A okg, FMC LP77 bay antenna w/mounts, 300' Andrew 1-5/8" heliax, Collins 542-1 freq mon 107.1 MHz, Shafter automation brain & racks, \$11,800. B Larson, KSOS, Layton Hills Mall, Layton UT 84041. 801-546-1722.

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Weston 2031 percent power meter for Continental AM/FM xmt, \$45. D Peluso, DGP Consult, 2900 E Charleston Blvd #197, Las Vegas NV 89104. 702-384-0081.

Harris BC10H 10 kW AM stereo xmt (1981), Motorola AM stereo incl, avail June 1st. D Gehman, WASG, 1210 S Main, Altmore AL 36502. 205-368-2511.

Collins 550A, 500-250 W AM, \$1500. S Vellmer, KDMN, Box 639 Buena Vista CO 81211. 303-395-2004.

RCA BTF10D 104.1 MHz, \$7500. J Eves, WPAY, 1009 Gallia St, Portsmouth OH 45662. 614-353-5176.

RCA BTA-1R, 550 kHz, \$3000. N Allebaugh, WICE, 100 John St, Cumberland RI 02864. 401-725-9000.

Plate xformer TMC, 18 KVA, 3 phase, 210-250 V primary, sec yields 6000 VDC, 3 A, \$300. A Emerald, Emerald Ent, 8956 Swallow Ave, Fountain Valley CA 92708. 714-962-5940.

Gates BC1T 1 kW AM w/100' tower tuned to 1450 kHz, BO. J Chidester, KGLN, 162 W 6th, Glenwood Springs CO 81602. 303-945-6501.

Collins 20V2 500-1000 W, mint cond, 1140 kHz, BO. S Vellmer, KDMN, Box 639, Buena Vista CO 81211. 303-395-2004.

Continental 814R-1 2.5 kW FM, 802A new type exciter, 3 yrs old, new final tube, \$17,000. B Michaels, Tye Bdct Co, POB 5705, Abilene TX 79608. 815-695-7300.

Want to Buy

AM xmt, 3-4 tower antenna, phaser & phase monitor. B Barry, WAMB, 1617 Lebanon Rd, Nashville TN 37210. 615-889-1960.

Audio driver xmt T5 or T6 for Gates DC500K, L Weatherford, WSQR, Box 249, Sycamore IL 60178. 815-895-3636.

FM xmt, 25 kW in gd cond. E Kazmark, KAZZ, Box 1369, Deerpark WA 99006. 509-276-8816.

FM xmt, 1-5 kW. E Goetsch, WXPB, 303 W Prospect, Rhinelander WI 54501. 715-362-6000.

QE1 675 exciter. D Dietz, WZOQ, 710 N Cable Rd, Lima OH 45805. 419-222-9292.

Rust 5225 xmt, EMT 15ASCXB & manuals, will negotiate. R Speichinger, KBSR, 4040 Tower Rd, Rapid City SD 57702. 605-343-6822.

Lower power TV UHF & VHF xmt, call collect. N Davis, Davis Comm, 25 Tall Pines, Delunak Sp FL 32433. 904-892-4038.

AM, 1kW or less for wide area carrier current system. B Diefenderfer, Morning Star Ministries, 590 Main, Slatington PA 18080. 215-767-5985.

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SANTA CRUZ, CA (408) 458-0552

5 kW AM, gd cond, decent care, reasonable price. J. Brownell, WTNX, Rt 2 Box 96, Lynchburg TN 37352. 615-759-7111.

Gates BC5B 5 kW AM xmt, 570 kHz, parts avail for retune to 1310 kHz, w/book & tubes, BO. Bob Dobbs, KBBX, POB 388, Salt Lake City UT 84110. 801-292-5229.

Harris MW10 or similar unit. H MacDonald, KUMT, POB 710, Ennis MT 59729. 406-682-7598.

LPB carrier current xmt, pwr line coupler & instruction manuals, prefer solid state, paying \$100. D Sites, AmConGen, MRS, APO NY NY 09108.

TUBES

Want to Sell

RCA 8976 new cond, BO. T Smith, CCI Comm, 192 Lancaster Ave, Frazier PA 19355. 215-289-1725.

Hundreds of new old stock receiving tubes & ballast tubes, call or SASE for list. N Carlson, Mobile Sound Group, 721 W Melrose, Chicago IL 60657. 312-871-7459.

New, boxed, small audio & RF tubes, from \$1-5. write for list. D Peluso, DGP Consult, 2900 E Charleston Blvd #197, Las Vegas NV 89104. 702-384-0081.

Transmitter tube, 6181, still in factory sealed container. L Nixon, WTKV, 601 N Lee St, Valdosta GA 31601. 912-247-3333.

Want to Buy

Brimar D10-240GH view data 940A oscilloscope. F Anderson, 3801 5th Ave S, Great Fall MT 59405. 406-452-2810.

Tubes, 242C or 211 for WE-451A xmt. H Parrish, WOZK, POB 910, Ozark AL 36361. 205-774-5600.

TURNTABLES

Want to Sell

Sparta GT w/pedestal cabinet, \$150 plus ship. J Emmel, Emke Media, POB 401, Olyphant PA 18447. 717-383-1118.

RCA 12" TTs, 33/45 (3), \$75 ea. B Harlan, WFAH/WDJQ, 393 Smyth Ave NE, Alliance OH 44601. 216-821-1112.

AR turntable, circa 1972, hole cut for SME arm, original arm reinstalled, \$25 plus ship. J Martin, Box 160326, Mobile AL 36616. 205-460-2395.

Harris CB1201 12" 3 speed TT Micro-Trak tonearm & Shure cartridge, never used, \$350. B Mountjoy, Custom A/V Svcs, Box G1240, Elizabethton TN 37644. 615-543-5849.

Presto 16" transcription TT, EQ, tone arm, BO. R Nelson, Lutheran Gospel Hr, Box 1, Flaxton ND 58737. 701-596-3565.

RCA transcription player, 78/33 rpm, \$500. R Bellarva, WSBC, 4949 W Belmont, Chicago IL 60641. 312-777-1700.

QRK 3 speed TTs w/QRK tonearms, no cartridge heads (4), \$200 ea. W Brown, KVN1, Coeur d'Alene ID. 208-664-9271.

QRK 3 sp, w/Micro-Trak 303 arms, gd cond, \$135 ea. E Martin, Maxwell Prod, 220B Terrace View Rd, Louisville TN 3777. 615-970-2192.

Metron 12" TTs (2), 2 speed, \$50 ea. D Ibel, KICD, 2600 N Hwy Blvd, Spencer IA 51301. 712-262-1240.

Russco Studio Pro's, (2), \$450 both. D Angrem, WTMX, 4210 Norrose Dr, Indianapolis IN 46226. 317-545-8100.

Gates CD100 16" (2), Micro-Trak 303 tonearms, excel cond, \$300/both. C Lawson, LB Engr, 106 Skyline Dr, Bristol TN 37620. 615-764-3625.

Technics SP25 (2) same as new, about 5 hrs use, perf cond & working order, \$250 ea. C Dix, KJRG, Box 567, Newton KS 67114. 316-283-5150.

Sparta D-12 12" 3-speed TTs (2), fair cond, \$75 ea. D Davis, Davis Bdct, 1217 Valencia Dr NE, Albuquerque NM 87110. 505-255-2431.

Gates CB-500 16" transcription TT, excel cond, \$175; console cabinet for CB-500, \$50; dual console for CB-500, \$100; also equip by Rek-O-Kut, Presto, Grey, WE, send for list. R Van Dyke, Van Dyke Inc, Squares Ave, E Quogue NY 11942. 516-728-1327.

Micro-Trak long tonearms (2), one new, one slightly used, excel cond, \$75 & \$50. C Dix, KJRG, Box 567, Newton KS 67114. 316-283-5150.

GA CB77 drilled for Micro-Trak tone arms, BO/trade. R Hann, KDCR, Dorot College Campus, Sioux Center IA 51250. 712-722-0885.

Sparta GT w/pedestal cabinet, \$150 plus ship, vgc. J Emmel, Emke Media, POB 401, Olyphant PA 18447. 717-383-1118.

Russco MK-V variable TT's w/Micro-Trak 303's & 2 Harris preamps, excel cond, \$750 plus ship. R Kerbawy, WTNJ, Box 1127, Beckley WV 25801. 304-877-5592.

Rek-O-Kut, 3 speed, gd cond, \$125, free ship. J Sheppard, Globe Prod, 539 W Minister Ln, Salem VA 24153. 703-389-1670.

12" TTs w/tonearms (2), direct drive, excel cond, \$175 ea. S Vellmer, KDMN, Box 639, Buena Vista CO 81211. 303-395-2004.

Rek-O-Kut CVS 12 TT speed variance, \$150; Harmon-Kardon mixers (2) DPR7, \$100 ea. L Oliver, 304 W 89th, NY NY 10024. 212-874-7660.

Russco Cue Master, like new, w/Micro-Trak tonearm, \$150. J Cunningham, KEOR, Rt 2 Box 113B, Stonewall OK 74871. 405-265-4496.

Micro-Trak 303 tonearm (3), \$225, free ship. J Sheppard, Globe Prod, 539 W Minister Ln, Salem VA 24153. 703-389-1670.

QRK Studio Pro TT w/Micro-Trak arm (2), \$250 ea. N Allebaugh, WICE, 100 John St, Cumberland RI 02864. 401-725-9000.

Want to Buy

Gates M5202 tone arm for Gates 16" transcription TT, negotiable. R Nelson, Lutheran Gospel Hr, Box 1, Flaxton ND 58737.

EMT 927's, 930's, Thorens TD124, Gerard 301 & 401. C Dripps, Kurloff Entr 818-444-7079. 800-334-8223 CA only.

TV FILM EQUIP.

Want to Sell

RCA FR35A, new stock. T Smith, CCI Comm, 192 Lancaster Ave, Frazier PA 19355. 215-289-1725.

TV modified Graflex 16mm projector, \$800. M Mathis, WSSA, POB 831, Morrow GA 30260. 404-361-8843.

Want to Buy

Philco Cinescanner TV bdcg projector, DMT A/V, Box 9064-RW, Newark NJ 07104. 201-484-5291.

VIDEO PRODUCTION EQUIP.

Want to Sell

Sony PVM1211 cross pulse monitor, \$450. H Donnell, Creative Video Prod, 211 Windsor St, Reading PA 19601. 215-378-0994.

DVS Phaser II frame synch, new cond. T Smith, CCI Comm, 192 Lancaster Ave, Frazier PA 19355. 215-289-1725.

CBS 516 TBC (2), \$2600 ea. R Peterson, Pacific Comm, 1801 E 4th Ave, Olympia WA 98506. 206-754-7081.

Sony Trinitron DXC-1800 w/carrying case & cables; Sony VO-4800 3/4", w/AC power supply, cables, carrying case, \$3000 for both or BO. M Fiedler, Mahoney/Fiedler Prod, 5346 Dupont Ave S, Minneapolis MN 55419. 612-822-0013.

WV341P (2), WV360P, WV241P cameras; WJ545P special effects generator; PR910MM monitor; AC116 Ampex effects generator; 300' cable; 50' 10H50 cable; (2) headsets. E Davenport, United Methodist Church, 571 East Office, Haindsburg KY 40330. 606-734-4725.

RCA TD11B studio tripod, dolly 160679, & head ML26204, \$950 & frt. R Falhenstein, Tri God Ministry, 3447 Arbor St, Phila PA 19314. 215-739-6589.

CBS 5043 TBC, \$1400. H Donnell, Creative Video Prod, 211 Windsor St, Reading PA 19601. 215-378-0994.

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RCA TD11B camera tripod, RCA dolly 160679 & RCA head ML26204, \$1000. B Falhenstein, Try God Ministries, 3447 Arbor St, Phila PA 19314. 215-739-6599.

CVS 504 TBC, \$1400. H Donnell, Creative Video Prod, 211 Windsor St, Reading PA 19601. 215-378-0994.

Sony 2850A editing sys w/Convergence controllers, ECF10B. R Brady, Apollo Recdg, 6142 Beach Blvd, Buena Park CA 90621. 714-994-3761.

Goko VS10 photo to video converter, transfers 3x5 to video using conventional or camcorder. Automatically dissolves prints from two stage Biplerex with built-in light sources. With 50 picture holders, excel cond, \$100. B Whatrous, Whatrous Prods, 745 S Orange Ave, Sarasota FL 33577. 800-334-3658 at tone dial 3316.

Ikegami, Sony, Hitachi, Sanyo & JVC, various monitors from 9" to 25", BO. J Johnson, Interand Corp, 3200 W Peterson, Chicago IL 60659. 312-478-1700.

CMX I Squares 6 VPR2, VR1200, VO2660, GV1600, MM1200, BO. Nigel, Technichrome, 1212 S Main St, Las Vegas NV 89104. 702-386-2844.

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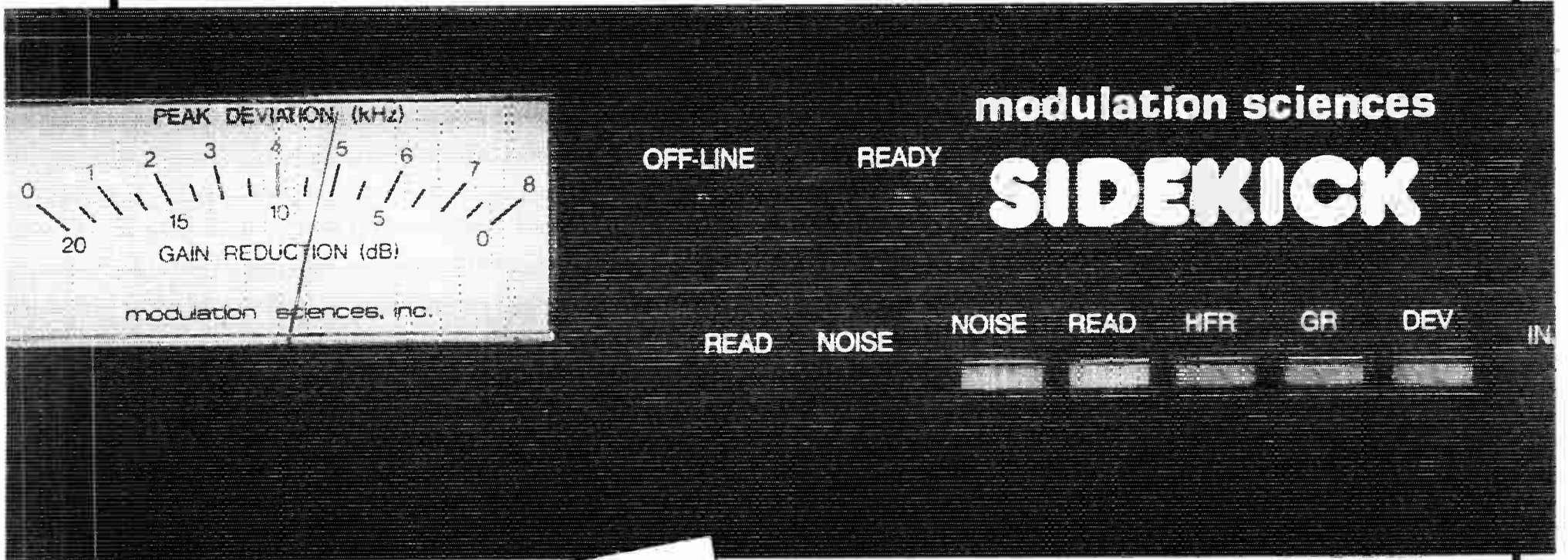
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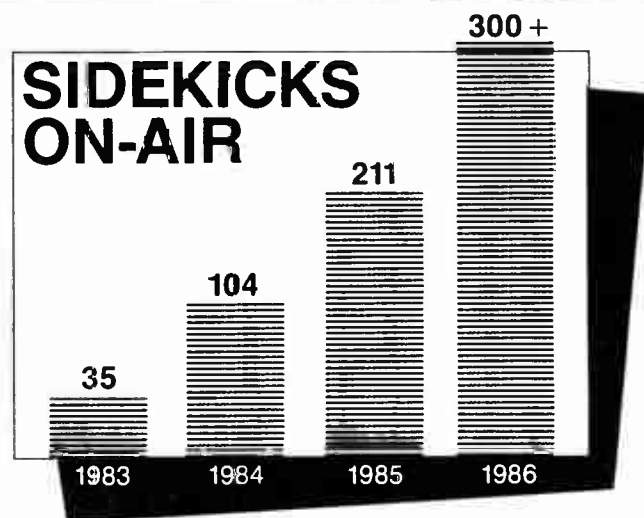
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Sidekick installation is quick, easy, and problem-free:

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THE OBJECTIVE was no small task: design a radio console that would become the new standard.

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THE SUCCESS: WHEATSTONE broadcast consoles are installed in major markets all over the country, from frontline independents to national networks. They are in use right now at some of the world's largest institutions.

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