BROADCAST ENGINEERING

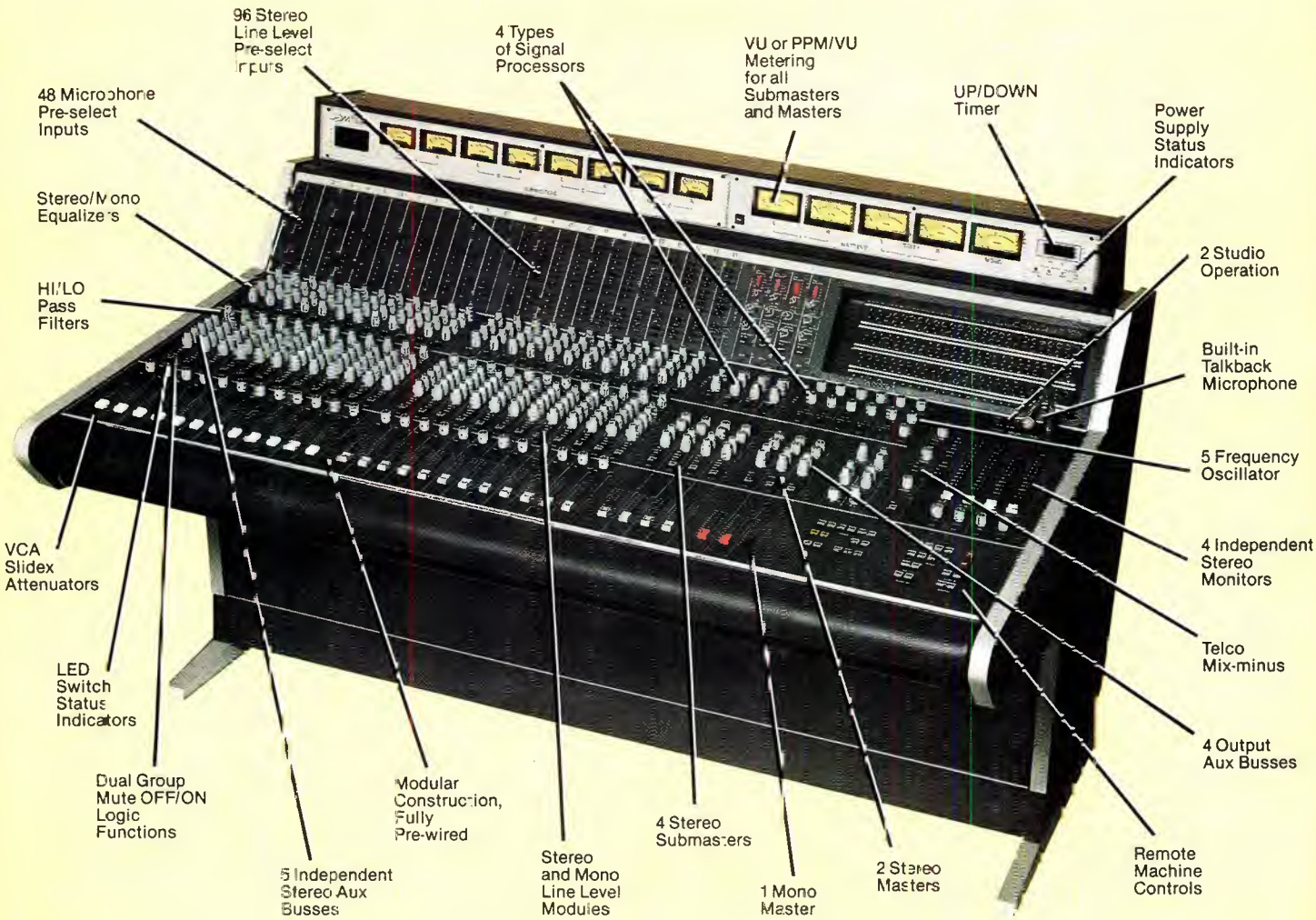
August 1984/$3

Senior Road Tower
Back up and on the air

Progress report
Cart machines

BE's proof program

A True Stereo Console from the Leader in Television Consoles



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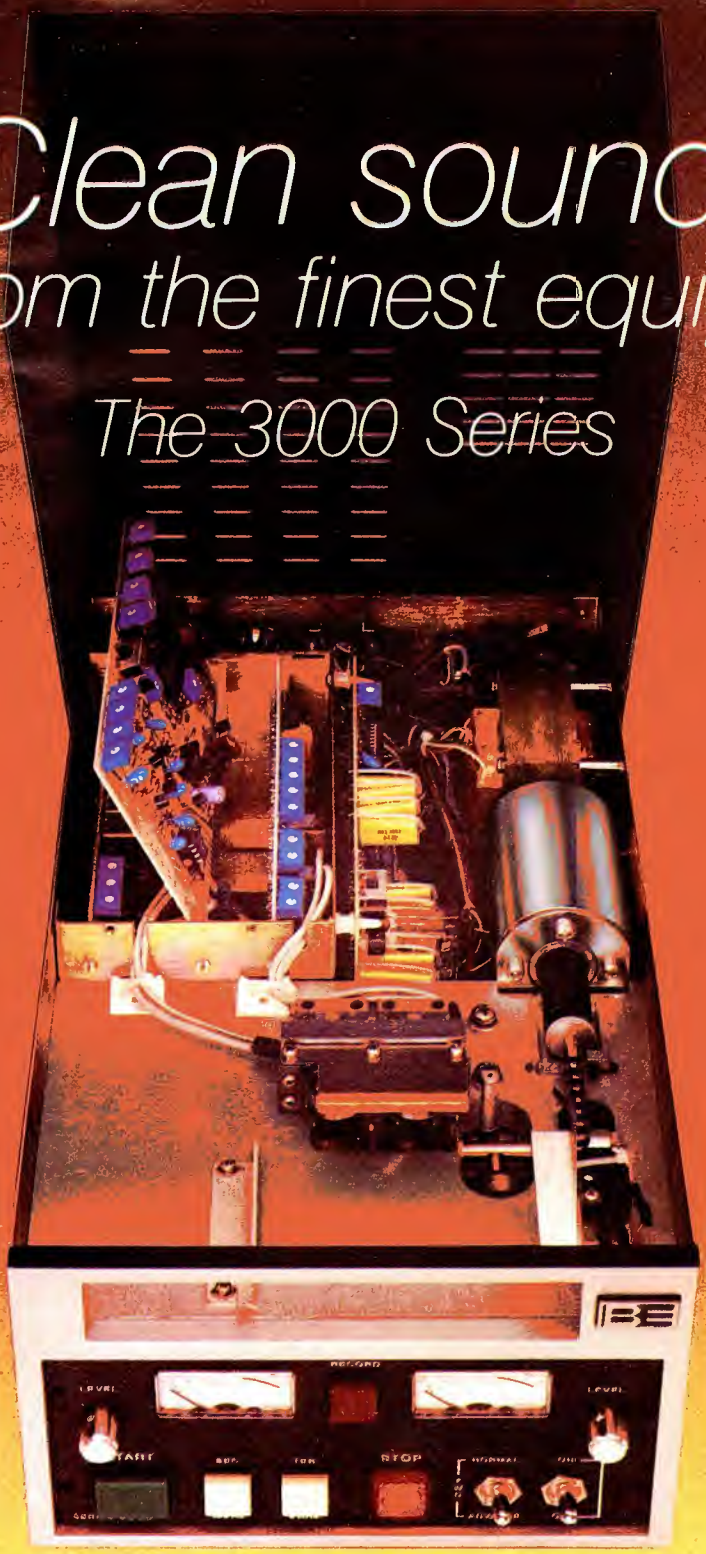

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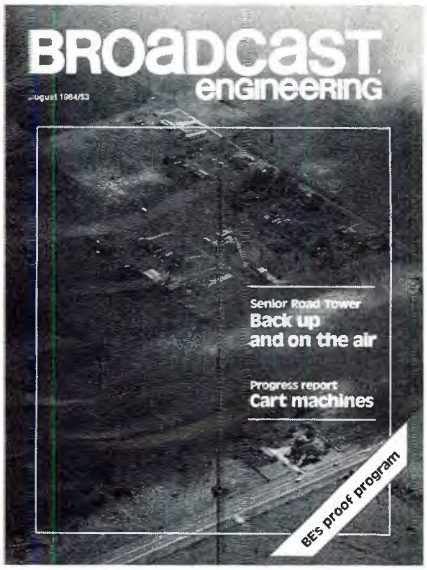

THE COVER this month shows the transmitting tower of the Senior Road Tower Group, Houston, TX. Nine Houston radio stations in a cooperative effort formed the group to construct a 2000-foot tower to improve each station's coverage area and satisfy the requirements of FCC Docket 80-90. A single broadband transmitting antenna is used at the installation, fed by high-power FM transmitters. A detailed article on the construction of the mammoth Senior Road project begins on page 20. *(Cover photo is courtesy of David G. Matyis.)*

Coming events

Sept. 16-19
Radio Convention & Programming Conference, Los Angeles

Sept. 21-25
International Broadcasting Convention (IBC), Brighton, England

Oct. 8-11
AES 75th Technical Meeting & Exhibits, New York, NY

Oct. 27-Nov. 3
SMPTE 126th Annual Conference, New York, NY

Oct. 28-Nov. 1
Scientific-Atlanta Earth Station Seminar

Dec. 3-5
Radio Television News Directors Association (RTNDA) International Conference, San Antonio, TX

Dec. 5-7
Western Cable Show, Anaheim, CA

NEXT MONTH:
- 17th annual *Buyers' Guide* Directory of products and sources

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By Jerry Whitaker, radio editor

RCPC looks at stereo

The upcoming Radio Convention and Programming Conference (RCPC), Sept. 16-19 in Los Angeles, will present an engineering session panel discussion on the implementation of AM stereo. Engineers at AM radio stations that are currently broadcasting in stereo are scheduled to discuss the process of converting from mono to stereo operation and will outline some of the problems they have encountered during the change. The status and future of AM stereo also will be discussed at several management and programming sessions during the RCPC.

Harris changes implemented

Harris Corporation, following up on an announcement made at the recent NAB convention, has begun shipping modification kits for its AM stereo exciters and monitors. The company announced in Las Vegas that it was changing the pilot frequency of its STX-1A exciter from the present 55Hz to 25Hz, so that the Harris system could be decoded by single-mode C-QUAM (Motorola-type) receivers.

Joe DeAngelo, product marketing manager for radio and RF at Harris, said the pilot frequency shift is accomplished by changing one capacitor in the exciter. He estimated that the work requires about 10 minutes to accomplish. The Harris modification procedure also includes changing some parts in the AM stereo modulation monitor. DeAngelo estimated that the monitor conversion process requires about one hour to perform. No retuning or recalibration of the exciter or monitor will be needed.

DeAngelo said the modification kits, which are being offered to Harris AM stereo stations at no charge, will not affect the audio quality of the STX-1A system.

National makes decoder kit

National Semiconductor plans to manufacture a 3-chip set of devices that will automatically decode any of the four AM stereo systems. The application is built around an integrated circuit originally designed by National to decode the Magnavox PMX AM stereo system. Two peripheral switching and support devices have been added to the basic PMX decoder to give the system the capability of switching between any one of four decode modes.

According to Dan Shockey, National product marketing manager for consumer linear devices, the 3-chip design is an interim solution to the need for multimode AM stereo decoders. He predicted integration of the three discrete devices into one IC package in the near future, if a market demand becomes evident.

More on NRBA survey

The National Radio Broadcasters Association has released additional information on its survey of AM radio stations across the country. The study was designed to identify the impact that AM stereo is having on the industry. As we reported in this column last month, the move to stereo operation probably will be a slow transition for the AM broadcaster.

Twelve percent of the AM stations responding to the questionnaire indi-

Continued on page 98

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Strictly TV

By Carl Bentz, television editor

Merry stereo to all, and to all a capital expenditure?

Multichannel TV sound (MTS), stereo TV if you will, is upon us. Evidence was quite apparent at the recent Consumer Electronics Show (CES) in Chicago. RCA reportedly showed 28 new models, 17 of which included stereo capability. Other manufacturers exhibited one or more MTS sets, as well as various adapters. We can expect a plethura of receiving systems by the year's end. Yet, this long-awaited boon for television brings hard-to-answer questions.

Bandwagon logic

Should *your* station convert to stereo immediately? Being *first* in the market to transmit in stereo undoubtedly brings interesting marketing ideas to management, time sales people and the ad agencies. But it is advisable to proceed with caution.

Is the economic atmosphere appropriate for dumping $60,000 or more into a concept that now lacks receivers in the home, that awaits any substantial library of program material and that will require a learning period for the production staff to learn how to handle it properly? That dollar figure may be high, but it could be much too low in terms of the costs of converting the transmission chain. There are a number of things to consider before jumping into this exciting, but puzzling new technology.

Our editorial *Stereo TV for Christmas 1984* (**BE,** March '84) called for a quick approval by the FCC of the EIA/BTSC-recommended Zenith/dbx system. Our call tacitly asked for the technology as much as for the recommended system, because we felt that US TV audiences deserved the chance to experience what the Japanese and German viewers had been watching for several years. We still feel that way, and we are pleased with the commission's approval, not of a standard, as many hoped, but of a protected system. The reregulation wisely does not preclude future development of TV aural subcarrier uses.

In March, many were unaware of some cost aspects of MTS operation. Our statement that the cost would vary based upon the degree to which a station went stereo was not wrong, but perhaps it wasn't complete. ABC-TV recently suggested that network conversion will approach $5 million, while its five owned-and-operated affiliates may expect expenditures between $100,000 and $1 million *each.* ABC is targeting KABC-TV, Los Angeles, to be in stereo later this year. NBC is considering the *Johnny Carson Show,* already taped in stereo for several years, and *Friday Night Videos* to be the prime programming material for a mid-1985 startup. CBS, however, has taken the matter under advisement, saying that the New York network center will require an extensive overhaul to do the job right and that it will make no predictions.

A hard look at software

The hardware conversion cost is one problem, which we will look at more shortly; but what about the software? Is Carson in stereo actually a drawing card? Music videos are interesting, but will the revenues generated by targeting that fan club foot the bill and the interest on the loans needed to make the conversion?

Music programs will undoubtedly be the easiest to produce. In that respect, PBS should do well, because it has been dealing with symphonic and operatic fare in stereo since the implementation of its satellite interconnect system. Yet some of its operatic material may suffer from problems dealing with psychoacoustics and reality, with which many listeners will find fault. PBS's early entry into the field of MTS, however, is admirable.

The Japanese offer music, baseball and Sumo wrestling in stereo, with news and public affairs broadcasts in the bilingual mode. After several years of experience with MTS, however, they admitted difficulty with an acceptable stereo image from dramatic material. With a world that depends more and more on microprocessors, that will come, but not tomorrow.

Presence simulated by one channel offering crowd noise might make sports more enjoyable, but are US viewers ready for the primordial grunts and groans of wrestling? Many films are now available in stereo, and a number of older classic movies have inherent ambient sound that can be reprocessed for a pleasant result. But are these items what the public will want to see?

News, weather, soaps and talk shows somehow seem to lack the draw that will be necessary to overcome the initial outlay for MTS. We have little else offered.

At the station level

The major cost of conversion for many stations seems to involve one small, but vital, section of the

Continued on page 94

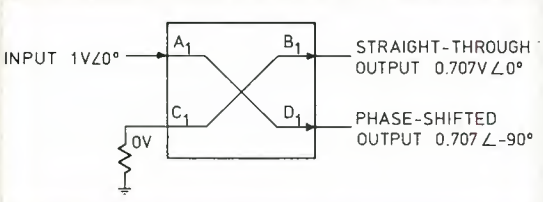

Figure 1. Action of a 3dB coupler.

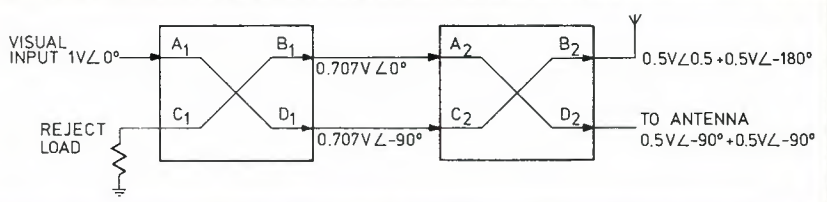

Figure 2. Cascaded 3dB couplers, showing visual signal action.

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FCC update

By Harry C. Martin, partner, Reddy, Begley & Martin, Washington, DC

Changes in ownership reporting requirements

Under FCC rules effective June 6, 1984, all radio and TV stations must file annual ownership reports on the anniversary of the filing of their renewal applications. Licensees that have had no changes in officers, directors or shareholders since the filing of their last complete reports may simply file a letter to this effect in lieu of the annual report. If a licensee has multiple stations, so situated that their renewal anniversaries do not coincide, it may choose which anniversary to use for its first report and continue to use that date thereafter.

As of Aug. 1, stations in North Carolina, South Carolina, Illinois, Wisconsin and California were due to have filed their first annual ownership reports under the new rules. On Oct. 1, reports are due for stations in Florida, Puerto Rico, the Virgin Islands, Iowa, Missouri, Alaska, Samoa, Guam, Hawaii, Oregon and Washington.

Under the new rules, the following types of interests are not *attributable*, and thus not reportable in ownership reports:

- Voting stock interests of less than 5% in a corporate licensee.
- Limited partnership interests, as long as the limited partnership agreement conforms in all significant respects with the provisions of the Uniform Limited Partnership Act of 1976.
- Non-voting stock interests.
- An interest in a trust that holds voting stock where the beneficiary or grantor has no power to vote the assets of the trust and may not, on his own, sell voting stock held in trust. However, a trustee who votes shares constituting an attributable (5% or more) stock interest must be identified.
- Non-voting stock that is convertible to voting stock.
- The identity of corporate officers or directors of multifaceted parent corporations when these individuals' duties are neither directly nor indirectly related to the activity of any broadcast licensee.
- A minority interest (up to 49%) in a licensee when a single shareholder has the majority, controlling 51% or more interest.

These changes were adopted in the FCC's *Report and Order* in the *attribution* rule making, released in April. The commission hopes to have available in the near future new ownership report forms reflecting these changes.

AM coverage requirement reduced

In late May, the commission reduced its AM signal intensity coverage requirements for community, business and factory areas to 5mV/m and deleted the requirement that permittees of directional AM facilities include measurements in their covering license applications.

Previously, the rules required that AM stations place at least a 25mV/m signal over a community's business district and a 5mV/m contour (or, at night, an interference-free contour, if of a higher value) over all residential areas of the community of license.

In making this rule change, the FCC noted that the vast majority of AM authorizations today were for small communities. In this setting, large buildings, which tend to absorb AM signals, and manmade noise are not serious problems. Also, the commission noted that it was now difficult to determine a community's principal business and factory areas due to the proliferation of suburban shopping and other business areas.

Freeze on applications on Canadian clears

In early June, the commission announced it no longer would accept AM stations on the six Canadian Class I-A clear channels (690, 740, 860, 990, 1010 and 1580 kHz) that filed applications for unlimited time.

The purpose of this freeze is to preserve the status quo with respect to the future use of the Canadian clears. The rules at present do not permit the filing of applications on the Canadian clears for communities within 650 miles of the Canadian borders. However, applications for communities beyond 650 miles of the border are permitted.

The FCC is now considering the adoption of rules that, consistent with the new US/Canadian agreement, will remove the 650-mile restriction. The freeze was imposed to give communities within 650 miles of the border a chance to compete for the frequencies once they became available within that area.

Policies on premature or nonconforming construction

The FCC has clarified its policies with respect to premature or non-conforming construction of broadcast stations. The following processing guidelines were set forth in a Public Notice issued in late April:

- In cases of construction prior to the issuance of a CP, or non-conformity between authorized and actually constructed facilities, no program test authority will be granted until the problem has been resolved if: *(a)* there is a question of potential interference, or *(b)* the applicant has not obtained FAA approval. Stations operating pursuant to automatic program test authority will be required to go off the air. Forfeiture action also will be considered.
- In cases involving neither interference nor lack of FAA approval, the commission will evaluate the nature of the deviation, the applicant's forthrightness in bringing the problem to the agency's attention and other public interest factors. The possibility of assessing a forfeiture also will be considered.
- Applications to correct non-conforming construction and premature construction will not be given expedited consideration despite possible loss of service to the community. However, the commission will consider granting special temporary authorizations in cases not involving interference or lack of FAA approval.

Clarification of these guidelines was needed because of the increase in instances of non-conforming and premature construction occurring since the adoption of *automatic* program test procedures several years ago.

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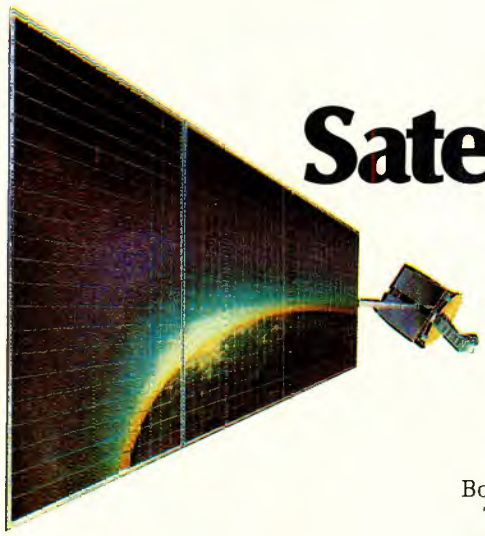


Satellite update

By the **BE** staff

Changes we have seen on high

The geostationary Clark orbit has recently experienced two changes in its player lineup. Marking the end of an era, the RCA SATCOM I bird was recently instructed to leave its spot at 135° west longitude. Retired after eight years, its original design lifetime, SATCOM I's future is somewhat uncertain. When boosted above the Clark orbit, the satellite should slowly spiral outward from Earth. As it eventually leaves the Earth's sphere of gravitational influence, it will undoubtedly be drawn to a fiery death in the sun. The date and details of its doom are unavailable.

SATCOM I made history in communications. Among its many users were some of the first long-distance satellite-relayed services for CATV. Those services have since been relocated to newer satellites.

New on the block

On May 22, a new member of the satellite family was boosted into space from Kourou, French Guiana. Spacenet I, also an RCA Astro-Electronics product, left Earth at 9:33 p.m. EDT atop an Ariane I rocket. From its first highly elliptical transfer orbit, varying from 120 miles to 22,300 miles, on Saturday, May 26, it was instructed into a controlled drift toward its parking location at 120° west longitude.

The first of a series of three satellites for GTE Spacenet Corporation, Spacenet I is also the first domestic system to provide both C-Band and Ku-Band services. With dual-frequency capability, the satellite will support existing 4/6GHz networks, as well as new telecommunications services in the 12/14GHz spectrum. It already has been booked for a number of services by Bonneville Telecommunications, GTE Sprint, Southern Baptists' American Christian Television System and companies such as Sunday School Board and EFC Satellite Services.

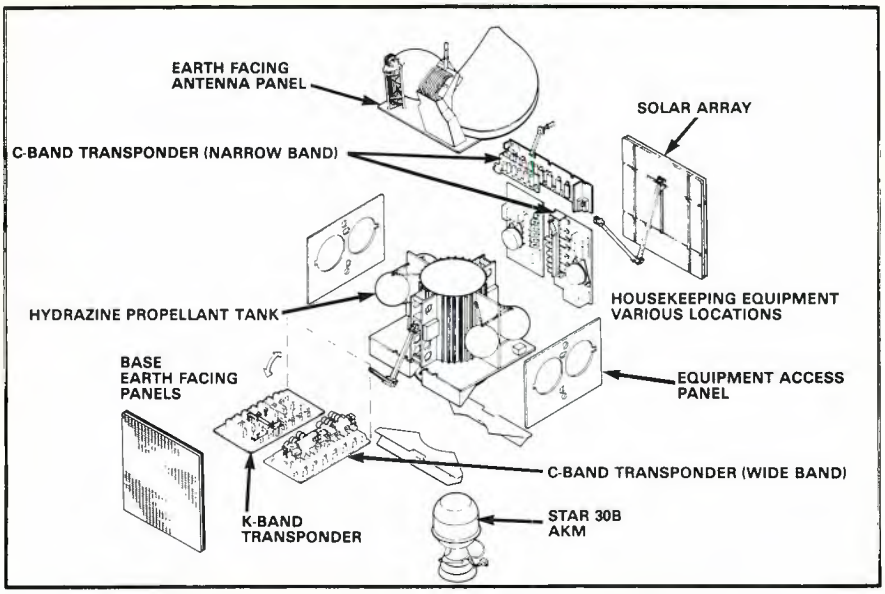
The satellite looks similar to the one used in this column's logo. The main body, housing electronics and antennas, measures 64"x52"x39". Solar panels from either side span to 47 feet. The solar arrays are used to charge two parallel-connected 40Ah nickel-hydrogen batteries. Charging is usually handled simultaneously, although as the array ages and efficiency drops, sequential charging may be instituted.

Each battery consists of 22 cells, one of which may fail—either short or open circuit—without affecting the mission. Subsequent failures would decrease the total power available during eclipse periods. Trickle charging at 1/60 of the battery capacity occurs during the 100% suntime of the orbit. Battery reconditioning is accomplished for each cell individually, one battery at a time, prior to each eclipse period.

Housekeeping facilities, to make sure the satellite continues to be in the proper location, include two redundant sets of eight thrusters—six catalytic reactor engine assemblies and two electro-thermal hydrazine thrusters. Either set of eight engines, using propellant from either or both of two tanks, provides the required impulse and torque energy for the mission lifetime of approximately 10 years. That lifetime figure is based upon the capacity of the two hydrazine fuel tanks.

On the 3-axis stabilized spacecraft, 12 C-Band subsystems provide for six narrowband horizontally polarized and six wideband vertically polarized signals. In a 7-for-6 redundance switched network, 14 solid-state amplifiers, each rated 8.5W RF, serve narrowband transmissions to the continental United States and Puerto Rico/Virgin Islands. Seven more TWT amplifiers, at 16W RF, handle the wideband signals. An additional six wideband transponders at Ku-Band frequencies offer horizontal (downlink) signals to the continental United States.

The launch of the new satellite was carried out by Arianespace and marks the company's first American customer venture. Arianespace is a private space transport company representing a European industrial and banking group, and uses the family of Ariane launchers developed through the European Space Agency.



FINALLY, AN "UNDER $10,000" NEWS CAMERA WHOSE BIGGEST SELLING POINT ISN'T THAT IT COSTS UNDER $10,000.

There's no shortage of portables out there that sell for under $10,000. The trouble is, price isn't the only thing they're short on.

The new Sony BVP-150, however, is another story. Its MF diode gun Saticon™ tube delivers performance that rivals cameras costing twice its $8,900* price. Like 650 lines of resolution at encoded output and a S/N ratio of 57 dB. Not to mention how it achieves a new height in depth of modulation for cameras in this class.

There's also the BVP-150's considerable range of automatics to consider. Along with the fact that it can generate composite output for recording on ¾″ or 1″, as well as component outputs for direct recording on Betacam™. And, in either case, it's legally airable. Because, unlike many cameras in this class, the BVP-150 is equipped with an RS-170A sync generator and a true I and Q encoder.

But to get the whole picture, you should call: in NY/NJ, (201) 833-5350; in the Northeast/Mid-Atlantic, (201) 833-5375; in the Midwest, (312) 773-6045; in the Southeast, (404) 451-7671; in the Southwest, (214) 659-3600; in the West, (213) 841-8711.

And find out about the new BVP-150.

The "under $10,000" news camera that gives you something even better than a low price: high performance.

SONY® Broadcast

*U.S. list price (lens not included). Sony Broadcast Products Company, 1600 Queen Anne Rd., Teaneck, NJ 07666. © 1984 Sony Corporation of America. Sony is a registered trademark and Betacam a trademark of Sony Corporation.

The BE FM audio proof program

The radio broadcast industry has made great strides in recent years toward the realization of a transparent medium through which programming can flow to the listener. Although the technology for this goal is available, it is not always put to work in day-to-day broadcasting. Through the introduction this month of a **BE** audio proof of performance program, we intend to recognize the efforts of those engineers who have steadfastly guarded the technical integrity of the FM medium, and have kept alive Dr. Armstrong's promise of a full-fidelity transmission system.

The future holds many exciting possibilities for radio broadcasters, including digital-based program source equipment, computer-controlled transmission gear and improved consumer receivers. If broadcasters are to hold their positions in the marketplace, they must move with the times. Those who fall behind will find that new technologies and more aggressive competitors have walked away with their audiences.

The need for excellence in all phases of a station's operation is becoming painfully obvious to station managers across the country. The public is more discriminating now than ever before, and the competition has never been tougher. The consumer has demonstrated a strong desire for high-quality music programming. Compact disc systems are gaining wide acceptance, as the number of available titles expands rapidly. Consumer FM stereo receivers have achieved an impressive level of sophistication. In fact, some units can outperform many well-maintained radio stations. New technologies are also appearing on the horizon, not the least of which is stereo cable radio.

The drive for technical excellence should be made not only at major market stations, but at small market facilities as well. In coming years, small-market broadcasters will be fighting not only for audience shares, but—in some cases—for financial survival. The future will probably be bright, however, for those broadcasters who have the foresight to plan beyond the next financial statement. Excellence in broadcast audio is an expensive and time-consuming enterprise, but one that can pay handsome dividends.

In an effort to encourage a renewed spirit of technical excellence in the industry, **Broadcast Engineering** is launching in this issue an FM audio proof of performance program—the first in the industry—whose goal is top-quality transmission system performance. As the FCC slowly backs away from its traditional regulatory role, we feel the broadcast industry needs a set of maximum-performance goals for which to aim. The article, *FM fidelity: Is the promise lost?* (page 30), outlines the reasoning behind "**BE** Proof" and some of the technical objectives we are suggesting to FM broadcasters.

Our proof is not designed to replace the FCC-required equipment performance measurements (EPMs), which fulfill an important function by setting minimum levels of acceptable performance for FM stations. We would like to see the FCC tighten the EPM requirements to bring them more into line with the capabilities of present-day equipment and the demands of today's marketplace. In fact, we call on the commission to make at least some preliminary steps in this direction.

In light of the current deregulatory mood at the FCC, however, we are not optimistic about the possibility of action on this matter. Therefore, in an effort to stimulate industry discussion of the EPM question, **BE** is proposing a set of fidelity-oriented objectives for FM radio stations that take into account the conditions found in *real world* broadcasting and the competitive pressures that currently exist in the marketplace. The **BE** Proof objectives are geared to maximum station performance, not minimum performance requirements, as the FCC's EPM tests are.

The test procedures and suggested performance objectives proposed in the **BE** Proof program are not chiseled in stone. We are not suggesting that they are the only possible procedures and limits. We *do* believe that discussion should begin on this topic, and that the discussion needs a starting point. This is it.

The **BE** Proof Program, as we now see it, will begin with FM radio, and preferably will be expanded to other services (AM and TV) in the coming months.

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Broadcast Engineering is seeking the support of nationwide industry groups—such as the National Association of Broadcasters, National Radio Broadcasters Association and Society of Broadcast Engineers—in this effort. Perhaps the time has come for the establishment of an industry-wide committee to look into the question of equipment performance measurements. We urge these industry groups to consider this vital area of broadcast engineering closely for possible action in the near future.

Although discussion of this concept is important, the demands of today must also be heard. We urge readers, therefore, to study the introductory article on the **BE** Proof, and to conduct the measurements suggested in the program. We also ask that readers complete the post card questionnaire dealing with the program at the back of this issue. We want to make the **BE** Proof a 2-way effort that includes input from station engineers, the people who are in the best position to know the need for such a program.

We are considering a program of certification of technical excellence as part of the proof program. The basic concept would be stations running the **BE** Proof and submitting the results to us. If the data—supplied on the honor system—met the established guidelines, a certificate would be issued to the station. Some persons who have reviewed our certification proposal have expressed concern over the use of the honor system. We feel, however, that quality-conscious engineers who would take the time to participate in such a program would not falsify data simply to receive a certificate. The **BE** program, in fact, is no more vulnerable to cheating than the FCC-required EPMs.

As explained in the introductory article, the **BE** Proof Program suggests two sets of performance objectives—*Excellent* and *Superior*. These were established by two **BE** consultants—Dennis Ciapura (technology consultant) and Donald Markley (facilities consultant). The objectives are geared to practical and achievable broadcasting limits, and are designed to measure the performance of FM stereo systems in a typical operating environment, with test procedures that will give an accurate evaluation of the transmission system under normal program conditions. The **BE** Proof parameters are achievable and have been tested under actual conditions.

Follow-up articles on the program will concentrate on test procedures that should be used to measure the performance of a station, the reasoning behind the stated parameters, suggested guidelines for audio processing, test equipment considerations and reader comments on the program.

The broadcast industry is faced with unprecedented competition from alternative programming sources and new technologies. Stations can only compete with these services by delivering to their audiences top-quality programs through top-quality transmission systems. By adapting the **BE** Proof as a realistic, meaningful and economically sound gauge of performance, we will be taking our technical achievement goals and heading in the right direction.

Midwest puts on a great show because it uses the best components

One of the reasons that the Midwest M-40 Series is the most advanced class of large mobile teleproduction units available today is our policy of only using the finest components. This "no compromise" design philosophy ensures a system of superior quality and reliability. Our M-40 units give you up to 47 feet of unparalleled technical and creative capacity. Because we only use the best components . . . from companies like Ikegami.

Ikegami HK-322 automatic color cameras make Midwest picture perfect

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Ikegami HL-79E Series plays dual role for Midwest units

The Ikegami HL-79E Series camera was selected for use aboard the Midwest M-40 because it can handle two separate functions with superlative results. Although it's renowned as the perfect hand-held camera, the HL-79E Series can easily be converted into a field camera that produces higher quality images than many other manufacturers' top-of-the-line studio models.

is exceptionally fine performance is due to Ikegami's painstaking ention to detail. Designed to meet most rigorous performance stan-ds, the HL-79E Series also offers tional automatic set-up, either via own set-up computer or by inter-ace into the HK-322 set-up com-puter for total system integration. ith the HL-79E Series, Midwest's M-40 offers you the versatility quired to produce network quality roductions in any circumstances.

Ikegami 9-Series color monitors give Midwest "true to life" pictures

Ikegami 9-Series Color Monitors are standard in the Midwest M-40 mobile unit because of their superb resolution and ability to reproduce colors that are amazingly life-like. This performance is unmatched by any other monitor in the world. Since the 9-Series monitors use In-Line Gun CRTs, they provide more than excellent colorimetry and

fantastic resolution. They also offer high stability, unit interchangeability, low power consumption, and convenient pull-out circuit panels. By using the Ikegami 9-Series, the Midwest M-40 can reproduce colors that are true to life.

For more information on how Midwest and Ikegami can deliver world class performance for your company, contact any Midwest office in the U.S. or call toll free (800) 543-1584.

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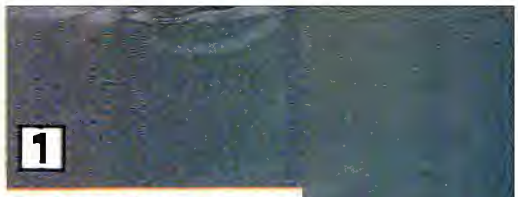
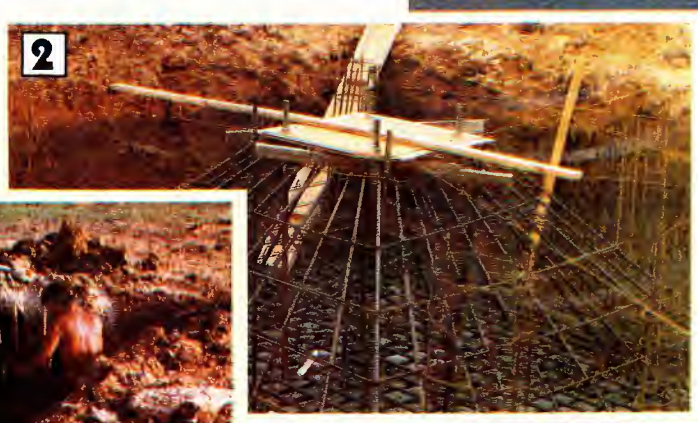
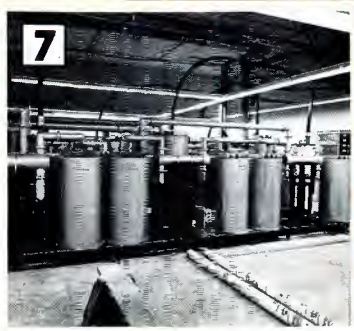




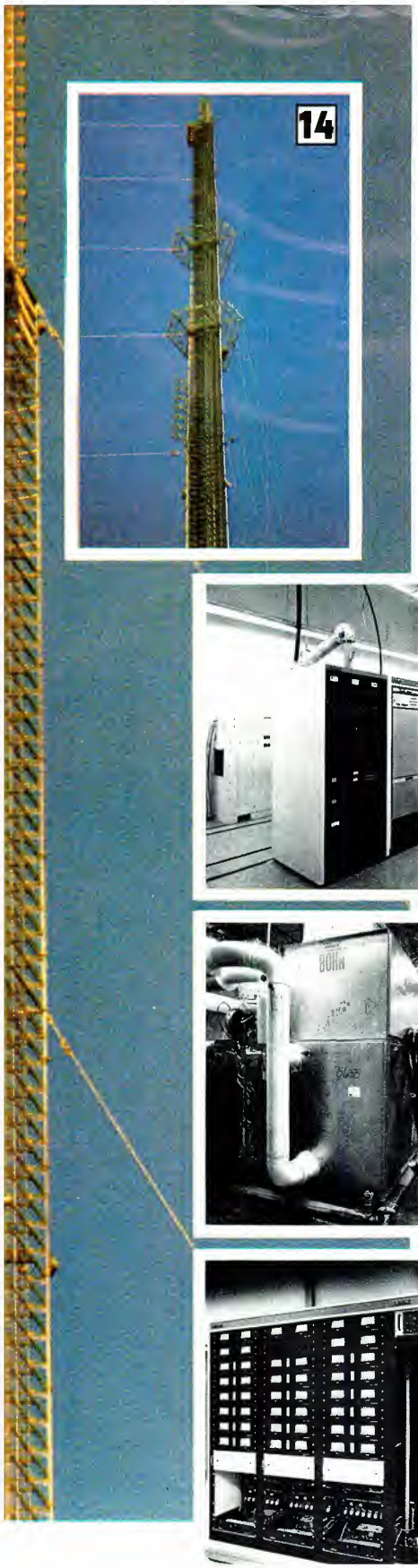


Senior Road Tower

Back up and on the air

By Bill Cordell, administrator, Senior Road Tower Group

The Senior Road Tower project—a mammoth effort that may point the way for hundreds of FM stations across the country—is now fully operational. After six years of work and $7 million, the country's first 9-station,



Class C, 2000-foot master FM facility is on the air.

The Senior Road project is important to the industry not only because of its size and scope, but also because it represents an attractive solution to

1. The Senior Road Tower Group's 2000-foot transmitting structure, located outside Houston. The top portion of the tower shown holds a 12-bay Harris TAC-12 cavity-backed radiator antenna. Below the Harris FM antenna is a side-mounted Andrew UHF-TV transmitting antenna. All guy wires shown in this photograph are taut. The droop seen in the two guys in the picture foreground is caused by the angle of the shot.

2. The tower base concrete foundation is shown before the last pour of cement. Note the extensive reinforcing work.

3. Workmen prepare one of the nine guy wire anchor points for the application of a cement crown.

4. The 120-foot tower stub is shown in this photo as it is being lifted into position with a crane. Note the tower's pivot-point base structure.

5. The FM transmitter building under construction is seen in this photograph, taken from the adjacent tower. The large space in the center of the building is the combiner room, which houses the 10-port multiplexer. Individual transmitter rooms are arranged in a horseshoe pattern around the combiner equipment. The grating structure to the right of the SRTG building is for ice protection for the 110-ton air conditioning system.

6. The aftermath of the Dec. 7, 1982, tower collapse that killed five workers and injured three others. The structure hit the ground with such force that much of the tower buried itself into the ground.

7. Shown is a portion of the enormous 9-station combiner/muliplexer system installed at the Senior Road transmitting facility. The modular system will handle 350kW of RF power input.

8. The combiner system is monitored at a central equipment rack, shown in this photograph. Meters show the operator forward, reflected and reject power for each of the nine FM stations at the facility.

9. The distribution and control of ac power for the SRTG building is located at a central distribution center, shown here. Automatic emergency power switching is also provided at the facility.

10. The proper handling of heating and cooling functions is an important part of the transmitting facility design. Shown is a portion of the large HVAC system used at the SRTG site.

11. Shown is a typical FM station transmitter installation using a 25kW Harris transmitter. The transmitter high voltage supply can be seen to the rear of the unit.

12. This photograph shows the internal structure of the Harris TAC-12 cavity-backed radiator FM master antenna system. Radiating elements and interbay cabling can be seen in the photograph.

13. The view from the top. This photograph was taken from the top of the tower-antenna structure. This point is 1971 feet above the ground (2049' AMSL).

14. This photograph with a telephoto lens shows (from top to bottom) the master FM antenna, UHF-TV transmitting antenna, 2-way radio tiers (at the 1400- and 1200-foot levels) and seven single-bay ERI auxiliary antennas.

the *improve-it or lose-it* requirements of FCC Docket 80-90. 80-90 requires that FM stations meet certain minimum height and power parameters or face classification at a lower level.*

Planning the project

The Senior Road Tower Group (SRTG) took more than a year to decide on the technical specifications and funding methods for the project. A partnership was eventually formed, and a technical committee was established to direct the effort. Partners ranged from large broadcast chains, such as ABC, Westinghouse Broadcasting and Cable, and Viacom, to local radio station owners.

After many long and painful meetings, the technical group decided on a single 12-bay master panel antenna with a dual 8-3/16-inch feed system. The combiner would be a balanced hybrid type, capable of combining nine 30kW FM stations and allowing all stations to use right-hand circular polarization. Specific VSWR requirements were to be rigidly held. The master antenna would be required to be field tested and both elevation and azimuthal patterns were required at various frequencies and angles.

Land was sought on which to place a 2049-foot tower and antenna structure. The Federal Aviation Administration (FAA) eventually established a 2½-square-mile area southwest of Houston where such towers could be located. Unfortunately, SRTG's first tract of land (next to Senior Road—thus the name) was not within the FAA's approved area. Land was eventually located within the approved zone, but not without a number of problems. It seems that in Texas, the mineral rights owner has more rights than the surface owner. So, after settling with the mineral rights owner, the project proceeded.

The SRTG technical committee received several bids on various portions of the project. After evaluating the proposals in great detail, the group decided on a Stainless tower, a Harris TAC-12 cavity-backed radiator 12-bay master FM antenna and two runs of RCA 8-3/16-inch transmission line. The combining system, purchased from Harris, was to be built by Dielectric Communications.

*For more information on the implications of Docket 80-90, see "Updating FM Facilities" in the April 1984 issue of **Broadcast Engineering.**

Building the facility

The antenna and combining systems took more than one year to build and test. Measured results on the systems were better than the specifications set by SRTG's technical committee. The combiner VSWR could not be more than 1.05:1. The same VSWR was also established and maintained for the transmission lines and the antenna. Transmission line tuners, 17½ feet long, were installed at every sixth section to keep line VSWR low.

The massive combiner assembly cost more than $1 million by itself. The 10-port modular multiplexer has a total power-handling capability of 350kW, and the combiner includes more than 6000 feet of transmission line. Each of the 10 input ports was specifically designed for use at the Senior Road complex. The insertion loss for each input is only 0.8dB.

Once the combiner was assembled at the SRTG site, a full-power operational test was conducted. A dummy load was constructed that could dissipate 360kW of power. Four 80kW water-cooled loads were connected to the building's chilled-water air conditioning system to dissipate the energy. The combiner system worked as expected under full-power conditions.

The SRTG's building measures more than 10,000 square feet. The combiner room occupies 2400 square feet, and each of the nine stations at the facility has 400 square feet of transmitter room space. The building is divided into individual rooms, so that spare parts and clean-up problems are avoided.

The typical transmitter installation is two 25kW units feeding an automatic transfer switch. The building has two 400kW diesel generators and motor control centers, giving full redundancy for emergency power. If one of the two generators should fail, or fail to start, the other will take the entire load. Under single-generator operation, the air conditioning chillers are shut down and all transmitters are automatically dropped to one-half power.

The HVAC (heating, ventilation and air conditioning) system consists of two 55-ton chilled water units. Air filtration is as good as a hospital would require, which keeps the dust problems down for all equipment. Transmitter waste heat is removed through ducts out of each room and exhausted by a central exhaust fan. During the winter, this waste heat is used to warm the tower complex.

The transmitting building measures 100'x100'x18'. The outside walls are constructed of double-thickness concrete block, and the roof deck is made of 6-inch concrete panels with a membrane seal. The roof deck is covered with 2"x6" boards so that falling ice will be cushioned.

A neighbor and tenant in the SRTG project is KTXH, Channel 20. The station uses a Harris 110kW transmitter, Dielectric 8-1/16-inch single transmission line and and an Andrew side-mounted antenna.

The tower collapse

On Dec. 7, 1982, the Senior Road Tower project suffered a disasterous blow. The entire tower, transmission line and antenna system came down. I was a witness to the accident, as the crew was just completing placement of the top half of the Harris TAC master antenna. Five workers were killed as the pulley mechanism that was hoisting them and the antenna section to the top of the tower failed, causing one of the guy wires anchoring the structure to snap. The tower then began to wobble, and came crashing down on the transmitter building of KTXH. Three men on the ground who were not affiliated with the tower crew were also injured. The tower workers killed were employees of Worldwide Tower Service of New Jersey. *Continued on page 26*

FINALLY, CASSETTE MACHINES FOR PROFESSIONALS WHO'D RATHER SWITCH THAN FIGHT.

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The new S-230D easily interfaces with new or existing Microtime T²E-120 A/B Roll Effects Systems to provide the ultimate in input signal flexibility and freeze effects capability.

The S-230D allows inputs such as in-house camera signals, external ENG, microwave, satellite, network and remote studio feeds, as well as ½" and ¾" heterodyne VTR formats with or *without* capstan servos. You also have the choice of operating in either standalone heterodyne *or* 3.58 MHz subcarrier feedback modes. And by using the S-230D on one or both channels of the E-120 A/B Roll Effects System, you get the additional "effect" of manual or automatic freeze.

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T²E-120. This established configuration consists of two T-120D TBCs capable of DYNAMIC TRACKING* operation with a SONY* BVU-820 U-MATIC* VTR.

TSE-120. This new configuration consists of:

- one T-120D TBC capable of DYNAMIC TRACKING* operation with a SONY* BVU-820 U-MATIC* VTR and
- one S-230D TBC/Synchronizer with freeze and auto mode switching.

S²E-120. This new configuration consists of two S-230D TBC/Synchronizers with freeze and auto mode switching for maximum flexibility in both channels.

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E-120 A/B Roll Effects System.

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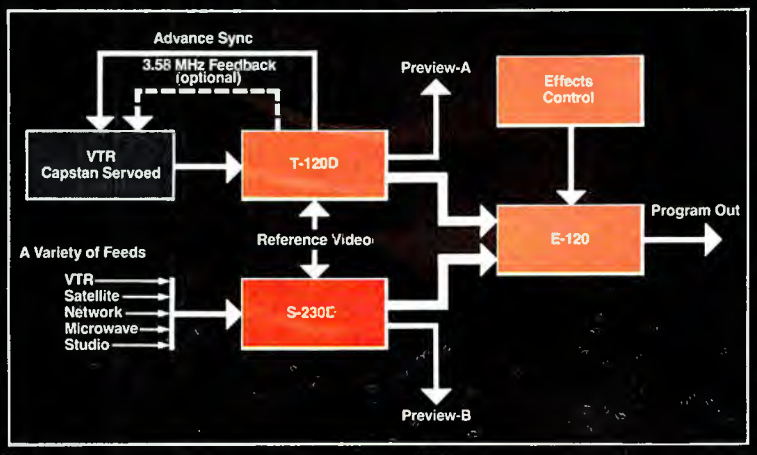

DT* operation is possible with the T-120D with a single cable interface to the SONY* BVU-820 U-MATIC* VTR.

T-120D or S-230D units can be separated from the systems for standalone operation.

Each E-120 System includes the E-120 A/B Roll Effects Processor and Effects Control with a 75′ cable. Each features an 8 bit, 4x subcarrier design for high reliability and transparent performance and is controllable by VTR editor for preview and record. Each contains a RS-170A gen-lock sync generator to assure precise output timing. Each is made in the U.S.A., rigorously tested throughout the manufacturing process, and comes with a full one-year warranty on all parts and labor.

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Continued from page 22

Channel 20, which had been on the air exactly one month, was totally destroyed, with the base of the tower literally falling across the Harris UHF transmitter. SRTG's FM transmitter building was not touched by the tower collapse.

After getting over the initial shock of losing five friends and millions of dollars worth of equipment, we started over. Three months after the disaster, Channel 20 was on the air with a temporary transmitting facility on a 999-foot building in downtown Houston. Cleanup of the SRTG site took four months. We assisted the insurance companies in repurchasing the Harris FM antenna, RCA transmission line, auxiliary antennas and lines and the tower itself. The total cost was estimated at $4.75 million.

Harris Corporation, through its experience in building the first antenna, built a better antenna the second time. The VSWR measurements from 88-108MHz never rose above 1.06:1,

and on each carrier frequency the VSWR was less than 1.05:1. The azimuthal and elevation patterns were slightly better than the original antenna.

The transmission line, purchased from RCA and made by Dielectric Communications, had fewer tuners than the original system, with a worst-case VSWR of 1.045:1 across the FM band.

The second tower, transmission line and antenna were completed in October 1983.

Ready to go

On Oct. 15, 1983, after extensive low-power testing, the SRTG site was put into service. Robert Silliman and Jim Kemen of Silliman and Silliman performed the RF proof of performance, which is required for multi-station combined systems. During the time Silliman performed the RF proof, many stations also performed their audio proof of performance. No mixing products were detected above the FCC specifications, and most products were lower than calculated. VSWR measurements for all stations were quite low, with an average of 25-100W, reflected with forward powers ranging from 20-24.5kW.

Any transmission system is only as

Marco Polo uses SONEX a little differently...

and so do thousands of others.

Just listen—1. He uses it in Ecuador. And his is the first station in Quito to import SONEX. "It is perfect. We are promoting it to our visitors and they are impressed. We are satisfied because of the acoustics. But it's also good-looking and easy to put up." Marco Polo Torres Vasco is General Manager at HCM-1 Radio, Quito, Ecuador.

2. "We use SONEX around the drums when recording basic tracks, and around the vocalist during overdubs. It works very well because sound waves are confined, not bouncing off walls." Rick Bacus of The Janet Jameson Band, Linwood, Kansas.

3. "SONEX is impressive-looking, and even better than that, it does what it is supposed to do for acoustics" in the church recording booth. Jim Moore, Audio Department Director, Northland Cathedral, Kansas City, Missouri.

4. Multi-Images Resources in Dallas uses SONEX for soundproofing one wall of a "cavernous" presentation room. "SONEX is above reproach," says George Minton.

5. Tri-Video Productions, Lake Tahoe, Nevada, is 95% location TV. "SONEX ships well and performs beautifully. It's great—we use SONEX for cleaner location recording and sharper pictures," says J.P. Davis, Producer/Director.

Pictures do speak louder than words.*

When we asked our customers to show us how they used SONEX, we weren't surprised to hear that it did the job. We knew that this patented acoustic foam with a specially sculptured anechoic design absorbs sound successfully. What really amazed us was the number of different applications they showed us. And what you're looking at here are just five responses out of the hundreds we've received. Even so, you can see (and hear) for yourself: Wherever sound is the problem, SONEX is the solution.

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*SUBMITTED BY FOURTH ROUND OF SONEX PHOTO CONTEST WINNERS.

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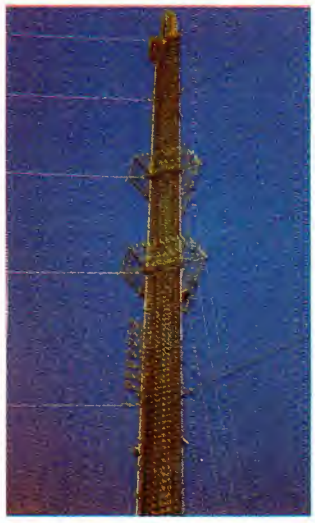
good as its component systems, and all parts of the SRTG project were thoroughly tested. The system has performed flawlessly. Common housekeeping chores have been the only problems encountered; balancing the air conditioning system and the efficient removal of transmitter waste heat have been the greatest troubles.

Seven auxiliary single-bay antennas have been mounted since sign-on at the 1000-foot level of the tower for emergency standby use. Plumbing the seven 3½-inch transmission lines from the antennas to the various transmitter rooms proved almost as difficult as mounting the two 8¾-inch main antenna transmission lines.

Three 2-way radio tiers have been placed at the 800-, 1200-, and 1400-foot levels of the tower. It is projected that the income produced by these 2-way tiers can soon defray the operating costs of the facility and possibly begin to cover the huge electric bills for the site.

Service area coverage

At a height above average terrain (HAAT) of 1920 feet, all stations in the SRTG project have received reception reports from hundreds of miles away.



Generally speaking, a listener can now receive any of the SRTG stations, depending on adjacent channel stations, from Beaumont, TX, 90 miles east of Houston; Huntsville, TX, 60 miles north of Houston; and Victoria, TX, 100 miles south of Houston.

Because of FCC Docket 80-90, more facilities like the Senior Road Tower project will surely be built. Stations that are currently on the air with less than the authorized power and antenna height and do not want their signals compromised by newly created FM stations must improve their facilities. To do this economically and efficiently, stations (even though competitors) must join together technically and financially for their own best interests.

With the technology now available to combine multiple FM stations efficiently, the only hindrance is the chemistry that it takes to bring corporations and managements together to start, fund and complete such an undertaking.

The more you see, the more we hear

Look who's talking about Dubner now.

While we claim no responsibility for the famous line, "Build a better mousetrap and they'll beat a path to your door," we'd like to think it might have been said about the Dubner CBG-2 video graphics/animation system. In any case, we thought you might like to hear what your colleagues are saying about us:

"The CBG-2 is undeniably the most novel and flexible state-of-the-art real-time animation graphics device currently available.

—Mark Bernardo, Chief Graphics Design Engineer, Olympics
ABC Television

"We needed a machine that would allow us to compete effectively in an already competitive market. The CBG-2 gave us the capability to create weather maps and news graphics quickly, it could be operated by department personnel, and it was the best buy on the market."

—Bob Plummer, Director of Engineering, Fisher Broadcasting
KOMO (Radio & Television, Seattle)

"It's a digital computer and animation tool that allows artists to create quality animations independently. The CBG-2 is relatively inexpensive, it works fast and enhances the creative process with real-time imagery."

—Elaine Schwartz, Computer Animator
Atlantic Image (New York animation house)

"The CBG-2 is much faster and less expensive than standard film animation. The real-time animation, clean key capability, expandability and great software support make it one of the best computers around."

—Corinne Sousoulas, Art Director
Motion Picture Laboratories (Memphis post production house)

"The CBG-2 is a valuable tool due to its ability to create effective graphics quickly. It offers three dimensional animation, graphic enhancement, and character generation all in one unit. And these features are difficult to find in any one machine."

—Victoria Henigman, Electronic Graphic Designer
WPBT-TV (Miami PBS Affiliate)

"The Dubner was purchased for its advanced animation capabilities, its ability to be upgraded via software, and its cost effectiveness. We love it!"

—Dan Sokol, Vice President, Engineering
Video Post & Transfer (Dallas post production house)

With all the nice things being said about Dubner, all we can say is thank you. We plan to keep up the good work. You'll keep seeing it and we'll keep hearing about it.

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With this issue of **Broadcast Engineering,** we launch a new audio performance testing program for broadcasters. The *BE Proof* series begins with FM radio and will be expanded to other services in the coming months. We welcome comments from readers on the concept of the program, which may include certification of outstanding technical facilities.

Broacast Engineering's Audio Proof Program

FM fidelity: Is the promise lost?

By Dennis Ciapura, **BE** consultant on technology

Now that we have spent a full decade making FM loud, perhaps it is time to work on the fidelity side of the success equation.

Even though FM has blossomed into a whopping commercial success, many engineers and programmers have just cause to feel that we have not completely succeeded. Unfortunately, the competitive pressures that are an inevitable byproduct of commercial success have forced many stations to engineer for loudness as a first priority. Although most everyone goes through the motions of preserving as much audio fidelity as possible, few observers can honestly say that the FM band sounds better today then it did 10 years ago.

Ironically, the source and transmission equipment have improved dramatically over the same period, and hardly a home in the United States is without some sort of high-quality FM receiver. What strange road have we taken then, that has led us so swiftly into the embrace of economic comfort, while leaving behind much of what once was of value? As the FCC continues to withdraw from its role as administrator of technical righteousness, the only hope of reversing the trend lies in the economic pressure that spawned the present situation in the first place.

There is good reason to believe that heightened interest in FM fidelity will develop as a competitive factor. The key to understanding how this might happen lies in understanding how loudness, at the expense of fidelity, got to be so important.

The proliferation of FM stereo in autos and the horrendous multipath problems that were generated resulted in a significant practical requirement for higher average levels and smoother RF coverage. FM stations went to tall towers, and competitive processing became the name of the game. During that period, we were rather unsophisticated in our handling of pre-emphasis and filter overshoot problems; therefore, many stations simply overcompressed the audio.

As the number of FM receivers in homes and autos grew rapidly, FM stations began to make a lot of money and the number of well-financed, full-power FMs expanded, thus breeding strong competitive pressures. Programmers demanded "punch," "sock," "dial presence" and a host of other sonic phenomena, all leading to heavier processing for higher average levels.

With the advent of the composite clipper, modulation Karma was at hand! The peak light could be kept aglow at 100% and the mod monitor needle hung happily around 95. Today, many FM stations are processed way beyond the point of diminishing returns (in terms of coverage optimization). At some stations, FM audio processing has developed into a bizarre art form.

Each time creative audio processing designers have introduced new products, they have implored their users to swap some additional level gained for better fidelity. However noble the intent of the audio munitions suppliers, a processing war is on and nothing short of an industry-wide processing non-proliferation treaty (with verification) can halt it.

Now that there are enough processors in everyone's hands to affect the universal elimination of audio fidelity several times over, perhaps it's time to disarm. Fortunately, the same equipment that now clips, clamps and compresses in anger can be turned to peaceful employment without signifi-

cant loss of level by careful testing and adjustment.

Now that almost everyone on the band is incredibly loud, the next *new* frontier must be the restoration of lost audio fidelity. After all, the only way an FM station can sound different and distinctive these days is to sound better. It is as simple as that, and with various forms of cable radio and other new sources of competition just around the corner, broadcast FM needs to sound great.

It is much easier to engineer a *loud* station than it is to fashion a *loud and clean* one. Cleaning up the signal without losing level is a much more complicated task than simply turning down the processing. It starts with the cleanest, flattest possible transmission system. In the end, a system design approach, including everything in the chain from tape head or stylus to antenna, will be required.

This process is a sonic adventure requiring both wit and endurance, as test instruments become constant companions in the night. Nine-to-five, tweek-by-ear enthusiasts need not apply. The reward for those who persevere, however, is a distinct signature on the air that the station can be proud of. Honestly, how many engineers out there are a little tired of rationalizing squashed, clipped audio?

There are a couple of key points that are often missed at proof time. The first is that the proof proves little. A really clean stereo transmission system would maintain all distortion components at 50dB below operating level (0.3%), which is a far cry from the 2%-and-greater FCC specs. It used to be fun to speculate about how the FCC would bring its 1930s parameters in line with present-day performance capabilities, but those days are gone. Therefore, it is incumbent that quality-conscious broadcast engineers be creative and design a meaningful proof routine.

FM broadcasting has made great strides in recent years toward the realization of a transparent medium through which programming can flow to the listener. Although the technology for this goal is available, it is not always put to work in day-to-day broadcasting. The *BE Proof* program outlined in this article describes how the goal can largely be met, while still preserving a competitive position in the marketplace.

In many ways, the equipment performance measurements required by the FCC for FM stereo stations are obsolete from a technical standpoint. For instance, attempting to check high-frequency linearity with harmonic distortion tests at 10kHz and 15kHz is pointless. Stereo generators filter the audio above 15-17kHz to protect the 19kHz pilot, so even the second harmonics of 10-15kHz inputs are also filtered. Under these conditions, the harmonic distortion meter is not reading distortion at all, just residual noise. Remove the input signal and you get the same reading. Performing similar measurements at 50% and 25% modulation makes even less sense, because the reference levels are 6dB and 12dB closer to the noise, so the distortion indications get higher as the input level is reduced. Obviously, these rules were pre-stereo and have never been changed.

There are all sorts of little quirks that render the FCC-required equipment performance measurements (EPMs) of limited value except for compliance purposes, but the important point is not how inadequate the required tests are, but what additional testing should be done.

To that end, **Broadcast Engineering** is proposing a new set of fidelity-oriented objectives. These objectives are not intended to replace the FCC tests, but are in addition to the usual proof to ensure state-of-the-art FM fidelity. We plan in future months to expand the program to AM radio, and possibly to television.

Our performance specifications may look tough, and indeed they do describe superlative FM fidelity. They are, however, achievable. Even though the distortion targets suggested may be tighter than the manufacturer's specs on some of the individual links in a system, it is possible for the overall system performance to be better in some respects than the manufacturer's specifications for one of the component parts for two reasons. First of all, the factory specs are usually conservative enough to accommodate production variations, so typical performance is generally better than the specification.

Also, distortion figures in a complex system are not usually additive, although they can be, and the weakest link generally sets the overall system performance limit. Frequency response errors can be manipulated to cancel each other and, fortunately, most FM response deficiencies occur at the extreme high end of the audio band, affecting only a small fraction of an octave. They are, thus, quite inaudible. The point of all this is that one should not be discouraged if the station's stereo generator distortion

spec is equal to or slightly in excess of the **BE** system performance target. Even if a unit, when tested by itself, is nudging the factory specification, a call to the manufacturer's engineering department will often produce some suggestions for minor adjustment or component swapping to improve performance.

If part of the system is due for replacement, by all means consult the new vendor's engineering department to see what the *typical* performance figures are before making a purchase decision.

This is especially important when it comes to modulation monitors, because some of the older monitors have rather unimpressive distortion specs. Most broadcast engineers do not have the test equipment necessary to check the mod monitor independently, so the measured system performance is really the combination of transmission system and demodulator performance. This is an acceptable situation when testing for FCC compliance

General test considerations

- System in stereo mode.
- Input signals applied to console line input(s) used for most program sources.
- System output sampled and demodulated at transmitter antenna output.
- All processing and EQ left in line and adjusted as usual.
- Operating level defined as 0VU or equivalent at console.

Frequency response
Conditions

- AGC voltages switched off, not simply bypassed. Unfortunately, not all processors provide this feature. In such cases, use the *bypass* mode.
- Any convenient modulation level between 50% and 100%.
- Input level as required to maintain reference modulation level.
- Response error expressed as input level deviation required to maintain reference modulation level, compared to the 75μs characteristic for non-Dolby stations or 25μs characteristic with Dolby encoding.

*Superior performance**
- ± 1dB 30-15,000Hz
- ± 0.5dB 50-15,000Hz
- ± 0.2dB 100-10,000Hz

*Excellent performance***
- ± 2dB 30-15,000Hz
- ± 1dB 50-15,000Hz
- ± 0.5dB 100-10,000Hz

*Superior performance is the first proposed **BE** spec representing the maximum performance capability of a state-of-the-art FM stereo facility.
Excellent performance is the second proposed **BE spec. Although it is tighter than the FCC numbers, it is attainable by almost any properly engineered station with typical equipment.

Distortion
Conditions
- AGC switched on, input levels as required to produce specified console levels. De-emphasis in.

Superior performance
at standard operating level
- THD = 0.3%, 30-7500Hz
- IMD = 0.3%, 60Hz & 7kHz, 4:1
at operating level + 10dB
- THD = 0.5%, 30-7500Hz
- IMD = 0.5%, 60Hz & 7kHz 4:1

Excellent performance
at standard operating level
- THD = 1% 50-7500Hz
- IMD = 1% 60Hz & 7kHz, 4:1
at operating level + 10dB
- THD = 1.5% 50-7500Hz
- IMD = 2% 60Hz & 7kHz, 4:1

Audio clipping
Conditions

- Same as for distortion tests except that the input level is increased until left/right channel clipping is observed on an oscilloscope at the indicated test frequencies.
- Clipping level is defined as that level above operating level (0VU) required to produce visible clipping as the input level is increased.

Superior performance
- 30-5000Hz + 15dB

Excellent performance
- 50-5000Hz + 10dB

Composite clipping
"A" conditions

- Composite output of the monitor demodulator viewed on an oscilloscope with the transmission system in the stereo mode (and 19kHz pilot on).
- Clipping level is defined as that level above operating level required to produce visible clipping of the *total* waveform.

Superior performance
- 15dB at 1kHz

Excellent performance
- 10dB at 1kHz

"B" conditions

- Switch pilot off, view waveform clipping as defined above.

Superior performance
- 10dB at 7.5kHz
- 5dB at 15kHz

Excellent performance
- 10dB at 7.5kHz

Noise
Conditions

- Measured at each stereo audio channel output with all processing equipment in the line and adjusted for normal operation.
- Noise level is referred to the output level produced by an input signal at 0VU at the console.

Superior performance
- – 60dB, 30-15,000Hz unweighted, de-emphasis in.

Excellent performance
- – 56dB, 30-15,000Hz unweighted, de-emphasis in.

Separation
Conditions

- Measured at each stereo audio channel output with all processing equipment in the line and adjusted for normal operation.

Superior performance
- 40dB, 400-15,000Hz
- 30dB, 30-400Hz

Excellent performance
- 36dB 400-15,000Hz
- 30dB 50-400Hz

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Hugh Ford, *Studio Sound*
November, 1983

"Overall, the 422A/424A should prove to be a system of diverse capabilities, able to tackle the widest variety of material—once the user masters its operation. In addition, its solid construction and excellent service documentation should insure years of reliable operation. Such qualities are typical of timeless designs that tend to retain their value long after the accountants have depreciated them away."

John Monforte, *db Magazine*
July-August 1983

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because the proof limits are so much greater than even the worst demods.

If we intend to go for all-out fidelity, however, we must know that the monitor demodulator is clean and is not setting the limits of our measurement resolution so high that improvements in transmission system performance cannot be detected. If the old monitor just isn't up to snuff and the factory isn't too optimistic about the unit ever getting down to 0.1% residual distortion and at least a 70dB S/N ratio, then a new monitor is a must.

It is incredible to see how many stations use FM tuners for audio monitoring at the studio because the signal from the modulation monitor is noisy, and then use the same modulation monitor to make measurements. Or in some cases, the shiny new hi-tech monitor lives in the studio because it's pretty and/or it has a smarter peak flasher, while the old monitor does the measuring at the transmitter. If optimizing the station's fidelity means anything at all, you've got to get the best possible demodulator out at the transmitter.

Some of the newer monitors are superb audio test instruments and are a real investment in a station's on-air sound. The QEI 691 for instance, features 0.05% THD and IMD specs, as well as 75dB S/N ratio. It also provides scope outputs that generate a spectrum analyzer display for field calibration checks. Our current **BE** *Spec Book* lists several state-of-the-art monitors, including the new TFT units, which are rated at 0.1% distortion, but perform considerably better. These are only two of several models available to broadcasters. Any of the manufacturers represented in the *Spec Book* would be happy to answer questions about typical performance.

Test measurements

Before getting into the details of some suggested procedures for optimizing the fidelity of FM systems, a look at the **BE** FM broadcast performance targets is in order. Comparing the station's last proof results to be **BE** specs is probably an irrational act, because our tests are geared toward maximum performance in the real world. We will propose two sets of specifications. The first and more stringent parameters will yield *superior performance* and represent the maximum performance capability of a state-of-the-art FM stero facility. Although relatively few stations will provide this level of performance, the targets are achievable and are challenging performance goals for those in quest of all-out fidelity. The second set of specs will provide *excellent fidelity* and, although they are considerably tighter than the FCC numbers, almost any properly engineered station with typical equipment can make the grade. (See chart on page 32.)

Final thoughts

Although the *superior* set of **BE** FM fidelity objectives are not easy to attain, they certainly are achievable.

The *excellent* objectives describe far better performance than the FCC requires, but are still well within the grasp of most FM stations. Even stations with older equipment should achieve this level of performance if everything is properly maintained and engineered.

In Part II of this series, we will discuss some suggested test methods and more thoroughly explain the reasons behind some of the specifications and test conditions proposed. We will also propose a range of processing levels for various formats.

We welcome feedback from station engineers and managers on the **BE** Proof Program. Please take some time now to fill out the post card questionnaire located at the back of this issue.

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PBE-84

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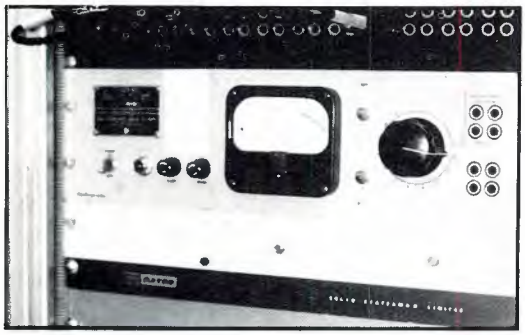
Creative audio processing

By Andy Laird, chief engineer, KDAY, Los Angeles,
and audio engineering consultant



The evolution of audio processing technology from simple overmodulation protection to complex station image creation has had a major impact on radio broadcasting. Audio processors have—more than any other single piece of equipment—changed the way a station sounds on the air.

The evolution of audio processing equipment from the 1960s to the present is illustrated in this pictorial sequence. At the top is a Gates Radio Solid Statesman AM limiter, released in the late 1960s. The middle photo shows a CBS Laboratories Model 4000 AM Volumax limiter, released in the early 1970s. The bottom photo shows a current-technology Orban Associates Optimod® FM audio processor/stereo generator.

The art and science of audio processing has advanced greatly in the last 10 years. The way a radio station sounds technically—its intensity, texture, loudness, attention-grabbing and/or long-term listening characteristics—have become the focus of program directors as important ingredients used to create a total impression and station identity to the listener. Manufacturers have responded with all types of magic boxes that will alter and control the audio signal, preferably without destroying the aesthetic and musical values of the programming involved.

The roots of audio processing

Audio processing was inspired by the need to prevent program audio peaks and loud sounds from overmodulating the transmitter. The design objectives of the early processors were to make the units as sonically unobtrusive as possible, while protecting the transmitter from overloads. Greater audio density with some modification of program dynamics resulted, along with new sounds often described as *pumping, thumping, background noise modulation* and *changes-in-mix relationships.*

Then, along came the disc jockey/board operator combination, in which one person handled both the entertaining and engineering duties. Predictably, the combo operation resulted in widely varying audio levels coming out of the mixer console. Manufacturers responded with the automatic gain control (AGC) amplifier, which further modified the program audio. Along with the new sounds created by the AGC amplifier came another set of sounds created by the interaction of the AGC and limiter.

Gating circuits soon appeared in AGC units, such as the CBS Labs Audimax and Gates Radio Level Devil. Other developments included the first 2-band limiter, designed by Altec, and the Kahn Symetrapeak all-pass filter. These advances brought radio and TV audio processing up to the solid-state age, when the real technological changes began to unfold.

In the 1960s, tube designs were converted to solid-state without much sonic change, except for the addition of clippers as the final peak limiting stage. Examples of such units were the CBS Labs Volumax and FM clippers like the Fairchild Conax. Gain-control devices in the 1960s ranged from the Jim Laurence LA-2 compressor—using a light-dependent resistor as the control element—to the EMT system, a total audio processing package released in the late '60s that used pulse code modulation to adjust the gain.

The Dorrough 310 3-band processor marks the beginning of major design changes. The 1970s brought us such things as soft clipping, side-chains, control-loop frequency response tailoring, pre-emphasis curves for AM broadcasting, band-splitting filters, solid-state all-pass filters, RMS-level detection, variable knee compression slopes, smart clipping and composite clipping.

Processing equipment today

The audio processing systems available to broadcasters today offer unparalleled flexibility and performance. The industry now has multi-multiband processors with distributed clipping, distortion detection and feedback correction, overshoot correction for transmitter and antenna problems, low-end tilt correction and matrix processing.

We have total station processing systems that come in one box, with whatever controls the designer feels the program director/end user will want to make the station sound just right. We also have multiple-box systems with knobs for every adjustment a broadcaster could ever dream of making. Flashing LEDs, along with meters, have become popular indicating devices. Typical gain reduction devices include FETs, transconductance amplifiers, light-dependent resistors and voltage-controlled amplifier (VCA) modules.

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The total processing systems found in radio and TV stations today can be unbelievably complex, with many differnt audio paths to achieve the results that programmers now demand.

Sorting out the sounds

With all of the processing devices available today, it is difficult to learn the *sound* of each unit in the audio chain. To be effective in reaching the goals of the program director, however, an attempt should be made. By learning how each stage of the processing system sounds, adjustment of the total chain is made easier, and interaction of various steps is easier to correct. Specific *trends* or *sound cues* can often be noticed for different approaches to gain control in the unit. RMS compression, for example, has a specific sound quality that can be heard in all RMS-type compressors.

For single-box total processing systems, listen to each function separately by bypassing the other functions. This will help identify all of the sounds that the system makes. The multibox total system units are easy to audition one box at a time.

Once a program director and engineer have developed the sound they want with the station's audio processing system, the next problem is trying to pass that signal through the transmitter and into a consumer-type receiver. The usual approach at this point is to lump everything in series—layer upon layer—and adjust the processing again to approximate the desired station sound. The results of such an approach, however, are often disappointing.

A different approach

An approach I have used for years with success has been to develop separate processing chains to achieve specific goals, and then sum them in parallel ahead of the final transmitter processor, which is set up to be as transparent as possible. This approach has several advantages for event-to-event level control and the application of special effects. This arrangement requires a multibus console, which results in a somewhat more complex studio operation. The benefits, however, far outweigh the added cost and effort.

All live events, such as those involving microphones, are assigned to one bus and receive processing treatment specifically to control the problems of live dynamics. Special effects (such as reverb and equalization) can also be easily added at this point without interfering in the overall station processing chain.

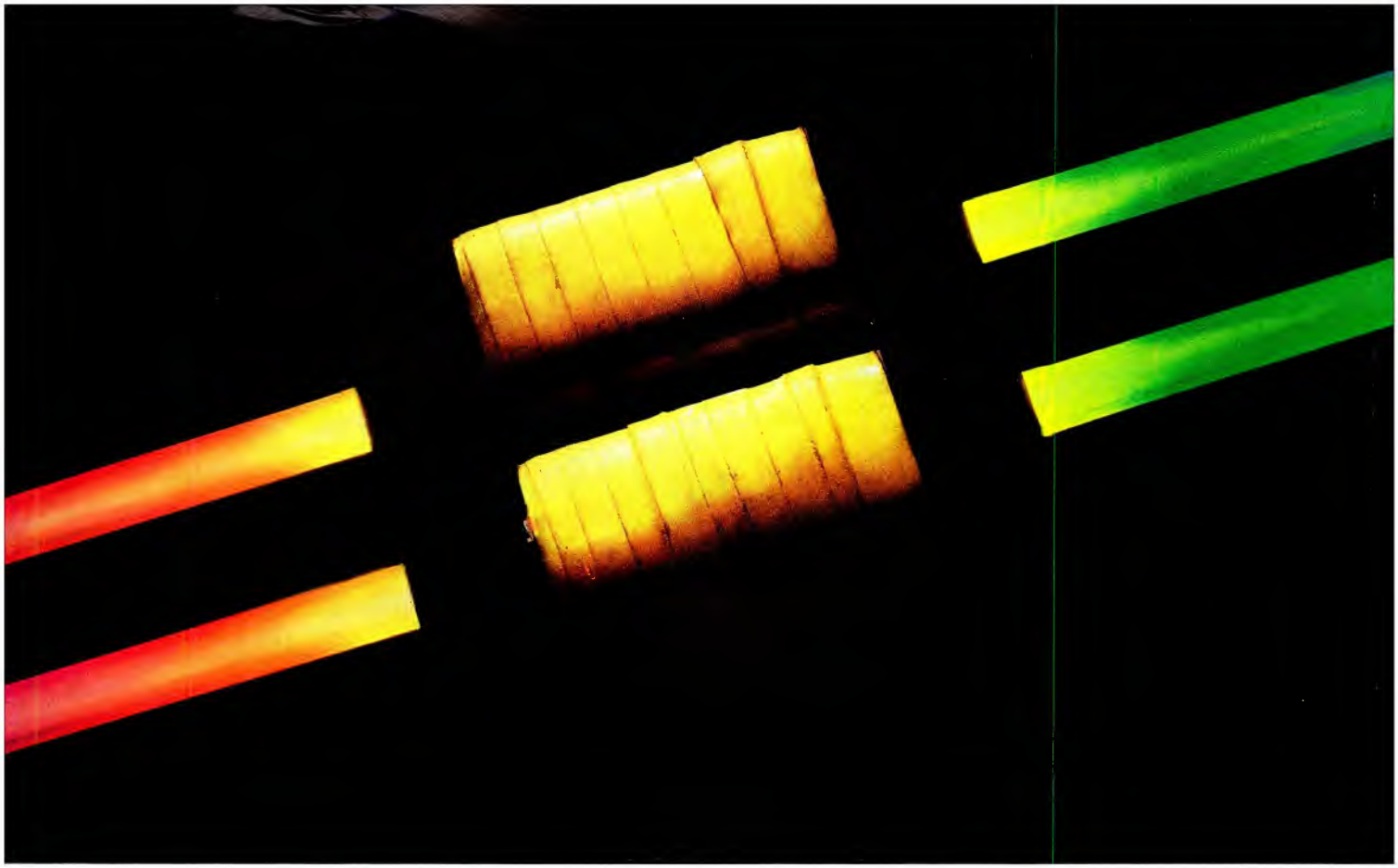
A separate mixing bus is assigned to music playback sources, where the specific needs of finished music processing are addressed. If the station wants to sound somewhat processed in terms of constant level, then commercial source machines can be added to this bus (unless there is a special effect the program director wants to use on music or commercial sources only). If the station runs open music processing, commercial sources can be assigned to a third mixing bus, with the output of their processing reduced 1dB or 2dB to match the overall loudness and intensity of the music channel. This approach is useful for *easy listening* and *beautiful music stations*.

These elements—and others if required—are added for a final mix, which is passed through a *protection processor* stage and sent to the transmitter. The final processing unit is adjusted to be as transparent to the program audio as possible. The summing of separately processed elements allows the station to establish talkover ratios and event-to-event controls, which are somewhat independent of DJ board operation. If, for instance, the final transmitter processor is an Optimod 8100, it can be set up to operate slowly for a wide-open music sound with the processed microphones mixed into the music for perfect talkovers. This arrangement will prevent the final audio processor from pushing down the music level due to a high mic level.

Evaluating the system

No test equipment is available at this time to define the dynamic subjective characteristics of audio processing. Measurement of a processing system must, instead, be made by listening to the air signal. It is obvious that a high-quality monitor is an essential tool for such work. The station's engineer and program director need to be able to hear the processing effects before they become audible to the average listener. There is nothing like A-B comparison on a good monitor to point out signal differences when adjusting processing equipment.

An important consideration in the setup of processing equipment is the technical quality of the broadcast plant. Source and transmission gear should be well-maintained and recently designed. This is especially true of phono pick-ups, turntable preamps and microphone preamps. Problems generated at the program source can be greatly magnified by audio processing. Processing is often blamed as the cause of problems heard on the air, when many times the actual problem is distortion fed into the processor.



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Contact Harris Corporation, Broadcast Transmission Division, P.O. Box 4290, Quincy, Illinois 62305-4290. 217/222-8200.

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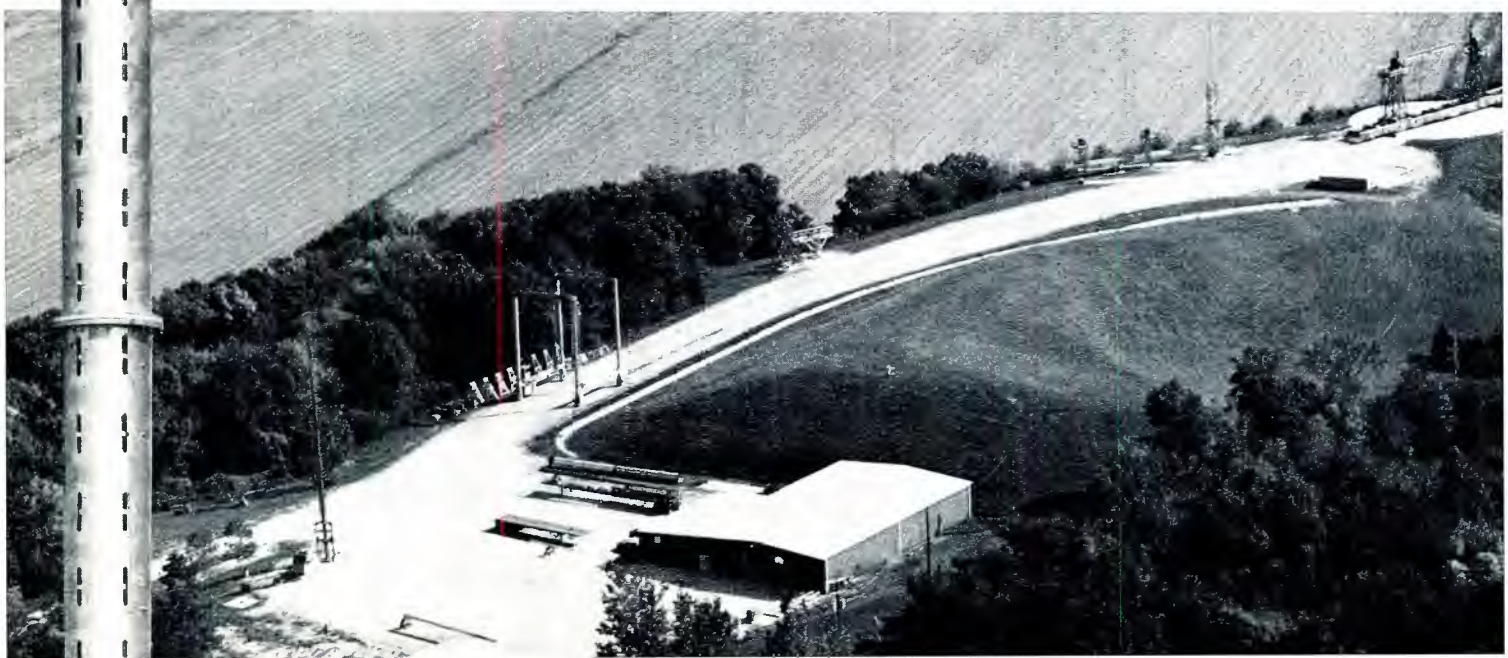
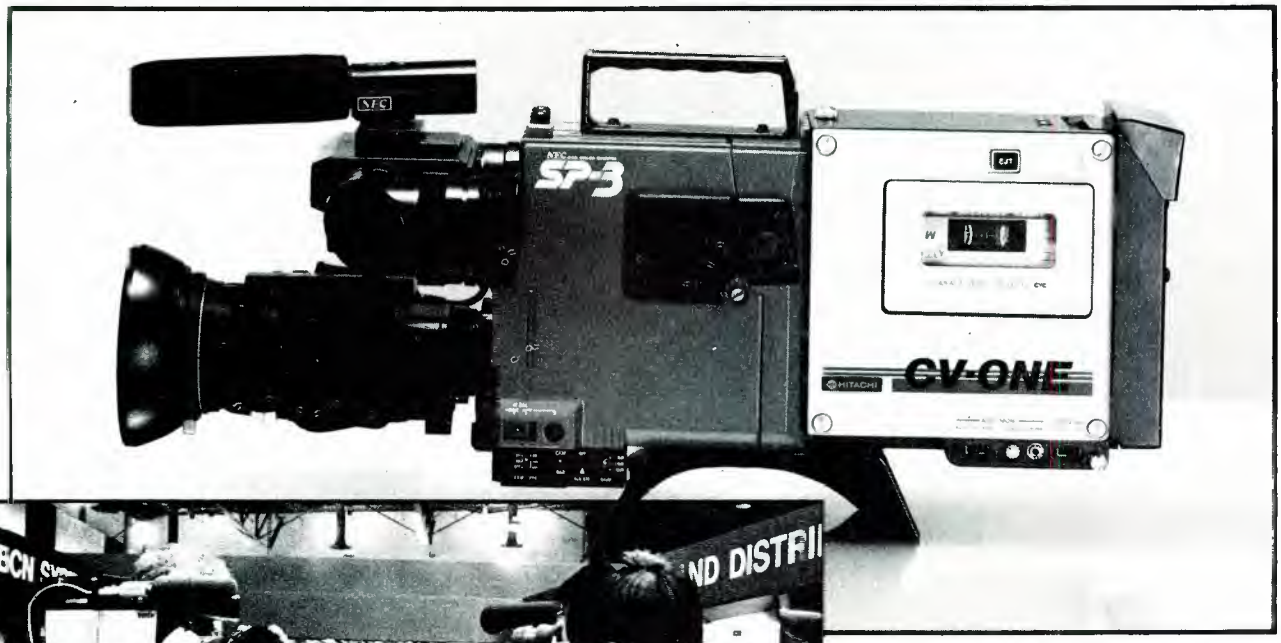


1/4-inch: An '84 reality



NEC's SP-3 CCD video camera, shown here with optional Hitachi ¼-inch recorder.

Quarter-inch shootout. Bosch KBF-1 vs. Hitachi CV-One at NAB-'84.

By Bebe McClain, B. F. McClain Productions, Asheville, NC

At NAB-'84, manufacturers of ¼-inch format equipment not only displayed their production models, they also took orders.

For the past two years with only prototype models shown, many broadcasters figured that ¼-inch would remain a distant dream. But, developments by Bosch, Hitachi, Ikegami, NEC and Philips combined with the announcement of a tentative ¼-inch standard by the SMPTE working group a week before NAB, have awakened broadcasters to the fact that ¼-inch recording is here. The wide selection of equipment allows mixing and matching of cameras and VCRs. This variety is probably what has made ¼-inch so much more attractive than ½-inch. Manufacturers hope a unified ¼-inch format will enjoy the same kind of acceptance that ¾-inch has had in the past.

Three manufacturers at NAB-'84 showed complete families of ¼-inch products, while two others showed cameras that use a common electrical/mechanical interface between the camera and the ¼-inch VCR. This interface development was requested by the SMPTE.

With a common docking system, most camera manufacturers should soon offer cameras that match the ¼-inch VCR or can be adapted with a small interface between the camera and VCR. The new generation cameras will also attach, by cable, to ¾- or 1-inch video recorders.

Bosch

Bosch displayed the KBF-1 Quarter-Cam, a combined VCR and camera. The units use the Lineplex recording system with time expansion and compression, followed by time division multiplex of the luminance. Henry Zahn, of Bosch, said that models soon would be available in the SMPTE format.

Marketing of the Lineplex system

has begun in Europe, and simultaneous compliance with the SMPTE format is expected by October 1985. Zahn said Bosch had many orders for the Lineplex system and plans a series of adapters designed to interface their recorder with any composite signal camera.

The KCF-1, the camera portion of the KBF-1, can be used as a stand-alone camera. A separate remote unit controls major camera functions such as iris, gains, black, painting, microphone and volume.

The BCF-20 field editor is made complete by attaching the VCRs from two KBF-1 systems. Edit electronics are in the ac/dc field editor and not in the attached VCRs.

The BCF-9 studio recorder with TBC performs head-to-head dubbing and interfaces to ¾- and 1-inch recorders. The more sophisticated BCF-10 studio recorder includes edit capability. Also boasting a 1-line correction TBC, the BCF-10 has video outputs for component, U-matic and composite, plus it interfaces to editing controllers from Sony, Convergence and CMX.

The approximate prices for Bosch units are $30,000 for the KBF-1 VCR/camera; $21,000 for the BCF-9 studio recorder; and $30,000 for the BCF-10 studio recorder/editor. Pricing was unavailable for the BCF-20 field editor.

Henry Zahn (Bosch) holds a 20-minute ¼-inch cassette atop a BCF-9 Lineplex studio recorder.

Hitachi Denshi

Displayed in the Hitachi Denshi

ABC's Summer Games International Broadcast Center engineering team, led by Richard W. Rodgers, chose ADC to supply over 200 Pro-Patch jackfields, such as the ones shown here.

For the biggest broadcast event in history, ABC chose ADC

With over 30,000 pieces of equipment and 660 miles of cable to install, ABC wasn't looking for extra work.

But, as host coordinating broadcaster for a worldwide audience of more than 2 billion, with 188 hours of scheduled coverage for the USA alone, ABC needed reliable jackfields.

The back panels of Pro-Patch jackfields feature ADC's unique split cylinder contact modules. Each contact will terminate up to four solid or stranded wires—22, 24, or 26 AWG—two on each side. ADC's split cylinder contacts make hooking up to the back of a panel almost as easy as plugging in to the front. Just a push on a convenient hand tool bares a wire, locks it into the contact inside an insulated housing, and trims off excess length. Disconnecting wires, if you choose, is just as easy. No unsoldering. No tools.

They needed flexibility, too—with 1300 total hours of competition to cover at 30 locations in just 13 days.

Modularity was another consideration, so the jackfields can be used elsewhere after the Summer Games.

For these reasons, Richard W. Rodgers, head of engineering at ABC's International Broadcast Center, and his staff, chose ADC. They installed our 100% prewired, computer tested Audio Pro-Patch® jackfields exclusively.

Like ABC's busy engineers, your own staff has more important things to do than soldering jackfields. You'll see higher productivity, faster installation and lower up-front costs with ADC's 100% prewired Pro-Patch® jackfields and Ultra-Patch® panels. With our patented split cylinder contacts, they're solderless and hassle-free.

For more information on these state-of-the-art units—or on more than 300 ADC standard audio and video patching components—write to the address below. Or call (612) 893-3000.

ADC/Magnetic Controls Company
4900 West 78th Street
Minneapolis, MN 55435

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booth were the SR-3 recorder/camera combination, weighing only 18 pounds, and the field playback unit that uses a VCR from the SR-3. The user detaches the SR-3V VCR from the recorder/camera and slips it into a slot in the field player.

Hitachi plans an array of ¼-inch products, including a field editing controller that connects to two field playback recorders. Another field editor option has a built-in monitor and requires the addition of one SR-3V. An editing VCR is built into the editor. The Hitachi units use an encoding system that records luminance on a Y track. R-Y and B-Y are compressed onto a chrominance track.

Besides field equipment, Hitachi demonstrated the ¼-inch ECR-5 players. These units, with a few dozen CV-One ¼-inch recorders/cameras, have been in use for about one year in the news department at NTV in Japan. The CV-One recorder/camera is a predecessor of the SR-3.

Although the running time of the CV-One was 10 minutes on metal particle tape cassettes, 20 minutes is offered by the SR-3 on either metal particle or oxide tape.

The SR-3 is scheduled for delivery by the end of 1984 and is priced at $23,500 for the Quarter Recorder combined recorder/camera. The ECR-5 studio playback unit is tagged at $15,000. Pricing was unavailable for the field editor.

Bob Thomas of ABC and chairman of the ¼-inch SMPTE working group looks over a Philips LDK-54 system.

We're so confident about Saticon II performance, we don't have to count the hours.

Our Saticon II warranty is measured from the date the tube is placed in service, with full adjustment for up to *six months,* regardless of actual service hours. The Saticon II in-service warranty covers, in effect, full-time operation for the entire six months—more than **4,000 hours of service.**

Plumbicon's warranty is based on hours of service with full adjustment for just *50* hours of service. If Plumbicon were used at a minimum of only one hour a day, this 50 hours service warranty would expire **in less than seven weeks.**

In what may be a more typical comparison, if Saticon II averaged 30 hours of service per week, after six months the service would total to 780 hours. Compare this with the Plumbicon warranty of only 50 hours of service. Saticon's full adjustment warranty period is still **15 times longer** in this "real world" example.

Saticon's pro-rated adjustment policy is better, too. Should a Saticon tube fail after the six month in-service period, we'll pro-rate the cost of its replacement for 12 months, regardless of service hours. With Plumbicon, pro-rated adjustment is limited to only 1,000 of total service.

Saticon II not only gives you the best warranty in the business, it also gives you best performance in your cameras. The improved Saticon II photoconductor ensures high resolution, distortion-free color, very low lag, high sensitivity and depth of modulation. Pictures are clearer, sharper and crisper. Highlight memory (without red trail) is significantly reduced.

For more information contact your RCA distributor or write to RCA Camera Tube Marketing, New Holland Avenue, Lancaster, PA 17604-3140. Or call (800) 233-0155. In Penna., phone (717) 295-6040. Overseas, contact RCA Sunbury-on-Thames, Middlesex, England. Hong Kong. Mexico 16DF, Mexico. Rexdale, Canada.

Our convenient camera tube selection guide will help you compare the performance characteristics and design features of all major camera tubes. Call or write today for your copy.

RCA

Take out the doubt.

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Hitachi Denshi SR-3 VCR/camera and field adapter.

Philips

Great interest was shown in the Philips LDK-54 VCR/camera. Philips plans to market the unit in the Lineplex format. The LDK-54 should be available later this year and will cost approximately $42,000.

The camera portion features special HS (high stability) electrostatic focus and magnetic deflection in ⅔-inch Plumbicon tubes, referred to as mixed field tubes. The camera has a built-in diascope and provides component and composite outputs.

Like Bosch's field editor, the LDL-2020 accepts the VCR from two LDK-54 units. An LDL-2009 studio player and an LDL-2010 recorder/ player with edit capability are similar to the corresponding Bosch units.

A little different

Ikegami and NEC have taken a different approach. They have designed cameras that can use VCRs of ¼-inch, ½-inch Beta or ½-inch M-format. Not trying to predict which format(s) the broadcast market will eventually select, these manufacturers are covering all the bases.

Ikegami

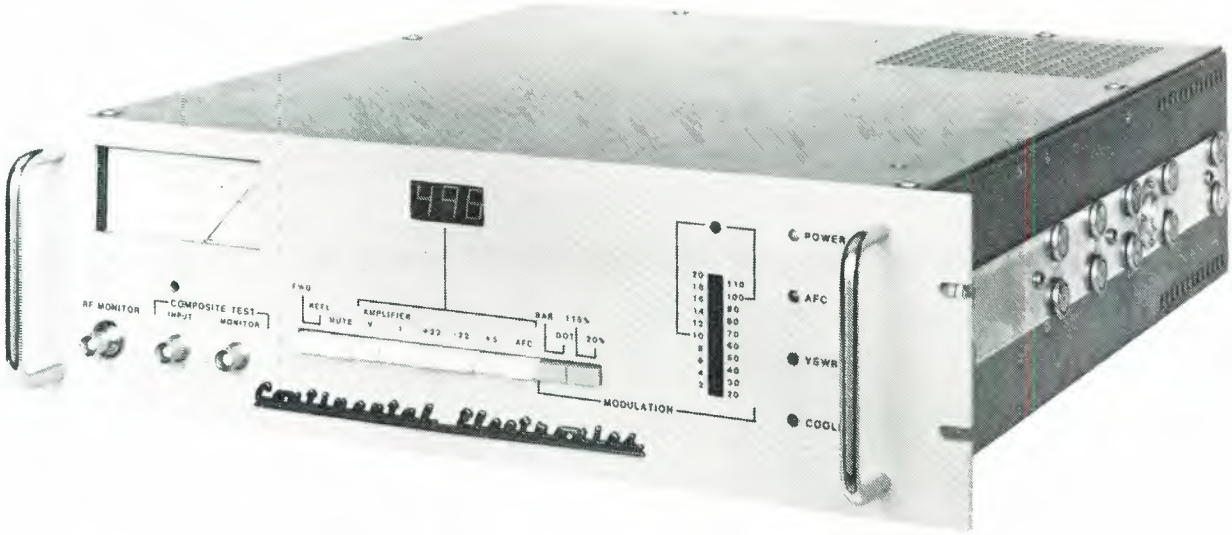
Ikegami displayed the HL-95 camera in tandem with an Hitachi ¼-inch VCR, although it also interacts with ½-inch. The HL-95 Unicam includes three ⅔-inch mixed field HS Plumbicon tubes and is a stand-alone camera that is made to accept any small format VCR. A different interface box is needed for each format. The HL-95, first shown at SMPTE-'83 in Los Angeles, can be cabled to a ¾- or 1-inch recorder and has remote triax and multicore cable control units.

The HL-95 camera, with tubes and gen-lock, but no lens, is priced at $27,000. Any lens for the HL-79 camera can be used on the HL-95. Interface modules for ½- and ¼-inch are priced separately.

NEC

A unique offering is the NEC SP-3

Continued on page 52



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Continental's Type 802A solid-state FM Exciter offers broadcasters unmatched performance.

The modulation performance of Continental's new FM Exciter exceeds all currently known/marketed FM exciters.

State-of-the-art design includes modular construction and subassemblies: any subassembly within the exciter can be removed without removing the exciter from the transmitter. The Type 802A accepts a composite baseband signal from a stereo generator, STL system or monaural audio and SCA programming.

No tuning adjustments are required, other than selecting the operating frequency. The exciter generates its frequency with a digitally programmed, dual speed, phase-locked frequency synthesis system.

Power output is 50 watts into a 50 ohm load at all frequencies in the FM band, and the exciter may be used as a low power transmitter.

Special circuits protect the amplifier from any mismatched load including open or short circuits. Automatic power control maintains exciter output at any preset level from 5 watts up to the maximum level.

The case design is very clean: front-panel analog and digital meters, along with LED readouts, give clear and accurate indications of system status and performance. A digital LED display indicates true peak level of the modulating signal in 5% increments, with an accuracy of better than ±2%.

For information, call (214) 381-7161: Continental Electronics Mfg. Co.; Box 270879, Dallas, Texas 75227.

Continental Electronics

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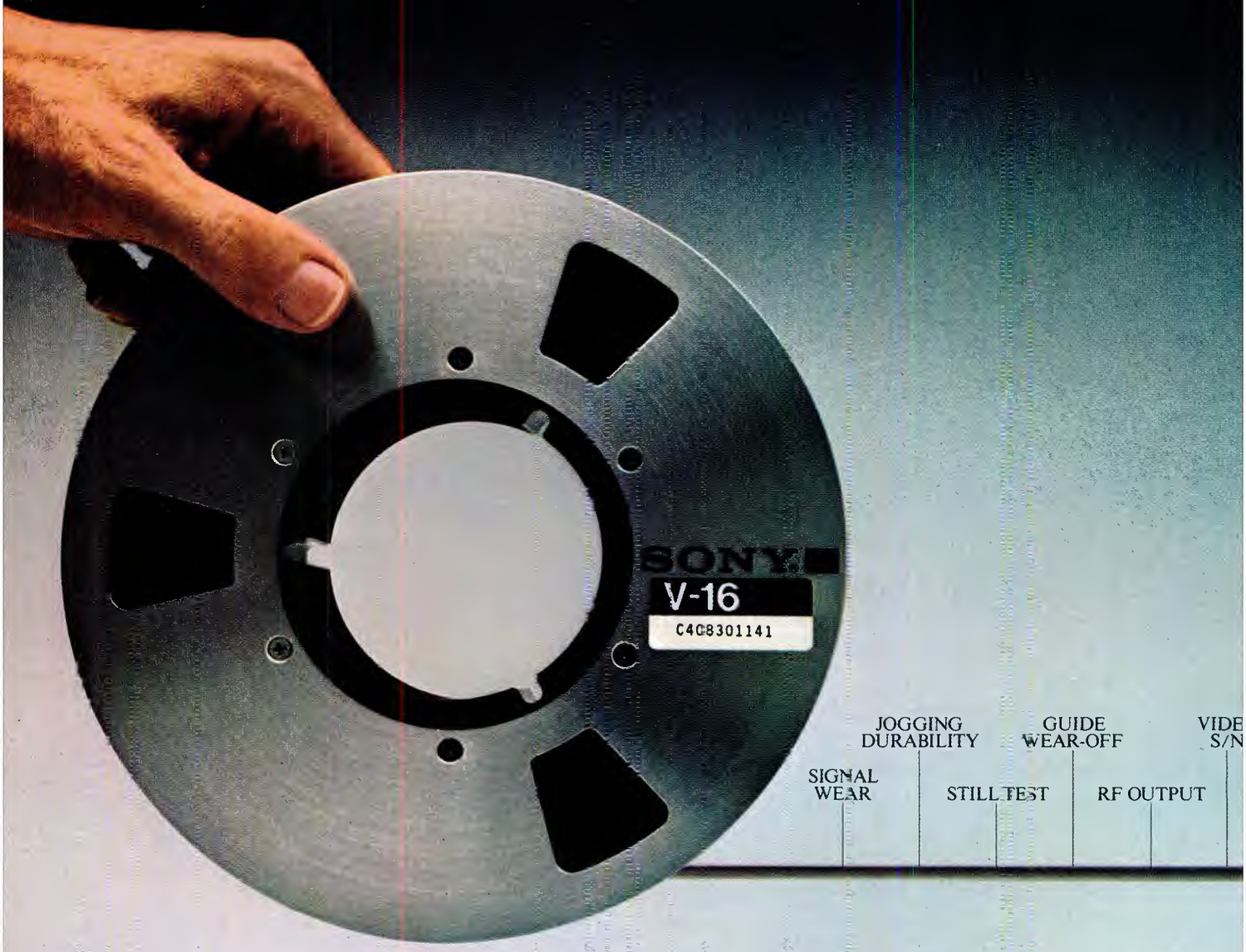
THE SONY 1" T



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What good is a recording tape that gives you a terrific video signal-to-noise ratio but falls short in signal wear? Or one that excels in video sensitivity but is dismal in dropouts? Or, for that matter, one that reduces head wear but sticks and slips in the jogging mode?

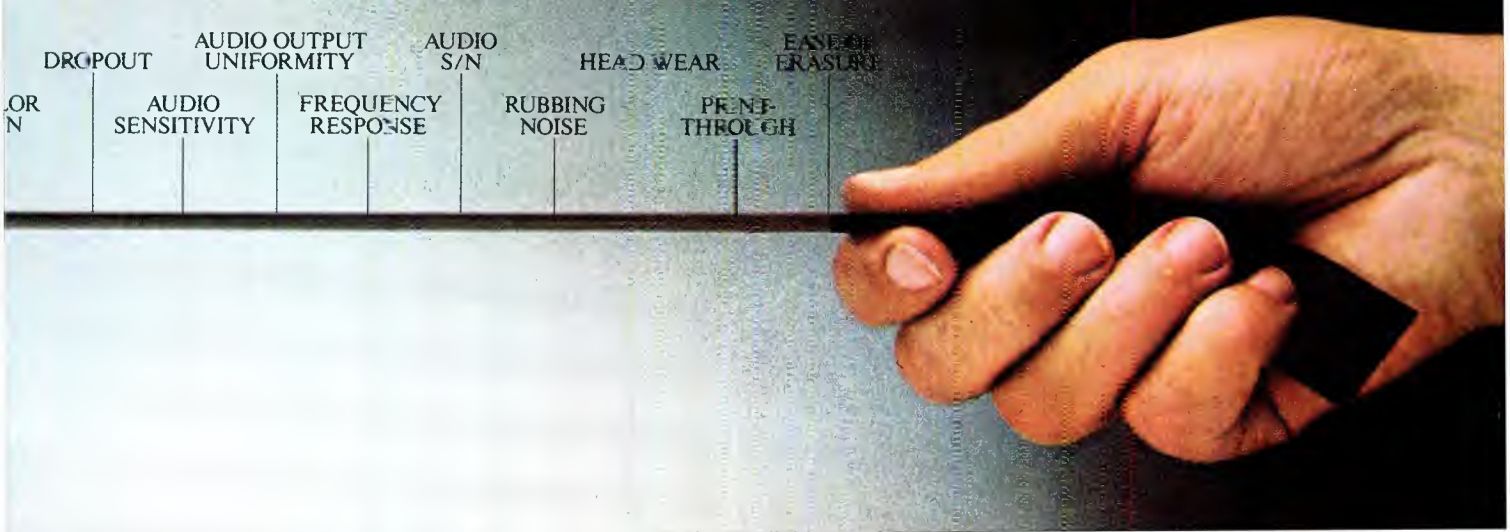
The answers bear the simplicity of common sense: no good. Which is why Sony created the yardstick for all 1" videotape: the Sony V-16.

The V-16 is based on the assumption that the only good tape is a perfectly consistent tape. And to achieve this consistency Sony has developed exclusive tape production techniques, created special binding materials, lubricating oils and additives. And then each batch of V-16 is submitted to over 16 quality-control checks where meticulous attention is paid to every detail from dropouts to print-throughs.

Any Sony tape that isn't perfectly balanced in picture quality, runnability, durability and audio will never find its way into your editing suite.

So if you're looking for the best overall performance in a 1" tape, look for the one that's superior in 16 points, not just some of them: V-16 from Sony.

SONY
Industrial Tape Division



Continued from page 48

The Ikegami HL-95 camera attaches to a ¼-inch Hitachi or other format recorders.

CCD camera, which mates to various recorders. (See **BE** April 1984, page 286.) The 3-chip camera, like the Ikegami camera, is marketed as a stand-alone camera that attaches directly to a small format VCR through interfaces. The SP-3 supplies component, composite and RGB outputs.

The advantages of the CCD camera include its weight—5.9 pounds without lens—the elimination of registration adjustments and the elimination of burn-in or lag characteristics. With solid-state devices instead of tubes, the camera can take much rougher treatment.

Ghosting is reduced with low-pass filters in the red/blue channels. The manufacturer claims a 55dB S/N ratio, sensitivity of f/5 at 2000lux and horizontal resolution of greater than 500 TVL. The vertical resolution is more than 350 lines. NEC attributes the camera quality to its ⅔-inch, high-resolution, interline CCD image sensor with 490 x 384 pixels. The sensor exhibits a wide dynamic range and has increased photosensitivity.

The camera head without lens is priced at $16,500 and accepts many ⅔-inch ENG lenses, such as those by Canon and Fujinon. Canon's 13:1 lens is priced at approximately $4500. NEC says it can deliver an SP-3 with an adapter for the Hitachi ¼-inch VCR within 90 days.

Looking for a standard

With five major manufacturers displaying production models of ¼-inch equipment or cameras that match ¼-inch VTRs, there is no doubt that ¼-inch is a reality. The manufacturers seem to be encouraging each other and others to develop more ¼-inch-related products.

Following the successful precedent of ¾-inch, those involved in ¼-inch are also looking for a standard format. Market acceptance is expected if there is a variety of offerings, which might have been the missing ingredient in ½-inch. Apparently, those involved in ¼-inch are determined not to repeat this mistake. |:-)))|

BOSCH FDL-60

UPDATE

FILM TO TAPE TRANSFER SYSTEM

An Advanced Film to Tape Transfer System

Frame-by frame color correction of the FRP 60 Film Reproduction Programmer added to the advanced technology of the Bosch FDL 60 Digital CCD Telecine now represents a film handling system with unprecedented advantages.

PanScan and black stretch, superb picture resolution and quality, with excellent signal-to-noise ratio and brilliant color rendition from either negative or positive film are additional features of this award-winning film-to-tape transfer system.

The long maintenance-free life and semiconductor reliability of the FDL 60 CCD sensors coupled with the FRP 60 Film Production Programmer will deliver a better picture without afterglow, burn-in or field-lag. With the FDL 60, there is no photoconductive or phosphor layer and no costly tubes to change. Flicker shrinkage, vertical deflection, horizontal misregistration and positioning errors of all kinds are also eliminated.

Things You Should Know

FRP 60 operating criteria

The FRP 60 in the system allows the operator absolute priority to recall any partial operation without regard to the present status of the system. The absence of a specific operating sequence allows greater flexibility to adapt to widely varying operating procedures.

No computer or software experience is necessary. Communication with the color correction system is implemented by a function-keyboard with clear and easily understood labeling. Responses from the system are displayed in text on the data monitor.

FRP 60 performance characteristics

For fast access to correction data in "on-air," "frame-by-frame," or "fade" modes, 800 events can be stored in the system battery-protected memory.

Color hue, saturation and luminance adjustment values can be stored and automatically recalled for the colors red, green, blue, yellow, magenta and cyan (secondary color processing).

During superimposed scene changes or camera pans on film, a linearly interpolated transition from one correction state to another is possible. The duration of the transition is programmable and after each frame, a completely new set of correction data is produced.

Up to 32 additional correction data sets for adjustments related to film material can be stored independently in a standard event list without film position. Eight additional stores with direct access are also available for typical or recurring correction data sets.

Corrections upstream and downstream of the FDL 60 frame store are treated separately by the RESCAN and Loop functions.

The FDL 60 frame store contents can be frozen and released again (for example, while the film continues with audio). This function can be stored and recalled automatically.

New audio sources and levels can be stored and recalled automatically, with two channels independently controlled. Pan positions with respect to film position can also be stored and recalled automatically with the PanScan programmer.

Special features

The FRP 60 is based on a high speed 16-bit 8086 microprocessor, with a decentralized control concept and distributed intelligence. A separate microcomputer is used to control the operating console, master processor, floppy disk, FDL 60 and VTR.

The user may utilize up to six freely allocatable analog functions and nine freely allocatable switching functions for use of subtitling equipment, film grain reducer, digital video effects, etc. Analogue channels provide 12-bit resolution, with 48 programmable channels available. 52 programmable switching functions are available.

Call or write to Robert Bosch Corporation for details on the FDL 60 Digital CCD Telecine with the FRP 60 Film Reproduction Programmer.

Robert Bosch Corporation
Video Equipment Division
P.O. Box 31816, Salt Lake City, Utah 84131
(801) 972-8000

BOSCH

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IBC-'84 preview

By Carl Bentz, television editor

If your September plans include the International Broadcasting Convention (IBC) in Brighton, UK, plan on staying busy between Sept. 21 and 25. A record 134 exhibitors have booked space in the Metropole Centre, and a list of 91 technical papers is divided into 14 subject areas with something for nearly everyone. An extensive women's program will include tours of many local points of interest.

However, time and hotel space are running short for this 10th IBC meeting, and anyone needing to make plans should do so immediately. For conference information, contact:

IBC Secretariat
c/o The Institute of Electrical Engineers
Savoy Place
London WC2R 0BL UK
Telephone: 01-240 1871, ext. 222
Telex: 261176 IEE LDN G

For hotel accommodation information, contact:

Expotel
Banda House
Cambridge Grove
London W6 0LE UK
Telephone: 01-741-4904
Telex: 896788

Telephone or telex contact is suggested.

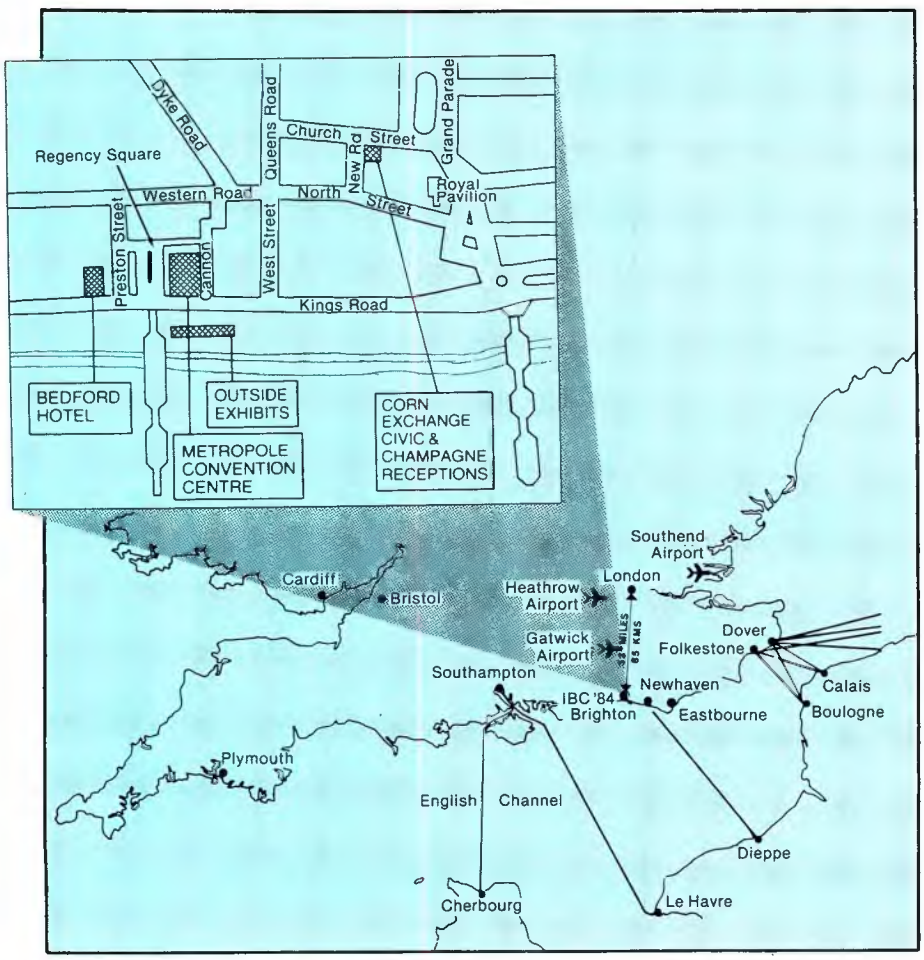
The provisional program indicates that the technical program will begin on Saturday, Sept. 22, with discussions of evolving technology. The talk will delve particularly into the economics of TV and DBS services, with a look at broadcasting and education, the future of enhanced TV services and trends in receiver design to accommodate new services. Topics will then become more specific, with concurrent investigations of component video signals within the studio complex and advances in transmitter system design and new klystrons for UHF.

Sunday's program will also include concurrent sessions with higher definition television concepts competing with AM radio transmitter topics. AMers can conceivably catch some of the enhanced TV papers, as the TV meetings will run longer on that day.

Monday morning, video signal origination will compete with satellite topics. The video session will include diverse subjects of OB vehicles, Meteosat weather imaging, special effects, electronic newsrooms, automatic camera registration and imperfection concealment in telecines, while satellite papers will involve DBS and encoding information for satellite transmission. The afternoon schedule will include video recording methods concurrently with DBS receiving systems. A late session will involve conditional access, encryption/scrambling and security for DBS transmissions.

Tuesday morning will present new services, including textual material and multiple channel sound for TV, in competition with papers on signal distribution and inter-facility links considering fiber optics, satellite systems and computer-controlled TV network switching. Afternoon meetings will consider digital audio sound in the studio and measurement technologies for component video and audio.

The technical schedule leaves little time to look over new and established products from 14 countries, including many European as well as Japanese and US manufacturers. The working language for the convention will be English and will improve communications for this definitely international gathering.



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The HOTRONIC AE61 upholds the standards of performance and easy operation that so many TBC users demand. While paring size and weight to the barest possible minimum, it does not sacrifice the rigid Hotronic standards of reliability and longevity. This product is not merely transparently *respectable*. It is transparently *superb*! The AE61 is custom-designed for the increasingly quality-conscious world of the 80s. The demand for quality in the 80s has *sharpened* the character of the AE61 — the standards of Hotronic have *formed* it!

Offered at $6000.

THE HOTRONIC AE61.

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TEL: (408) 292-1176

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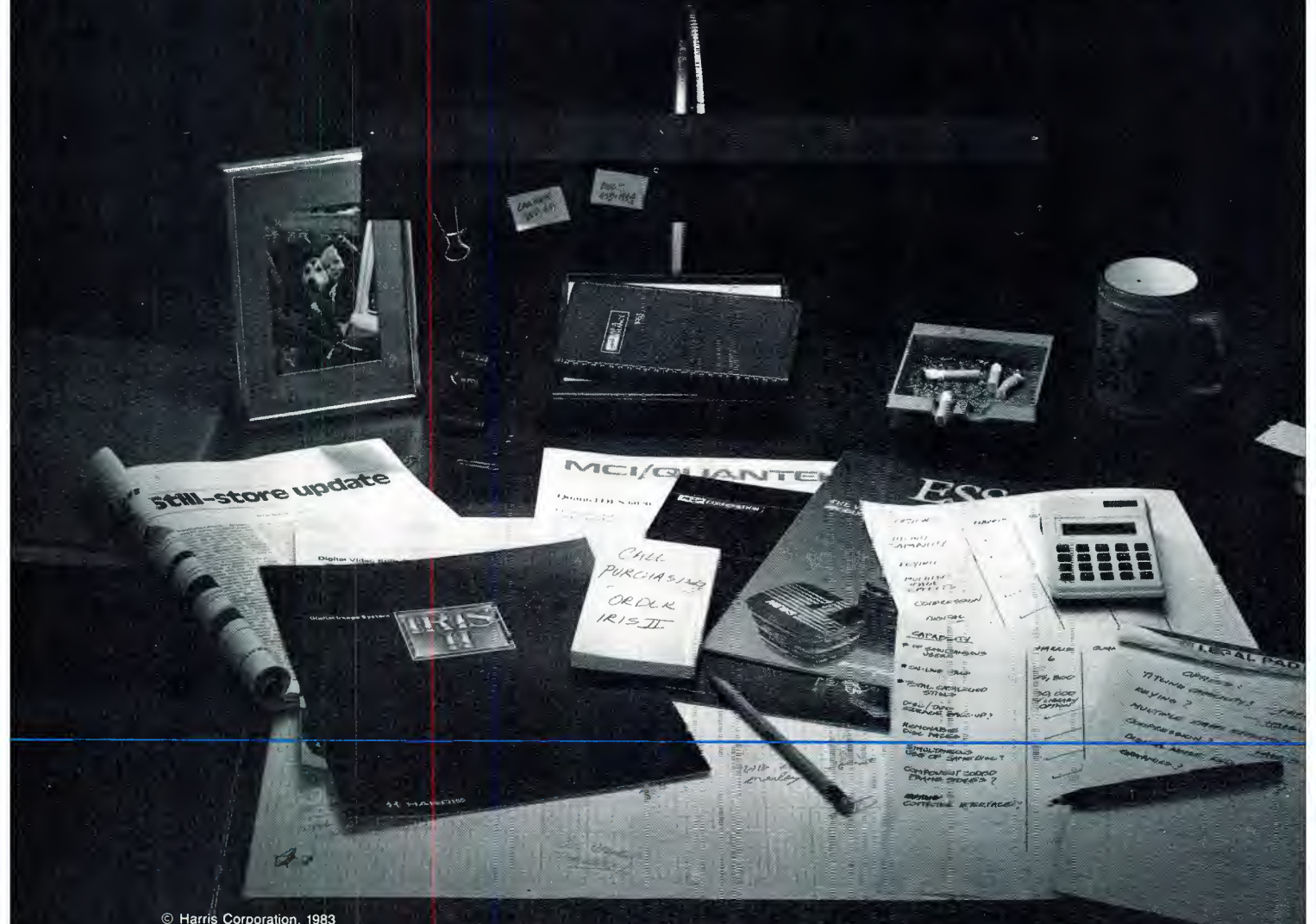
Adda, Ampex, Harris, and Quantel all make excellent Still Stores. But more and more the choice is Harris.



1 **Harris' new IRIS Composition Station (ICS) solves your video production problems with these exclusive features:**

Compression and Positioning
2X expansion
Variable size
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Adda doesn't. Ampex doesn't. Quantel doesn't.

The ICS is sophisticated enough to complement an artist's imagination, yet simple enough for use in the hectic pace of on-air production. And it's based on Harris' new *four frame* synchronizer, the 650.

Here's why.

2 **Harris' IRIS II offers you simultaneous access by up to six users, without costly networking of separate systems.**

Adda doesn't. Ampex doesn't. Quantel doesn't. Now when you want to expand, you can—cost effectively. Your system can grow just by adding inexpensive user stations.

3 **IRIS II lets you title stills from each user station.**

IRIS II gives you character generation with multiple fonts. It lets you title stills directly from *each* user station without tying up expensive character generation equipment.

4 **IRIS II solves your still sorting and locating problems with an integral library.**

In fact, IRIS II offers the most powerful search routines of *any* still store. Its library is also accessible by each user station, and has a capacity of over 80,000 stills.

5 **Problems with identifying stills are eliminated.**

You can get complete information on *all* the stills in your list, with full description, date, sequence, and I.D. information.

You also have the power you need to manipulate list order through addition, deletion and change of position. And, you can also link and loop your lists.

6 **IRIS II gives you the storage flexibility you need for future planning.**

IRIS II interfaces with the largest variety of storage drives of any still store. Several types of fixed and removable drives give you the capability of over 17,000 on-line stills. No other still store offers this flexibility. Period.

We think you get the idea. *We build the most powerful, and the most flexible, still store there is.* Whatever your business, if your problem is storing and manipulating video images, the best choice is the Harris IRIS II.

For more information about this superior solution to your video problems, call Dave Fabian, Product Manager at (408) 737-2100, or contact **Harris Studio Division, Video Systems Operation, 1255 E. Arques Avenue, Sunnyvale, CA 94086 Telex 4992172**

HARRIS

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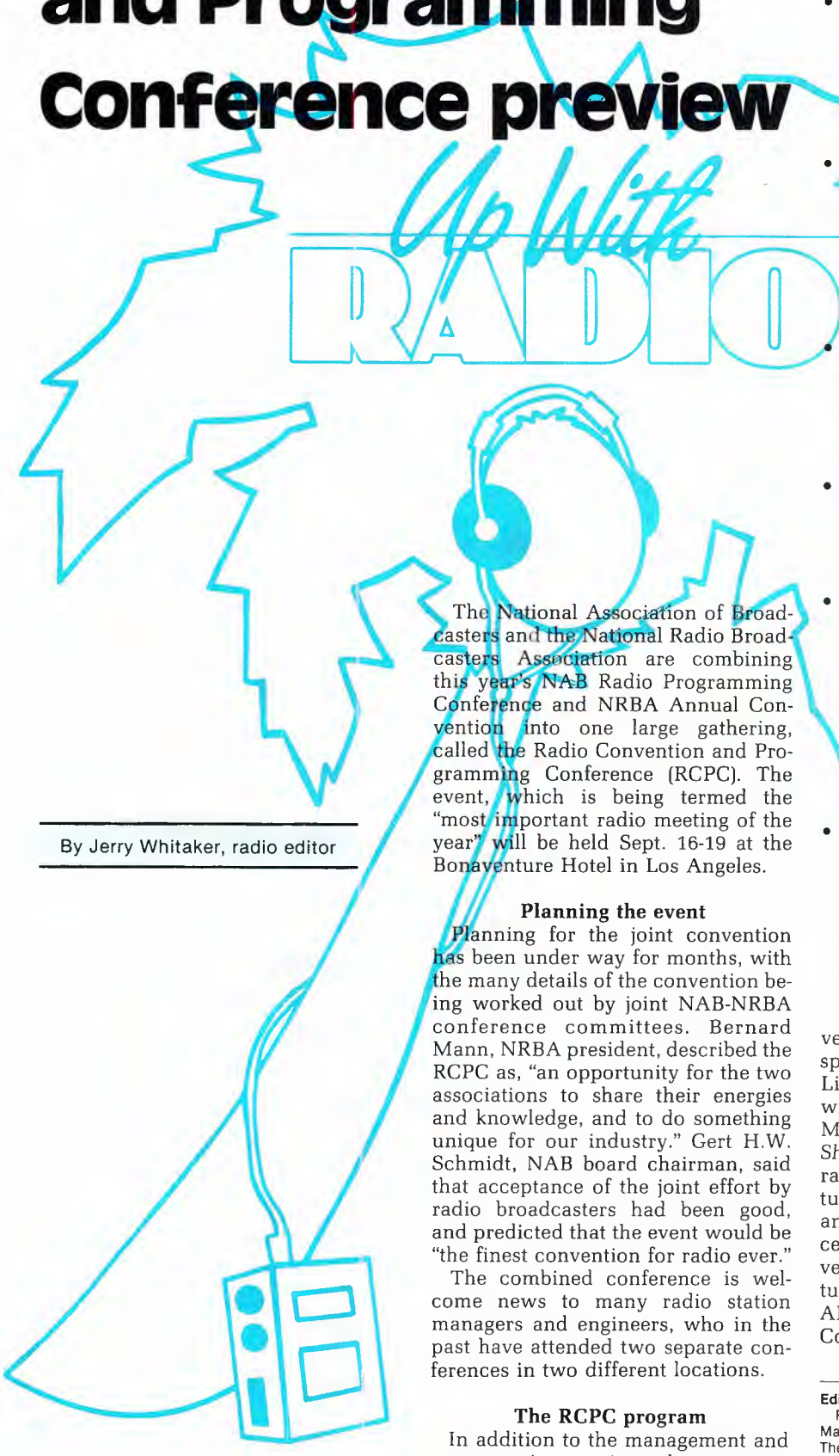
'84 Radio Convention and Programming Conference preview



By Jerry Whitaker, radio editor

The National Association of Broadcasters and the National Radio Broadcasters Association are combining this year's NAB Radio Programming Conference and NRBA Annual Convention into one large gathering, called the Radio Convention and Programming Conference (RCPC). The event, which is being termed the "most important radio meeting of the year" will be held Sept. 16-19 at the Bonaventure Hotel in Los Angeles.

Planning the event

Planning for the joint convention has been under way for months, with the many details of the convention being worked out by joint NAB-NRBA conference committees. Bernard Mann, NRBA president, described the RCPC as, "an opportunity for the two associations to share their energies and knowledge, and to do something unique for our industry." Gert H.W. Schmidt, NAB board chairman, said that acceptance of the joint effort by radio broadcasters had been good, and predicted that the event would be "the finest convention for radio ever."

The combined conference is welcome news to many radio station managers and engineers, who in the past have attended two separate conferences in two different locations.

The RCPC program

In addition to the management and programming sessions that are normally scheduled for the NAB programming conference and the NRBA annual convention, this year's combined RCPC will feature a number of technical sessions, designed to attract larger numbers of engineering personnel. At press time, the following sessions had been scheduled:

- **AM stereo:** Engineers at AM radio stations that are now broadcasting in stereo will discuss the process of converting from mono to stereo operation, and will outline some of the problems they have encountered during the change.
- **FCC panel:** Attendees will have the opportunity to discuss with FCC engineers a variety of topics, including field inspections, violation notices, station technical performance and problems caused by relaxation (or elimination) of certain FCC rules and policies.
- **FM panel:** The various factors that should be considered when an FM station is planning to upgrade its facilities will be discussed, with particular attention given to the requirements of FCC Docket 80-90.
- **SCA panel:** The problems encountered due to the expanded use of FM and AM subcarriers will be discussed, and possible solutions to those problems will be outlined.
- **Engineer's survival panel:** The problems that have arisen due to FCC technical deregulation will be detailed, and solutions to those problems will be offered. The session will touch on a number of areas, including assurance of technical performance, certification of engineering personnel and maintenance of proper technical records.
- **Telephone panel:** How to live with—and how to do business with—the new telephone system will be discussed, with special emphasis given to broadcast audio loop orders.

Other attractions

Manufacturers will be at the convention with exhibits, and several special activities have been scheduled Live radio broadcasts from the RCPC will include local area stations, the Mutual Radio Network's *Larry King Show* and national talk shows on other radio networks. The convention's featured entertainer, Irene Cara ("Fame" and "Flashdance") will do a live concert via RKO Radio from the Bonaventure during the gathering. The featured RCPC luncheon speaker will be ABC sports commentator Howard Cosell.

Editor's note:
For registration information, contact RCPC, 1724 Massachusetts Avenue, NW, Washington, DC 20036. The telephone number is 202-463-7905.

Shure's new FP31 Mixer takes a big weight off your shoulders.

Introducing the most innovative field production mixer of its kind. Shure's FP31. You won't find another mixer this small with these features, dependability and ease of operation.

The FP31 measures only $6\frac{5}{16}$" x $5\frac{5}{16}$" x $1\frac{7}{8}$", and weighs just 2.2 pounds! Incredibly, it offers the same important features as much larger mixers. Plus, a few of its own.

Every channel has a mic/line level and a low-cut filter switch. And to prevent overload distortion, there's a built-in limiter with adjustable threshold.

The FP31 can be powered by two internal 9-volt batteries, or from an external 12-volt source. A green LED flashes to remind you that the mixer is on. Phantom and A-B power are also provided to operate lavalier and shotgun microphones.

A slate tone can be laid down on the tape for locating specific takes, and there's also a built-in mic for voice slating.

The mixer also has two separate mic/line outputs for 2-camera shoots and a tape output to feed a cassette. For monitoring, there are two stereo headphone jacks—one ¼-inch and one for miniplugs. The FP31's rugged nylon carrying case allows you easy access to every mixer function and lets you piggyback the mixer on your VCR or other equipment.

For ENG, EFP and film use, Shure's FP31 has everything you need to make your mix a perfect success. Coming from a mixer this small, that's quite an accomplishment.

For more information on Shure's FP31 Mixer, call or write Shure Brothers Inc., 222 Hartrey Ave., Evanston, IL 60204, (312) 866-2553.

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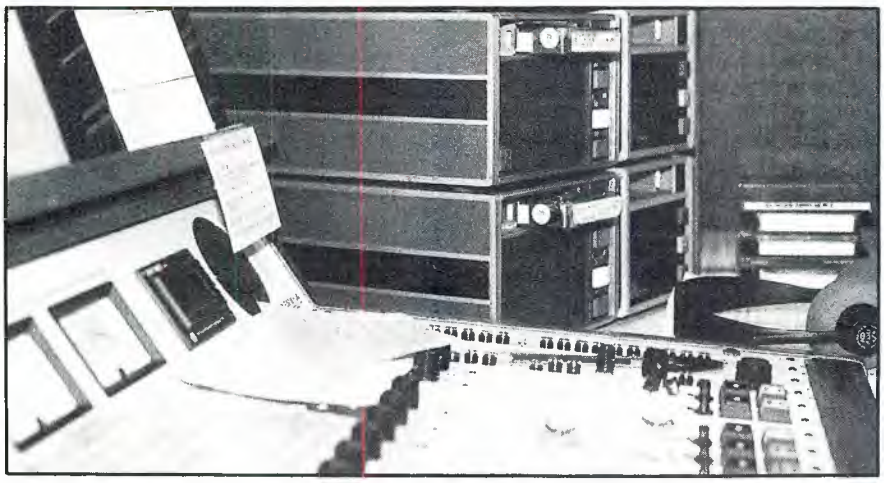
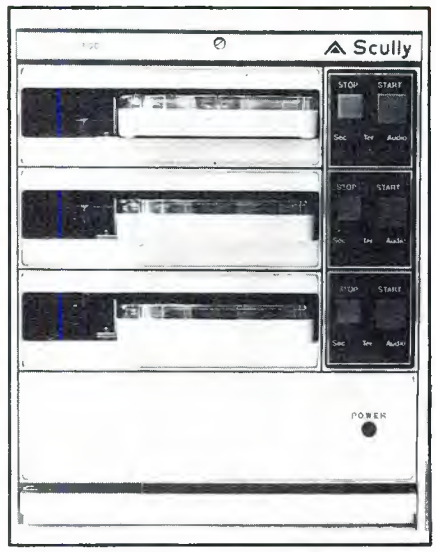
Circle (38) on Reply Card

Cart machine eq



The cart machine system has made significant strides in recent years, giving broadcasters a high-quality, reliable and convenient method of reproducing program and commercial segments. In this report, we look at some of the equipment currently available from cart machine manufacturers. (Shown in the photo is the control room of KUDL-FM, Kansas City, KS.)



The Scully 8300 3-play audio cartridge reproducer.

Continuous-loop tape cartridge systems are a vital part of the audio chains of virtually every radio station and most TV stations in the country. Whether a station runs as a 1-man combo arrangement or a fully automated facility, the cartridge is the primary format on which prerecorded repetitive segments are stored and reproduced.

The outstanding performance available today from cart machine systems is the result of decades of refinement in both the tape cartridge itself and the record/reproduce machine. Reliability has improved, along with audio performance, and operational features have expanded significantly.

The cart grows up

Until recently, cartridge systems were generally considered only good enough for mono commercial spots. Few stations used carts for mono music, let alone stereo music. Little by little, however, improvements were made in tape cartridges and machines. Now the limiting factor for audio quality at a radio station is no longer the cart system, but instead, the source material. This fact is being demonstrated by stations that use compact disc players, rather than vinyl discs as a source for cart recordings. Broadcasting made substantial progress during the last 10 years, and now the recording industry—the vinyl disc people—needs to catch up.

This discussion, of course, does not and should not weigh in the effects on received audio quality of high-density modulation, propagation-path disturbances or low-performance receivers. The technology for top-quality source, transmission and reception equipment exists and challenges the performance of the vinyl discs commonly used for music source material. Whether this technology is implemented, however, is another question entirely. (See "FM Fidelity—Is the Promise Lost?", page 30.)

Equipment update

Regardless of whether a tape cartridge system at a broadcast station is used for general purpose mono spot announcements or high-quality stereo music, the system's mechanical stability, electrical performance and reliability are vital to the application. Tape cartridge makers and cart machine manufacturers have made significant strides in recent years to improve every aspect of the cart format. Many new and innovative system designs are available for broadcasters today to match the needs of virtually any station.

The following summary of some of the new or recently released cartridge machines from various equipment manufacturers gives an overview of what is available to the broadcaster. The equipment listing is arranged in alphabetical order.

The selection of a particular piece of equipment for a specific application requires much more information than space permits in this report. For this reason, a listing of Reader Service Numbers for the cartridge machine manufacturers covered in the update has been included. (See page 66.)

Ampro/Scully
Division of TTC

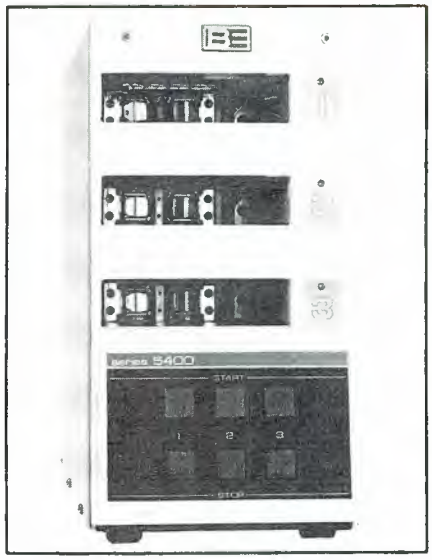
Model 8300: The Scully 8300 3-play cartridge reproducer, available for mono or stereo use, features an audio switcher/mixer circuit, standard secondary cue-tone detector and a cartridge-reload indicator. The unit's modular construction allows field conversion from mono to stereo operation and access to all major components for service. Options include a tertiary cue-tone detector, relay outputs for the secondary and tertiary tone detector circuits and program amplifier output transformers. The 8300 uses a crystal-controlled dc brushless servo motor, ½-inch-thick machined aluminum cartridge decks, low voltage 2-step solenoids and head bridge assemblies that allow noninteractive head adjustments.

The Audio-Cord TDS dual-deck playback machine, introduced at the 1984 NAB convention.

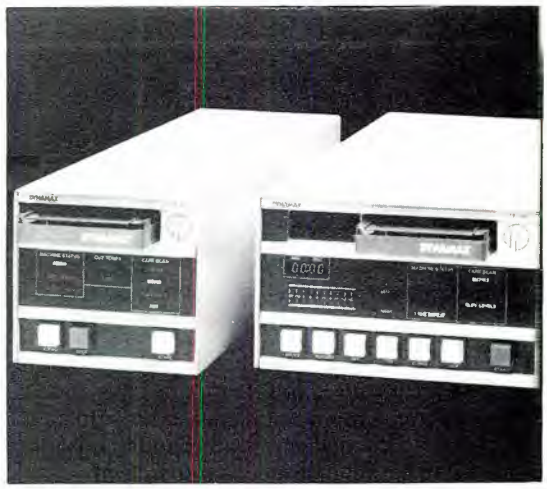
...ipment update

By Jerry Whitaker

The S series reproducer unit from Audi-Cord.



The Broadcast Electronics series 5400 3-play cartridge machine.



The new Dynamax CTR100 cartridge machine from Fidelipac for record/play functions (right) and play only.

Audi-Cord Corporation

TDA series: Introduced at the NAB-'84 convention, the TDS series of twin-deck playback cartridge machines is available in mono or stereo configurations. The basic machine features a removable lower deck and a double-ended motor shaft, which is designed to avoid problems that can occur with long shaft/capstan assemblies. The TDS uses an ac hysteresis synchronous motor, modular internal construction with plug-in printed circuit cards, reproduce equalizers for both low and high frequencies, selectable amplifier output impedance and +20dB headroom before clipping. Operational features of the TDS include indicator lamps for secondary and tertiary cue tones, replay reminder system with selectable user options and automatic motor shutdown after both carts have played.

S series: The Audi-Cord S series of reproducer and recorder/reproducer units is built around a modular design to accommodate a variety of requirements. Available in mono or stereo configurations, S-series options include off-speed motor lockout, to prevent start wow and replay lockout, to prevent accidental replays. The S series is built around a machined aluminum deck overlayed with stainless steel. A hysteresis synchronous motor is used in the unit, along with an air-damped solenoid and pressure roller regulating system. The recorder features an internal 3-tone response test generator, timed tone burst circuit with manual override and recording length timer.

Broadcast Electronics

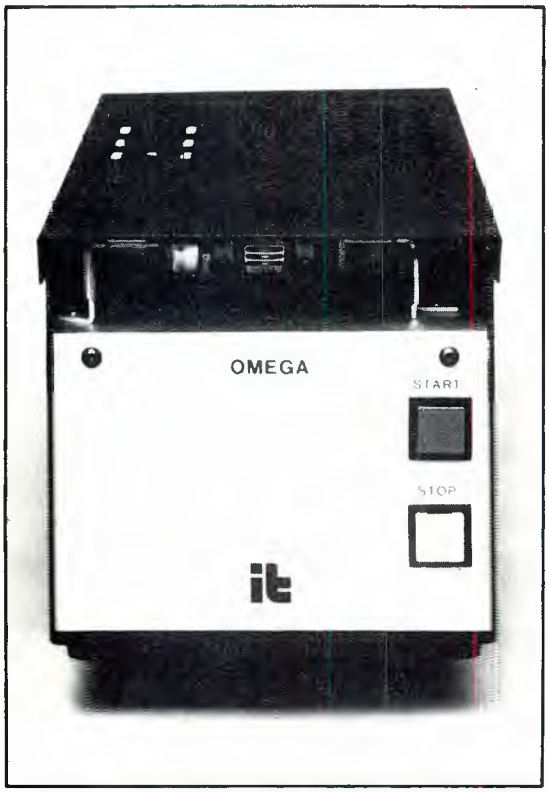
Series 5400: Introduced at the NAB-'84 convention, the series 5400 3-play cartridge machine is available for mono or stereo use. Options include secondary and tertiary tone decoders, a record amplifier unit and an automatic audio switcher. Each 5400 machine features a direct-drive hysteresis-synchronous motor, modular plug-in construction, ½-inch machined solid aluminum decks, air-damped solenoids and Phase Lok IV tape head assemblies. The compact design of the 5400 allows three units to be mounted side-by-side in a 19-inch equipment rack.

Series 3000: The series 3000 cart machine is available in several configurations, including play-only and record-play, for either mono or stereo operation. All series 3000 units use the Broadcast Electronics Phase Lok IV tape head bracket. Other mechanical features include an improved high-memory Nitrile pressure roller, low-voltage air-damped solenoid, ½-inch-thick machined cartridge deck and direct-drive hysteresis-synchronous capstan motor. Modular plug-in construction allows access to all major assemblies without unsoldering any wires. All circuit boards use gold-to-gold contacts for low resistance connections.

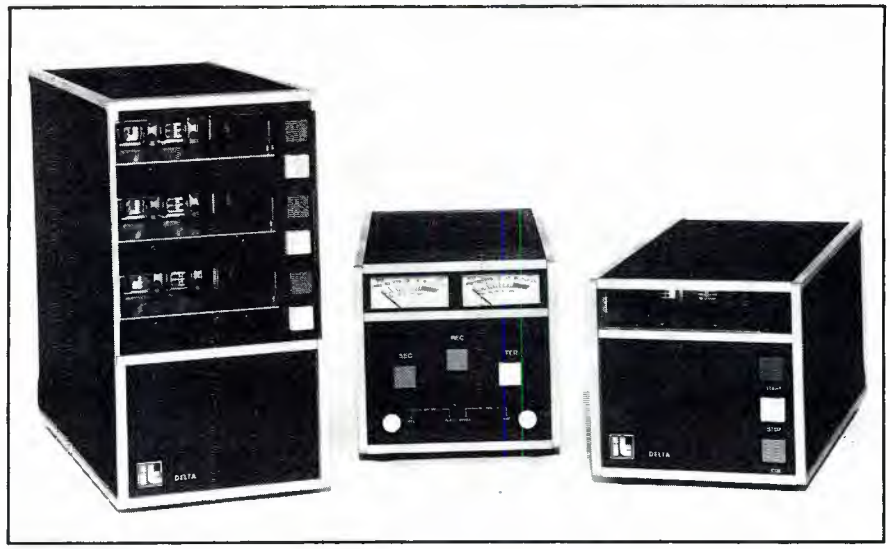
One of the models from the Broadcast Electronics series 3000 line of cartridge machines.

Fidelipac

Dynamax CTR100: The Dynamax CTR100 tape cartridge machine, first shown at the NAB-'84 convention, is Fidelipac's entry into the high-end audio cart recorder market. Available in mono or stereo versions for size A or B carts, the CTR100 has several unique features. The unit's Cart Scan system automatically—without operator intervention—enables the intermixing of cartridges recorded at an elevated level, or in either a standard mono/stereo or matrix mode. It also provides auxiliary outputs to activate external equipment, such as a Dolby encoder or decoder. A Vary-Speed function allows the operator to continuously vary the motor speed, while the machine automatically maintains cue-tone tracking and clock synchronization. Other CTR100 features include a dc servo drive motor, fast-forward capability, secondary and tertiary cue-tone detection, low-voltage constant current pinch-roller solenoid, audio switcher and mixer circuit, status display system and crystal-controlled reference oscillator for all internal functions.



The new ITC/3M Omega stereo reproducer.



The Delta line of cartridge reproducer/recorder units from ITC/3M.

ITC/3M

Omega: Introduced at the '84 NAB convention, the Omega reproducer is designed along the lines of the PD-II cart machine, but offers stereo playback capability.The Omega is expected to be available for delivery in early 1985. The unit is mechanically built around a milled ½-inch aluminum deck plate. The head module, cartridge guides and brushless dc crystal-referenced motor are mounted to this chassis, along with two electronic printed circuit boards. Several user-programmable features are standard, including cart-played flashing *ready* and repeat play lockout. Secondary tone decoding and mute are standard on the Omega.

Delta: The ITC Delta series includes single- and 3-play reproducers, a recorder add-on electronics module and stand-alone recorder/reproducer unit. The mechanical transport assem-

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If you're planning to update your audio, take note of these particulars:

- **Editing System Compatibility**–Operates with Audio Kinetics, Adam Smith, BTX, CDL, CMX, Electro-Optical, EECO, and Studer SMPTE-based systems.
- **Superior Tape Handling**–Accelerates quickly to 400 ips fast wind, slows, stops, and changes modes with uncanny smoothness.
- **Microprocessor Control**–The microprocessor governs all transport functions as well as audio, bias and erase switching.
- **Edit Rehearse**–Used with SMPTE-based controllers, the A800 lets you simulate electronic edits before making the "hot" edit.
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- **Remote Unit**–Options include 20-address autolocator, channel remotes, vari-speed remote, and SMPTE synchronizer.
- **All Formats**–8, 16, and 24-track standard; 4-track ½" on special order.
- **Legendary Craftsmanship**–Lift the top plate off an A800 and the competition disappears. Nothing else performs like a Studer because nothing else is built like a Studer.

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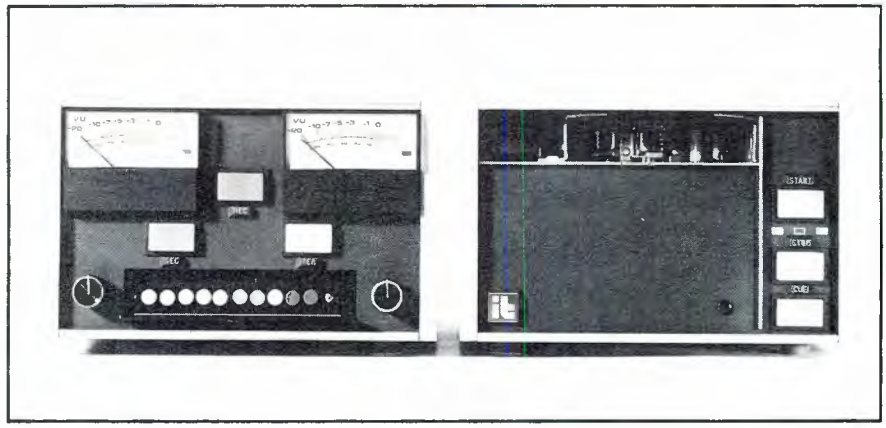
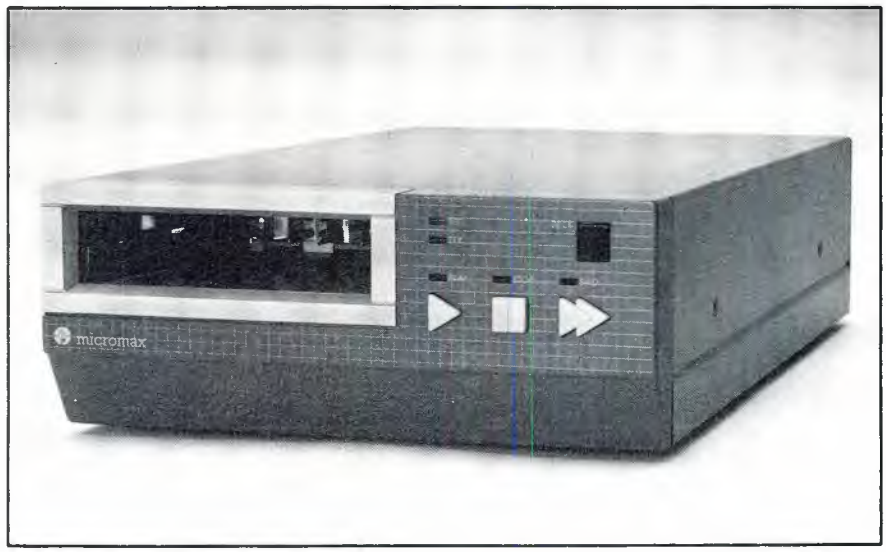


The ITC/3M Series 99 recorder/reproducer system.



The new Micromax stereo tape cartridge reproducer from Pacific Recorders.

bly is built around a milled, tool plate aluminum deck. The Delta uses a dc brushless servo capstan motor, air-damped pinch-roller solenoid, toroidal power transformer, modular motherboard design and rigid head and cartridge guide system. A microprocessor is used in the machine to perform timing, system control, cue detection and remote-control functions. User options include input and output impedance selection and level adjustment, end of message tone mute, repeat play lockout and capstan operating speed selection.

Series 99: ITC's Series 99 recorder/reproducer units incorporate an automatic record-alignment feature that is designed to compensate for cartridge variations that are often encountered during the record process. This ELSA (erase, locate splice, azmith) system also cues past the tape splice and erases the cartridge. A microprocessor is used to control all electronic functions, including solenoid action, cue-tone detection, cue-tone generation, test-signal generation and motor-speed control. High-speed cue is standard, and several user options are available.

Pacific Recorders and Engineering

Micromax: The Pacific Recorders Micromax stereo tape cartridge reproducer is housed in a compact, low-profile cabinet, and features function-shaped control buttons for easy visual recognition by operators. A user-settable LED deck number display and power indicator is also located on the front panel for operator convenience. The Micromax reproducer uses a dc servo capstan drive system and dc servo motor pinch-roller arrangement that includes a self-aligning ball-bearing design. The cartridge player uses the Pacific Recorders' Maxtrax wide-track tape head and low-noise electronics, providing active-balanced program outputs rated for +24dBm. Auxiliary cue-tone detectors are standard, as is the high speed recue function.

Tomcat: The Tomcat series of stereo reproducer and recorder/reproducer decks features CMOS microprocessor-controlled operation and the Pacific Recorders' Maxtrax wide-track tape head. Standard left/right channel recording or sum/difference encoding can be selected by the user. Other features built into the Tomcat

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In 1981, the Series II MTR-90 provided even faster, more accurate tape handling, and was the first audio machine to offer a serial port for computer control of the transport functions.

Along the way, we've worked with every major synchronizer and video editor manufacturer to provide our customers with the interfaces they require. Synchronizer interface connectors are now standard equipment on all MTR Series recorders.

Our commitment to audio post-production continues.

In 1983, we adopted the IEC standard for center-track SMPTE/EBU time code recording on ¼-inch tape. We also developed a 1-inch C format audio playback recorder conversion kit for the MTR-90, and an RS232C Serial control port for the MTR-10/12.

Now, we're introducing the EC-400 Series, an advanced tape speed resolver capable of phase lock over a ±30% frequency range.

These are just a few of the ways we've delivered on our commitment to the audio post-production professional. To get the complete picture, contact your nearest authorized Otari dealer.

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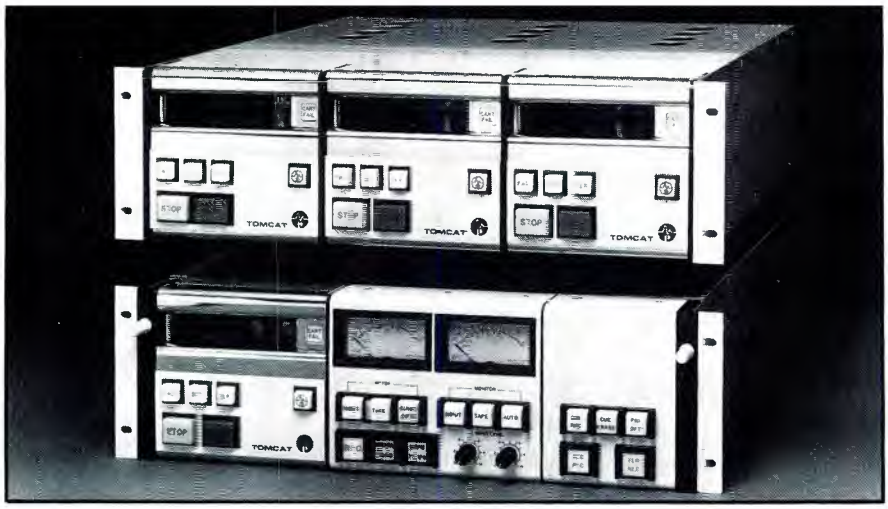

The Tomcat series of reproducers and recorder/reproducers available from Pacific Recorders.

include auxiliary cue tone decoding, 7.5ips and 15ips record/reproduce speeds, fast-wind operation using either 15ips or 30ips, and modular construction for component access during service. Mechanical features include a fast-start dc servo capstan motor that runs only while pulling tape, self-aligning center-supported ball-bearing pinch-roller assembly, precision cartridge positioning arrangement and optical sensing of mechanical operations.

Cart machine manufacturers

For readers who require additional information on cartridge machine equipment currently available, the following Reader Service listing is provided. The models highlighted in this *update report* are given for each company.

Pick a number from 9 to 52!

You've just chosen the ideal DC voltage to phantom-power these new ATM electret microphones.

Introducing four "universal" phantom-powered electret microphones. Designed to work from external power, internal regulation automatically handles any voltage from 9 to 52 VDC without adapters, switches, or rewiring. Just plug in and enjoy. With current drain a mere 0.3 mA at 9 volts (4 mA at 12-52V) a 9V battery lasts thousands of hours, not just the 60 or 70 hours typical of other mikes.

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But convenience and versatility are just two of the advantages of the new ATM models. All-new electronics provide plenty of headroom inside the microphone with no more than 1% THD even when used in acoustic fields of 141 dB SPL. Which sets new standards for clean sound even close-up to big brass or inside a powerful drum kit.

And the sound you hear is wide-range and *musical*. Presence without peaks. Highs to 20,000 Hz but without a raspy "edge." Yet despite their responsiveness, these new ATM microphones have the "Road Tough" reliability proved so often on stage and in the studio.

Before you add another microphone, compare our sound, our convenience, our reliability, and our cost. Write for literature and list of nearby ATM microphone specialists. Get great sound...right from the start! AUDIO-TECHNICA U.S., INC., 1221 Commerce Drive, Stow, Ohio 44224. (216) 686-2600.

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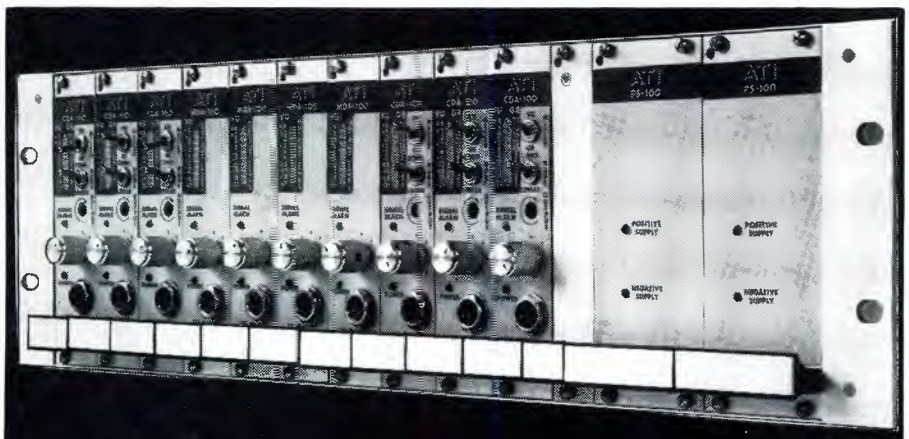

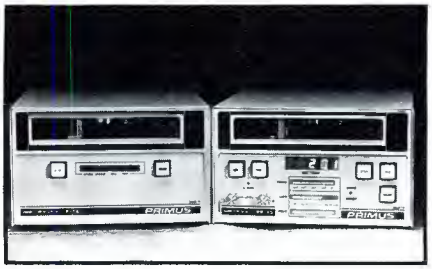

The Primus audiotape recorder, manufactured by Ramko Research.

Ramko Research

Primus: The Ramko Research Primus cart machine, available for either mono or stereo operation, features adjustable cart guides for A and B size carts, a 2-point roller bar cartridge hold-down assembly and ⅝-inch-thick cast and machined deck with a stainless steel overlay. The unit uses a crystal-controlled dc brushless motor, air-damped solenoid, ceramic capstan, high-traction Urethane pressure roller and machined tape head mount. Operational features include standard 3-cue tone decoding, dynamic noise reduction, a speed error indicator, phase meter on stereo units, cue-tone defete switch and an internal diagnostic test generator.

Phase Master: Available in either stereo playback or stereo record-playback versions, the Phase Master uses a timing code recorded on the cue channel to phase lock the left and right audio channels for minimum reproduced phase errors. Because of the encoding and decoding scheme used, a cartridge recorded on one Phase Master machine will automatically be optimized when played back on any other Phase Master unit. Other features include optical cart insertion detection, a crystal-controlled brushless dc servo motor, ceramic capstan, air-damped adjustable solenoid, solid-state digital timer, phase analysis meters and motor speed out-of-lock indicator.

Sonifex

Micro HS: The Sonifex, Ltd., Micro HS tape cartridge units, made in the United Kingdom, offer a modular approach to tape cartridge system design. A basic reproduce-only unit can be combined with a record module for record/reproduce capability, or stacked with other reproduce units to form a 3-play interlocked cartridge deck. Designed to work with the NAB AA-size cartridge format, the Micro HS is built around a ¼-inch aluminum alloy cartridge base, and all major components and sub-assemblies mount to this deck. A pinch-roller lifting and locking arrangement gives quiet operation, and draws power only during transition moves. A 680-gram flywheel is belt-driven

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3CX2500A3	5,000 hours/12 months
4CX1500A	5,000 hours/12 months
5CX3000A	5,000 hours/12 months

Fourteen other EIMAC types have these extended use-time warranties. Specific warranties for each tube type are available from the Varian EIMAC worldwide sales organizations.

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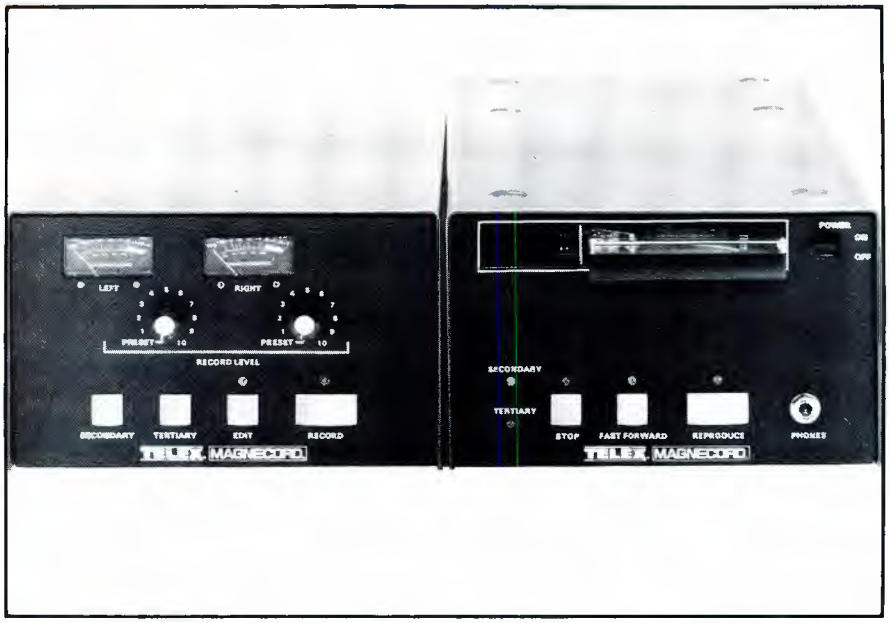

The Telex/Magnecord MC-II series broadcast cartridge recorder/reproducer.

from a dc servo motor. Cartridge guidance is performed by spring-loaded side and top guides.

Model CQ: The Sonifex CQ is a reproduce-only machine designed for NAB size AA cartridges. The transport assembly uses a rigid alloy deck plate with a ball-race capstan drive and micro motor pinch servo system. The capstan motor may be operated in either a switched or continuously running control mode. A fast-cue function is standard on the Sonifex CQ. Interconnection hardware has been incorporated into the system's design to allow for triple-stack sequencing. Both stereo and mono reproduce-only machines are available.

Telex Communications

MC-II: The Magnecord MC-II by Telex is configured as a stand-alone reproduce unit that can be field converted to record/reproduce capability with the addition of a companion record amplifier unit. Available in both mono and stereo versions, the MC-II offers the user fast-wind capability, a front-panel headphone monitor jack on the reproduce unit, a record edit control, replay warning indicator and audio output muting during fast-wind and stop modes. The machine uses a dc servo, Hall effect motor, with a belt drive arrangement to the capstan shaft. A machined aluminum base plate forms the mechanical heart of the MC-II, to which an air-damped solenoid and tape guides are mounted.

UMC/Beaucart

Model 200: The Beaucart 200 is available in mono or stereo record/play and play-only versions for size A, B or C cartridges. The basic tape machine uses TTL logic for system control. Balanced transformer outputs are standard, and secondary and tertiary tone decoding is available. All major adjustments can be made from the rear panel, and full remote-control capability is standard. The deck is driven by an ac hysteresis-synchronous motor.

Model 300: The Beaucart 300 is a 3-play cartridge machine that can be ordered in either mono or stereo versions with reproduce-only or record/reproduce capability. Each of the machine's three deck plates are removable and serviceable from the front of the unit. A hinged front panel gives access to all mechanical components. A hysteresis-synchronous motor is used in the machine. Modular PC board construction is used throughout the model 300. Independent power supplies and operational controls are provided for each cartridge deck in the triple-play 300.

Other manufacturers

Cartridge machine equipment is manufactured by several companies not included in this update report. Information on their products was not available by press time. Below, however, is a listing of those companies from the information we have on file:

- John A. Steven Professional Recording Equipment, Shenfield, UK.
- Consolidated Electronics Group, Thornbury, Australia.
- DB Electronics (UK), manufactured by DB Electronics, Maryland, USA.
- Fitch Tape Mechanisms, London, UK.
- SIS, Ltd., Northampton, UK.

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For your information, our name is Harris.

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Circle (49) on Reply Card

Analyzing S/N specifications

By Charles M. Bates,
International Tapetronics Corporation/3M,
Bloomington, IL

Comparing equipment performance on the basis of published specifications can be a difficult task because of the varying measurement methods that may be used. Each manufacturer rates its machine by attaching a standard of performance derived from intensive measurement and study. These measurements may be representative of the product's performance, but may not be comparable to competitive product specifications because of differences in test procedures or reference points. Signal-to-noise (S/N) figures can be particularly confusing because of the weighting curves that may be employed. A recent spec comparison of 16 tape cartridge machines revealed a 20dB variation across published specifications in S/N. To make an intelligent decision on equipment purchase, buyers must be familiar with procedures used by equipment manufacturers to arrive at published specs.

The NAB cartridge machine standard specifies parameters for measuring noise generated by a cart system. It says, "The reproducer S/N shall be measured unweighted with a bandpass of 20Hz-20kHz without tape running, but with an otherwise fully operating reproducer, from 160nWb/m at 1kHz reference level. The minimum S/N shall be 50dB for mono and 47dB for stereo." The key words in this specification are "unweighted," "bandpass" and "reference level."

Noise sources

There are entire textbooks available on the subject of noise sources, but tape machines are subject to four primary noise generators: thermal noise, shot noise, power supply noise and reproducer head induced electromagnetic interference (EMI).

Thermal noise is caused by thermal agitation of electrons in resistors. It is proportional to temperature and bandwidth, and commonly is called *white noise*. The open circuit noise voltage generated by each source is given by:

Continued on page 76

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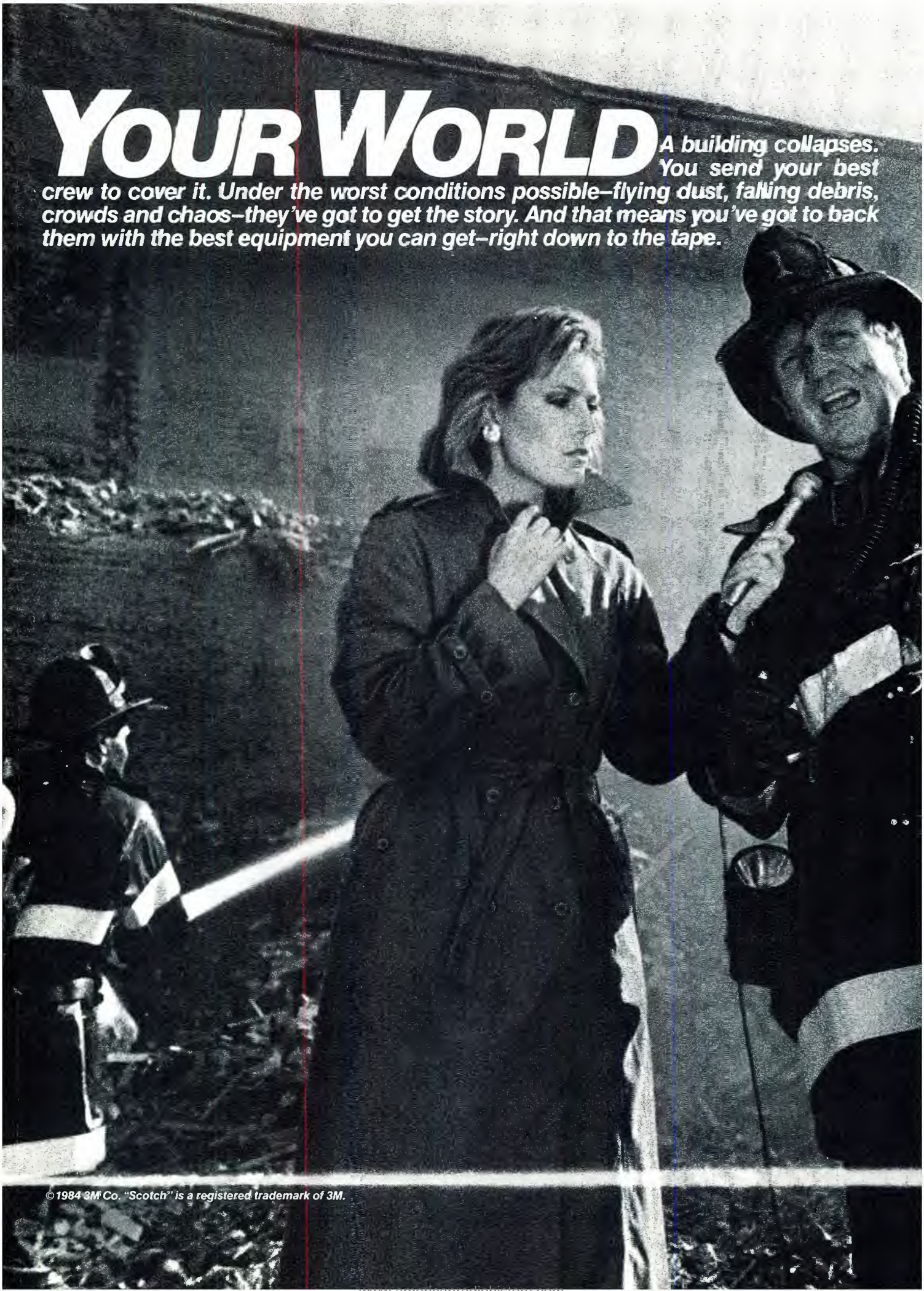

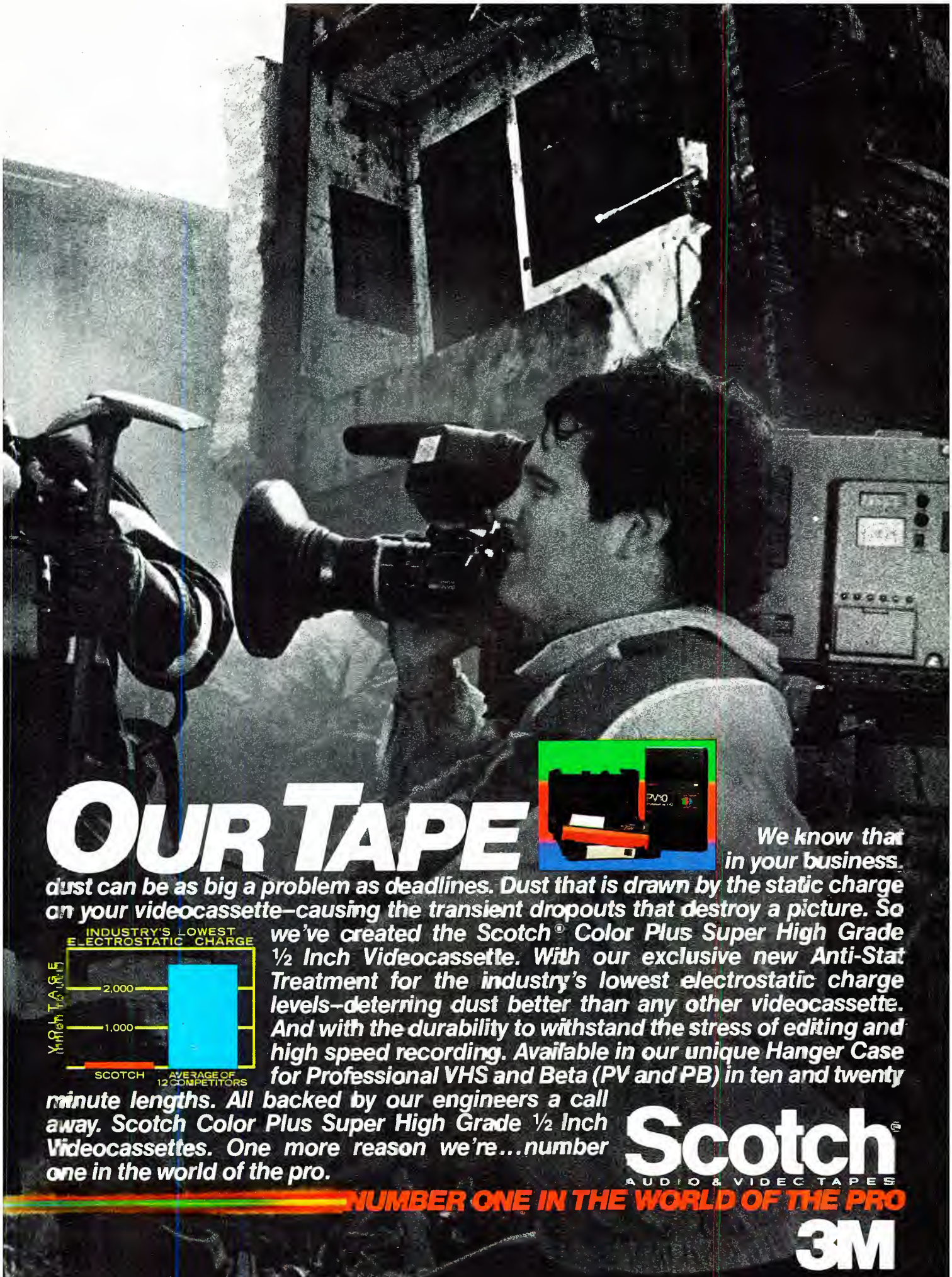

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3M

Circle (52) on Reply Card

Continued from page 72

$V = \sqrt{4kTBR}$,
where: k = Boltzmanns constant (1.38 x 10^{-23} Joules/°K
T = absolute temperature (K);
B = noise bandwidth (Hz); and
R = resistance (Ω).

Shot noise originates in semiconductors. It is generated by the random diffusion of minority carriers and the random generation and recombination of electron-hole pairs. Shot noise also is a white noise (having equal energy at all frequencies) and is expressed as a current:

$I_{rms} = \sqrt{2qI_{dc}B}$,
where: q = electron charge (1.6 x 10^{-19}C);
I_{dc} = average dc current (A); and
B = noise bandwidth (Hz).

The *power supply* related noise seen at the output of a tape machine consists of even and odd harmonics of the power line frequency. This noise can be induced in the reproduce electronics by stray magnetic fields, or generated by power supply ripple. Improper grounding also can result in noise generation in a cartridge machine.

The fourth major source of noise is *EMI* coupling into the magnetic head. The head is painstakingly designed to be an effective magnetic field transducer and can only be protected from EMI by proper shielding.

When unrelated noise voltages or currents are added together, the total power produced is equal to the sum of the individual powers from each source. As an example, two unrelated noise voltages would add as follows:

$V_r^2 = V_1^2 + V_2^2$.

For more than two noise sources:

$V_r^2 = V_1^2 + V_2^2 + ... + V_n^2$.

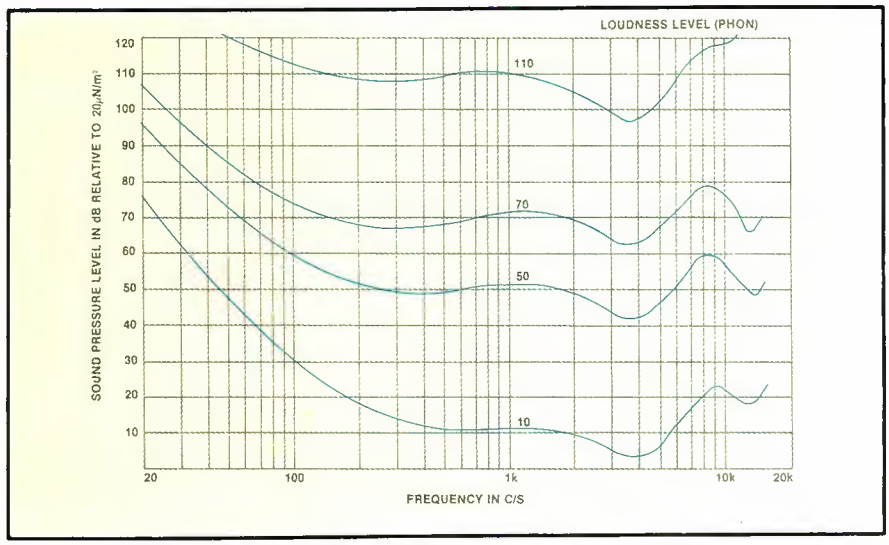

Figure 1. The equal-loudness perception curves for pure tones, determined by Robinson and Dadson in 1956 at the National Physical Laboratory, Teddington, England.

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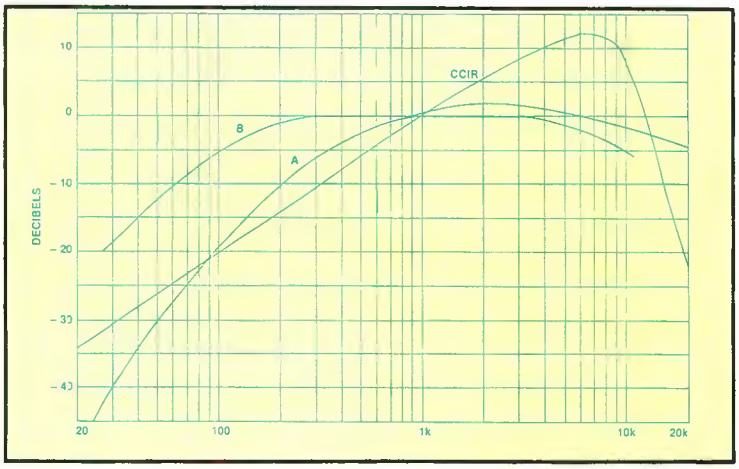

Figure 2. Frequency response or *weighting curves* used in measuring low-level noise to discriminate against low and high frequencies in accordance with the equal-loudness contours. A and B were developed for sound-level meters. Audio analyzers use A and CCIR.

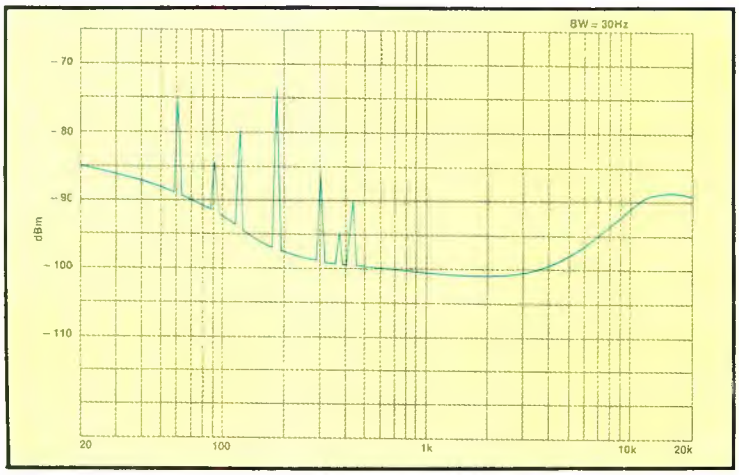

Figure 3. The spectrum of noise output from a cartridge machine measured unweighted, not pulling tape.

Fortunately, voltmeters are available to perform the needed mathematics for us. In this respect, the NAB guidelines calling for an "unweighted bandpass" come into play. The noise voltages generated by thermal and shot sources are limited by the bandwidth being measured and the weighting curve (if any) used in the test. The NAB-recommended bandpass of 20Hz-20kHz limits only very low or very high frequency noise sources with its unweighted curve.

Weighting curves

Subjective testing over the years has resulted in a number of human auditory sensitivity curves that clearly show that our ears are not equally sensitive to all frequencies in the audio spectrum. The Robinson and Dadson curves, shown in Figure 1, illustrate how our perception of loudness varies not only with frequency, but also with audio level. This type of data gave rise to the A- and B-weighting curves, which were developed to enable sound level instruments to measure more accurately what the human ear would actually hear. (See Figure 2.)

The A curve closely resembles the equal-loudness curve at the level of 40 phones (about the sound level of the average residence or business office) and is used in speech interference

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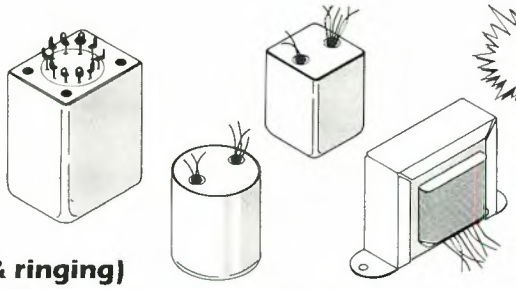

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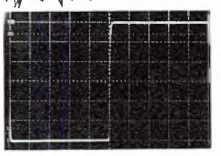

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INPUT TRANSFORMERS AND SPECIAL TYPES

Model	Application	Impedance Ratio Pri-Sec	Turns Ratio Pri:Sec	20Hz Max Input Level[1]	Typical THD Below Saturation (%) 20Hz/1kHz	Frequency Response (dB ref. 1 kHz) 20Hz/20kHz	Band-Width[2] –3dB @(kHz)	20 kHz Phase Response (degrees)	Over-Shoot (%)	Noise Figure (dB)	Magnetic Shield[4] (dB)	Number of Faraday[4] Shields	Package[5]	PRICES 1-19	100-249	1000
MICROPHONE INPUT																
☆ JE-16-A JE-16-B	Mic in for 990 opamp	150-600	1:2	+8	0.036/0.003	−0.08/−0.05	200	−8	<1	1.7	−30	1	A=1 B=2	64.21 68.86	42.89 45.99	29.60 31.74
☆ JE-13K7-A JE-13K7-B	Mic in for 990 or I.C.	150-3750	1:5	+8	0.036/0.003	−0.09/−0.21	85	−19	<2	2.3	−30	1	A=1 B=2	64.21 68.86	42.89 45.99	29.60 31.74
JE-115K-E	Mic in for I.C. opamp	150-15K	1:10	−6	0.170/0.010	−0.50/+0.10	115	−5	<7	1.5	−30	1	3	42.03	28.07	21.92
LINE INPUT																
JE-11P-9	Line in	15K-15K	1:1	+26	0.025/0.003	−0.03/−0.30	52	−28	<3		−30	1	1	103.47	69.13	47.69
JE-11P-1	Line in	15K-15K	1:1	+17	0.045/0.003	−0.03/−0.25	85	−23	<1		−30	1	3	40.05	26.76	20.90
☆ JE-6110K-B JE-6110K-BB	Line in bridging	36K-2200 (10K-600)	4:1	+24	0.005/0.002	−0.02/−0.09	125	−12	<1		−30	1	B=1 BB=2	62.86 71.52	42.01 47.79	30.83 32.97
* JE-10KB-C	Line in bridging	30K-1800 (10K-600)	4:1	+19	0.033/0.003	−0.11/−0.08	160	−9	<2		−30	1	3	41.56	27.76	19.16
JE-11SSP-8M	Line in/ repeat coil	600/150-600/150	1:1 split	+22	0.035/0.003	−0.03/−0.00	120	−9	<3.5		−30	1	4	151.90	101.47	70.01
JE-11SSP-6M	Line in/ repeat coil	600/150-600/150	1:1 split	+17	0.035/0.003	−0.25/−0.00	160	−5	<3		−30	1	5	79.22	52.91	36.51
SPECIAL TYPES																
☆ JE-MB-C	2-way[3] mic split	150-150	1:1	+1	0.050/0.003	−0.16/−0.13	100	−12	<1		−30	2	3	34.60	23.13	18.06
☆ JE-MB-D	3-way[3] mic split	150-150-150	1:1:1	+2	0.044/0.003	−0.14/−0.16	100	−12	<1		−30	3	3	60.09	40.15	31.35
JE-MB-E	4-way[3] mic split	150-150-150-150	1:1:1:1	+10	0.050/0.002	−0.10/−1.00	40	−18	<1		−30	4	1	96.90	64.73	44.66
JE-DB-E	Direct box for guitar	20K-150	12:1	+19	0.096/0.005	−0.20/−0.20	80	−18	<1		−30	2	6	43.57	29.11	22.73

1. Max input level = 1% THD; dBu = dBv ref. 0.775 V
2. With recommended secondary termination
3. Specifications shown are for max. number of secondaries terminated in 1000 ohm (typical mic preamp)
4. Separate lead supplied for case and for each faraday shield
5. Except as noted, above transformers are cased in 80% nickel mu-metal cans with wire leads.

PACKAGE DIMENSIONS:

	W		L		H
1 =	1 5/16"	Diam.		×	1 9/16"
2 =	1 3/16"	×	1 3/16"	×	1 5/8"
3 =	1 1/8"	Diam.		×	1 1/16"
4 =	1 1/2"	×	1 3/4"		2 1/2" w/solder terminals
5 =	1 5/8"	Diam.		×	1 3/4"
6 =	1 1/8"	Diam.		×	15/16"

NICKEL CORE OUTPUT TRANSFORMERS[6]

Model	Construction	Nominal Impedance Ratio Pri-Sec	Turns Ratio Pri:Sec	20Hz Max Output Level[7] (dBu)	across (n) windings	600Ω Load Loss (dB)	DC Resistance per Winding	Typical THD Below Saturation (%) 20Hz/1kHz	Frequency Response (dB ref. 1kHz) 20Hz/20kHz	Band-Width −3dB @ (kHz)	20kHz Phase Response (degrees)	Over-Shoot[8] (%)	Package[9]	PRICES 1-19	100-249	1000
* JE-123-BMCF	Quadfilar 80% nickel	600-600 150-600	1:1 1:2	+28	2	−1.1	20Ω	0.002/0.002	−0.02/−0.02	>450 160	−2.1 −4.1	<1	7	87.41	44.17	30.47
* JE-123-DMCF	Quadfilar 80% nickel	600-600 150-600	1:1 1:2	+21	2	−1.0	19Ω	0.004/0.002	−0.02/−0.00	>450 230	−1.2 −2.5	<1	8	50.71	33.88	23.38
JE-123-BLCF	Quadfilar	600-600 150-600	1:1 1:2	+32	2	−1.1	20Ω	0.041/0.003	−0.02/−0.01	>450 170	−1.9 −4.0	<1	7	61.30	35.79	24.70
* JE-123-DLCF	Quadfilar	600-600 150-600	1:1 1:2	+27	2	−1.0	19Ω	0.065/0.003	−0.02/−0.01	>450 245	−1.2 −2.5	<1	8	39.61	26.45	19.42
JE-123-SLCF	Quadfilar	600-600 150-600	1:1 1:2	+23.5	2	−1.1	20Ω	0.088/0.003	−0.03/−0.01	>450 245	−1.2 −2.8	<1	9	33.48	22.35	15.43
JE-112-LCF	Quadfilar	600-600 150-600	1:1 1:2	+20.4	2	−1.6	29Ω	0.114/0.003	−0.03/−0.01	>450 205	−1.2 −3.2	<1	10	25.48	17.01	12.49
JE-123-ALCF	Quadfilar	66.7-600	1:3	+26.5	3	−1.3	8Ω	0.125/0.003	−0.04/+0.06	190	−4.6	<6	8	42.14	28.15	19.42
JE-11S-LCF	Bifilar w/ split pri.	600-600 150-600	1:1 1:2	+30	1 (sec)	−1.7	63Ω	0.058/0.002	−0.02/+0.01 −0.02/−0.05	>10MHz 155	+1.1 −4.1	<1	8	42.14	28.15	19.42

6. Multifilar construction has no faraday shield. (Cannot be used as input transformer.) All specifications are for 0Ω source, 600Ω load.
7. Max output level = 1% THD; dBu = dBv ref. 0.775 V
8. Source amplifier −3dB @ 100kHz
9. Output transformers are horizontal channel frame type with wire leads, vertical channel frames available.

PACKAGE DIMENSIONS:

	W		L		H	Mounting Centers
7 =	1 1/2"	×	2 5/16"	×	1 15/16"	2 13/16"
8 =	1 5/16"	×	1 15/16"	×	1 5/8"	2 3/8"
9 =	1 1/8"	×	1 1/16"	×	1 3/8"	2"
10 =	1 1/16"	×	1 7/16"	×	1 3/16"	1 3/4"

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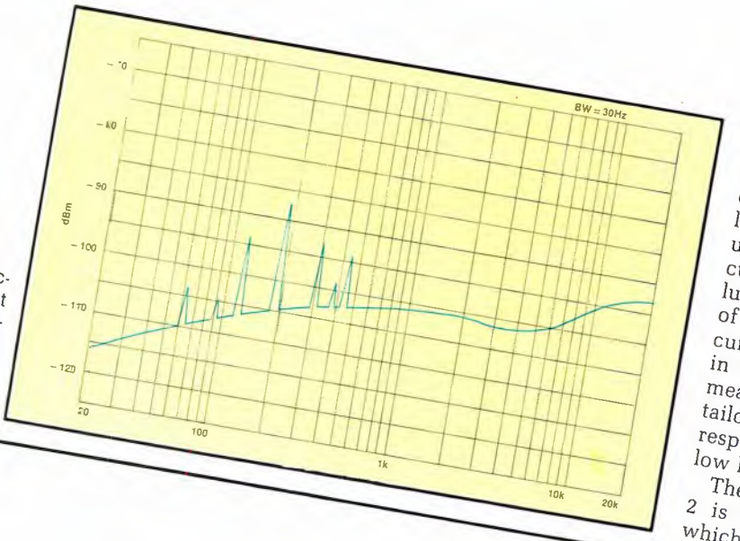

Figure 4. The spectrum of noise output from a cartridge machine measured with the A-weighting curve employed, not pulling tape.

measurements. The B-weighting curve typifies the equal-loudness curve of 70 phones (about the sound level of heavy traffic) and generally is used in traffic noise studies. The B curve is shown for comparison to illustrate the increased weighting effect of the A line. The A-weighting curve and the CCIR curve are used in some audio analyzers for noise measurements. Their purpose is to tailor the meter's reading to the response of the human ear at these low levels.

The one curve not shown in Figure 2 is the NAB-recommended curve, which is a straight line from 20Hz-20kHz at the 0dB reference level.

Spectral measurements

To graphically illustrate the effects of weighting, look at a typical noise spectrum. Figure 3 shows a 20Hz-20kHz spectral plot of the noise output of a cartridge machine (not pulling tape) measured unweighted (according to the NAB S/N specification). Figure 4 is the same spectrum with an A-weighting curve employed. Note that the primary noise components are 60Hz and its harmonics. These are the result of power supply ripple and EMI into the tape head. The spike at 90Hz is the capstan motor commutation frequency radiating into the head.

The effects of the A-weighting curve on these frequencies, and on frequencies above 5kHz, are dramatic, as these spectra show. The meter readings associated with the unweighted NAB spectrum (Figure 3) and the A-weighted spectrum (Figure 4) are −64dB and −70dB, respectively. This significant difference is achieved with the same cart machine, but different measuring techniques. Although both of these noise measurements are legitimate, it is important that potential buyers of such equipment understand what the numbers in the specifications mean.

The reference level for measuring cartridge machine noise is another important consideration for potential buyers. For comparison figures to be meaningful, the reference point must be known. A reference set to 250nWb/m has a 4dB advantage with respect to a cart machine tested using the NAB-specified reference of 160nWb/m.

Incidentally, the machine that produced the spectra shown in Figure 3 and Figure 4 was set up for a fluxivity of 250nWb/m. The published S/N specification on the test machine was 53dB, pointing out another topic for consideration. Buyers should know whether specifications published by the manufacturer are worst-case or nominal values for the specs to be meaningful.

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But the real reason for buying it is that it is upwardly compatible to the proposed SMPTE "Recommended Practices for Digitally Controlled Equipment." Which means the interfacing problems between video, audio and film equipment will be problems of the past. This Sony "Sync Master" synchronizer has a built-in distributed intelligence network that makes it able to talk to an entire universe of diverse machines developed by diverse manufacturers.

So before you invest in a synchronizer that just solves today's problems, perhaps you should first examine the one that will also solve tomorrow's.

SONY
Professional Audio.

The history of the cart machine

By Gene Randolph, sales support manager, Continental Electronics Mfg. Company, Dallas, TX*

Today the equipment exhibits that generally draw the largest crowds at the annual NAB convention are TV-related. But in 1959, the undisputed main attraction at the convention was the audio cartridge tape equipment manufactured by Automatic Tape Control and marketed by Collins Radio Company.

Until 1959 the playback of program material was handled by discs and reel-to-reel decks. The late 1950s was a time of dramatic change in radio, as the industry moved from a medium offering long, discrete programs to one offering a single, continuous program made of many short pieces. This rapid-fire music-and-news format came to be known as Top 40 radio.

Acetate discs could handle the pace of a Top 40 format, but offered poor fidelity. The lead-in grooves on those discs tended to sound scratchy after several cueings and, after many plays, the stylus often would jump grooves. Reel-to-reel, on the other hand, offered excellent fidelity but suffered from severe problems in loading, cueing, starting, rewinding, accidental erasure and tape breakage. The need existed, then, for a playback system offering the fidelity of reel-to-reel decks combined with the handling ease, rapid cueing and instant start of acetate discs.

Although I had nothing to do with developing the tape cartridge equipment introduced at the 1959 NAB Convention, I did have a hand in introducing the system to broadcasters. At that time, I was a sales representative for Collins, and my territory included Illinois. One day early in 1959,

*Additional background information was provided by Mark Wasserman, marketing communications manager, ITC/3M, Bloomington, IL.

Courtesy of ITC/3M

Shown is the world's first audiotape cartridge machine, built in 1959. Note the use of a microswitch to determine when the cartridge is inserted, and the tube-type reproduce electronics.

Harold E. Fellows (right), then president of the NAB, inspects the Collins-ATC tape cartridge equipment on display at the 1959 NAB Convention in Chicago. He is joined by Forrest Wallace of Collins.

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*Manufacturer's suggested retail price.

Circle (60) on Reply Card

I called on radio station WJBC in Bloomington, where Chief Engineer Ted Bailey and his assistant, Jack Jenkins, had put together a cartridge tape system that they were using on the air to play commercials. As a former control board operator who had handled countless small reels of tape for commercial announcements, I saw what a boon such a cartridge tape system could be to radio broadcasting.

When I returned to the Collins factory in Cedar Rapids, IA, I told John Haerle—then product line manager at Collins—about the cartridge system developed at WJBC. Within 24 hours, he and a company attorney flew to Bloomington and worked out a marketing agreement with Vern Nolte, general manager of the station. Nolte had come up with the idea of using short-length cartridges for commercial announcements and having them recue automatically. Design of the electronics to accomplish Nolte's idea belonged to Bailey and Jenkins.

The solenoid that engaged the pressure roller was a Moulic design and the Moulic Specialty Company assembled the first decks using Viking transports. The Automatic Tape Control Company (ATC) was formed by Nolte, and it provided most of the engineering designs that Moulic built and Collins sold.

In a crash program, Collins arranged with ATC to produce enough units to show at the NAB convention some 6-8 weeks later. The original models were designated the P-150 (for those having a 15-inch panel for desktop mounting) and the P-190 (for 19-inch rack mounting). The record amplifier, with a single cue tone, was a separate assembly.

Orders exceeding $100,000 were booked at the show. At that time, the cost of one unit (playback deck and record amplifier assembly) was $945.

Although Collins was the first to introduce a successful tape cartridge system at the NAB convention, others were working on similar systems, some of which were introduced a short time later. Ross Beville, founder of the Spotmaster line of cartridge tape equipment, was a pioneer in the development of cart systems and active in establishing industry standards for the new technology.

Almost simultaneously with the introduction of tape cartridge equipment, Gates Radio Company brought out its 101 Spotter. Unlike cartridge designs that used an endless loop of ¼-inch tape, the 101 Spotter employed a 14-inch-wide band of tape on which spots were recorded side-by-side. An indexed, sliding head arrangement allowed the user to select any one of 101 spots. These announcements, how-

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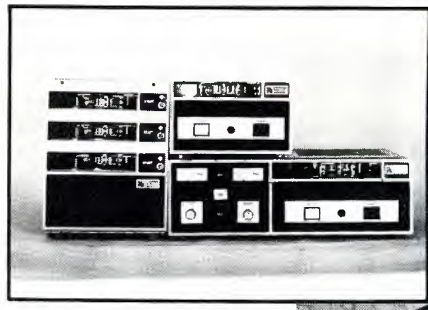
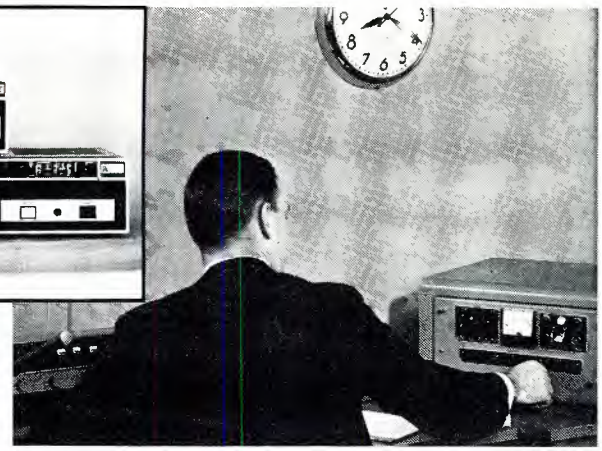
Circle (71) on Reply Card



Shown is the ITC premium line of audio cartridge machines, introduced in 1970 and a direct descendant of the Bailey-Jenkins design. Jack Jenkins was one of the founders of International Tapetronics Corporation, which later became ITC/3M.



An operator positions the selector bar on the Gates Radio Company 101 Spotter that determines which prerecorded announcement is played. The announcement playback system is shown on display at the 1959 NAB Convention.

ever, could not exceed 70 seconds in length and, before the next spot could be selected and played, the tape had to be rewound, similar to a player piano roll. Faced with the competition of tape cartridge systems, the 101 Spotter had a relatively short market life. Gates soon brought out its own line of tape cartridge equipment.

The majority of endless-loop tape designs used the Fidelipac cartridge, whose inventor-patents covered the movable pinch roller, which eliminated the need to have a roller mounted inside each cartridge. The Fidelipac drive system was used in some Viking tape cartridge audio systems designed for point-of-purchase displays. Bailey and Jenkins used this drive system in developing the first automatically recueing broadcast cartridge system. Fidelipac invented and patented the first endless-loop tape cartridge in 1956. The company was, for many years, the sole supplier of carts to the broadcast industry. Fidelipac's model 300 cartridge was introduced in 1960, and approximately 20 million have been produced since then.

Despite widespread enthusiasm for the new cartridge system, there were growing pains. One of the major problems was pressure pad adjustment. If not properly set, the tape audio could sound muffled or the cue tone (which stopped the cartridge in the correct position for later use) could be missed. Any early user of cartridge tape equipment can recall countless times when a tape ran past the cue tone and started playing again, often over other program material.

Stretched drive belts and improper pressure roller adjustment also proved to be headaches for the maintenance engineer. Through an evolutionary process, today's cartridge equipment is, for the most part, free of these early problems.

Among the early users of tape cartridge equipment in major markets was WJJD in Chicago. At that time, the station employed union musicians to operate its turntables. In what seemed to be an effort to eliminate this requirement, WJJD dubbed its entire record library onto tape cartridges. Its initial order for blank cartridges totaled more than 3000 units. And, the project proved to be reasonably successful, considering the problems inherent in the early tape cartridge equipment.

Although my enthusiasm for tape cartridge equipment did not falter, as a salesman I soon tired of hauling the record and playback units into radio stations for demonstrations. To circumvent this chore, I bought a used Cadillac limousine. Special enclosures were designed to hold the cartridge tape equipment, audio amplifier and speaker system in place. These units fitted neatly into the folding footrests in the back seat. With this setup, plus a 100-foot extension cord, I was able to demonstrate the equipment in the back seat of the car, free of interruptions. In cases in which the station's studios were in a downtown area, I would make prior arrangements with a nearby service station to use electric power and parking space while conducting the demo.

The approach must have been unique at the time, because it was featured on several TV newscasts by stations in my sales territory. More important to me, the commissions from sales of the cartridge equipment during the first six weeks of use returned my investment in the used limousine.

Although I can take no credit for the development of tape cartridge equipment, I was glad to be a part of the initial marketing efforts. There can be no question that it was one of the most important developments in radio program source equipment. [:-)))]

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Circle (66) on Reply Card

Carts & cassettes: Status report

By Jerry Whitaker, radio editor

In the April issue of **Broadcast Engineering,** we included a post card questionnaire on audio cartridge and cassette machine use. Although the questionnaire was not designed to yield a scientific sampling of the broadcast industry, it does provide an interesting look at the state-of-the-*cart*. The April questionnaire is shown in Figure 1.

The survey results are compiled in Table 1. Radio engineers formed the largest percentage of respondents to the questionnaire, with 69% of the returned forms coming from radio station personnel and 68% of the forms coming from technicians. Results of the survey show that audio cartridge systems are used primarily for commercial reproduction (42%), and that most of that production (62%) is in mono. We were somewhat surprised to find the small number of stations that reported using audio frequency shift keying (AFSK) for commercial logging purposes. Only 7% of the persons responding to the **BE** questionnaire indicated the use of AFSK encoding/decoding equipment. The median number of cart machines in use at radio and TV stations is nine, according to our study. The percentage breakdowns are shown in Table 1.

Two of the questions on the April questionnaire addressed the problems that stations might be experiencing with cartridge systems in general. The number one problem cited by the persons returning our form was cartridge system noise. Also reported to be troublesome were wow and flutter, cart jamming and system frequency response. To put these in perspective, though, only 9% of the respondents said that performance of most cart systems today was inadequate.

The results on cassette machine problems were, however, not as favorable. Twenty-one percent of the persons returning our form said that the performance of most cassette machines available today was inadequate. By far, the major concerns cited by respondents were cassette machine interface problems. Other areas of trouble reported were machine reliability, system frequency response and noise.

Our survey showed that most cassette machines were used for news applications (38%). Many stations also reported the use of cassettes for commercial demo (or spec) spots.

A space was provided on our questionnaire for comments on what respondents would like to see in the future for cartridge or cassette tape machines. Included in the responses were the following:

- More electrical and mechanical standardization of equipment.
- A professional-quality broadcast cassette tape machine.
- Cue capability, such as cartridges have, for cassette machines.
- More durable mechanical designs and easier head alignment.

Continued on page 92

Table I.

Persons completing the questionnaire:	Technical . . . . . 68% Management . . . . . 12% Operations 20%
Type of facility:	AM Radio . . . . . 29% FM Radio . . . . . 40% Television . . . . . 13% Other 18%
Cart machines used regularly for:	News . . . . . 32% Music . . . . . 24% Commercials . . . . . 42% Other 2%
Most cart work done in:	Stereo . . . . . 38% Mono 62%
AFSK encoding used for cart work:	Yes . . . . . 7% No 93%
Number of cart machines used at station:	4 or less . . . . . 22% 5 to 9 . . . . . 32% 10 to 14 . . . . . 25% 15 to 24 . . . . . 16% 25 or more . . . . . 5% Median value = 9
Biggest problems with cart machines:	System noise . . . . . #1 Wow and flutter . . . . . #2 Cart jamming . . . . . #3 Frequency response . . . #4
Performance of most cart systems today is:	Good . . . . . 42% Adequate . . . . . 49% Inadequate 9%
Cassette machines used regularly for:	News . . . . . 38% Music . . . . . 20% Commercials . . . . . 31% Other 11%
Biggest problems with cassette machines:	Equipment interface . . . #1 Machine reliability . . . . #2 Frequency response . . . #3 System noise . . . . . #4
Performance of most cassette machines today is:	Good . . . . . 33% Adequate . . . . . 46% Inadequate 21%

Table I. The results of the questionnaire on cartridge/cassette machine use.

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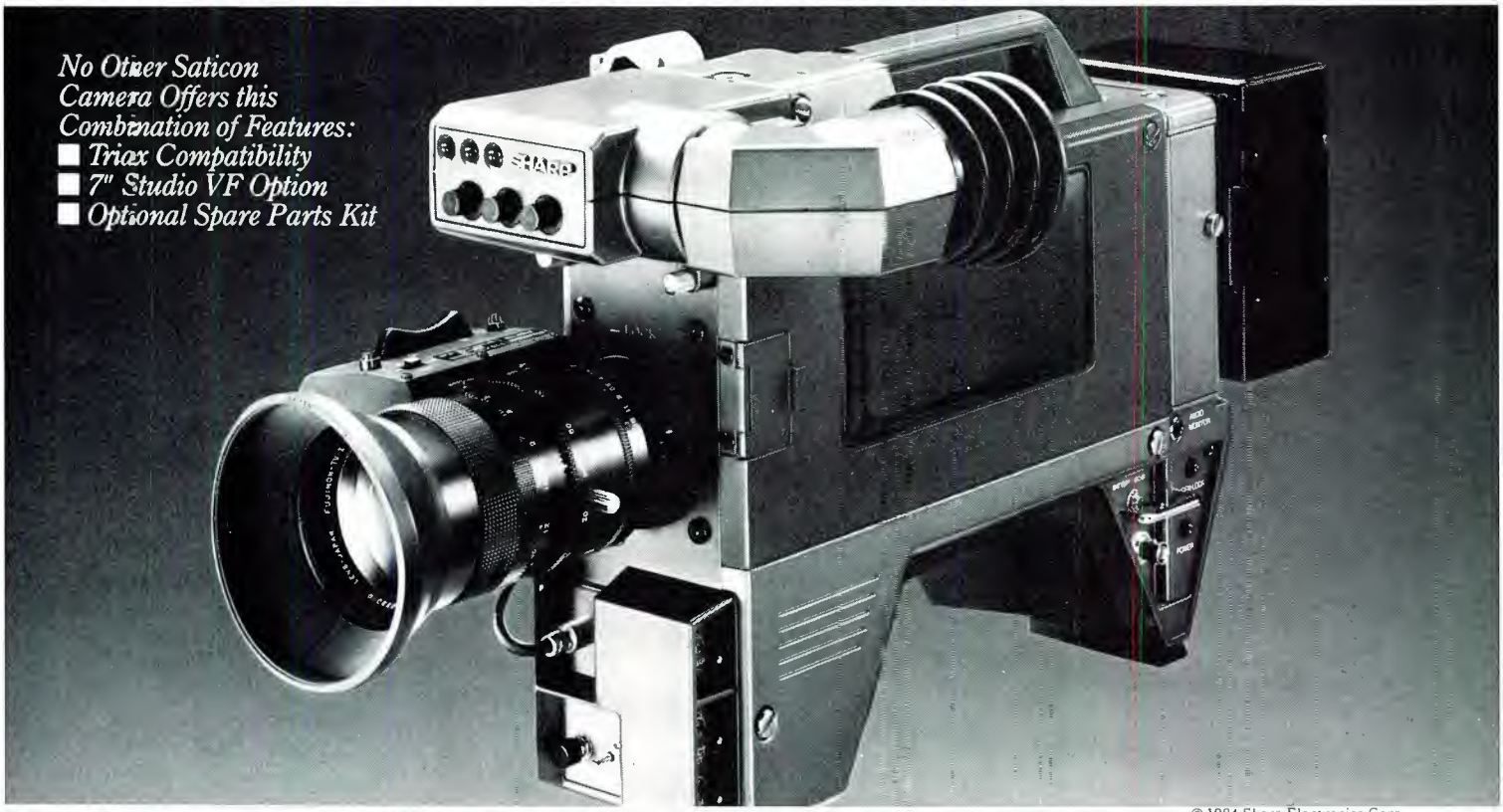

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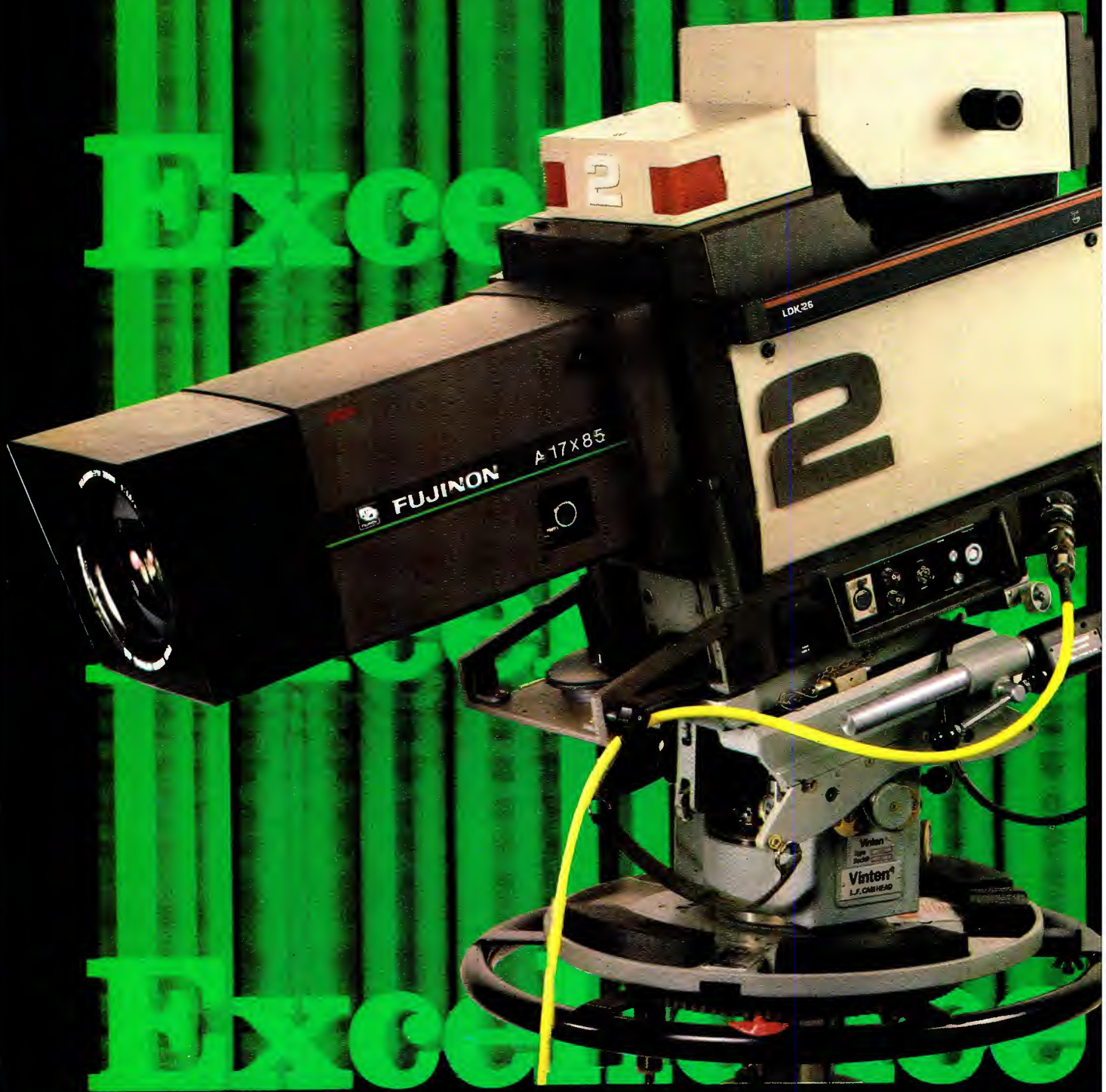

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BE 6 8 84

1. **What is your title?** _____

2. **What type of facility?**
   - ☐ AM radio
   - ☐ FM radio
   - ☐ TV station
   - ☐ Other _____

3. **Do you use cartridge machines regularly in the following areas of operation?**
   - ☐ News
   - ☐ Commercial production
   - ☐ Music programming
   - ☐ Other _____

4. **Most cartridge work at your station is done in**
   - ☐ mono
   - ☐ stereo

5. **Most of the cartridge work at your facility**
   - ☐ uses AFSK encoding
   - ☐ does not use encoding

6. **Estimate the number of cartridge machines in use at your station.** _____

7. **Please list in order the areas of operation most troublesome in cartridge use (#1 being the biggest problem).**
   - ___ Stereo phasing
   - ___ Wow and flutter
   - ___ Cart jamming
   - ___ System noise
   - ___ System frequency response
   - ___ Other _____

8. **Do you find the performance of most cartridge systems available today**
   - ☐ good
   - ☐ adequate
   - ☐ inadequate

9. **Do you use cassette tape machines at the present time in the following areas of operation?**
   - ☐ News
   - ☐ Commercial production
   - ☐ Music programming
   - ☐ Other _____

10. **Please list in order the areas of operation most troublesome in cassette machine use (#1 being the biggest problem).**
    - ___ Stereo phasing
    - ___ Wow and flutter
    - ___ Cassette jamming
    - ___ Machine reliability
    - ___ System noise
    - ___ System frequency response
    - ___ Interfacing to other equipment
    - ___ Other _____

11. **Do you find the performance of most cassette machines available today**
    - ☐ good
    - ☐ adequate
    - ☐ inadequate

12. **What would you like to see in the future for cartridge or cassette tape machines?** _____

Figure 1: The cartridge/cassette machine questionnaire that appeared in the April issue of **BE.**

Continued from page 88

- Quieter operation on cartridge machines.
- Universal serial interface port options for cartridge machines.
- Built-in timer capability on cartridge and cassette units.
- SMPTE time code editing capability for studio and portable cassette decks.
- Automatic network taping capabilities.
- Cassette machines with professional connectors and standard input/output levels and impedances.

Cleaning your cart machines

By Arthur Constantine, vice president, sales, Fidelipac Corporation

Regular cleaning of a cartridge machine capstan shaft and tape heads is vital to the reliable performance of any system. The use of the wrong cleaning chemical, however, can do more harm than good. Shown in this photo is Dennis St. John, production director, KUDL-FM (Kansas City, KS) cleaning one of the cart machines in the station's production room.

Almost everyone recognizes the need to keep the tape heads and capstan shaft of a cartridge machine clean. Many may not realize, however, the problems that may be experienced when trying to clean a machine containing a ceramic capstan.

Within the last few years, a significant number of radio stations have purchased cartridge machines that contain white ceramic capstan shafts. Within a short time, however, the proud owner of the machine discovers that the white ceramic material has been stained by oxides and pigment contained in the cartridge tape. This condition may show up after only a few hours of use.

Striving to keep the new machine clean, the chief engineer or production supervisor dutifully attempts to clean the cart machine capstan and heads with his normal isopropyl-based tape head cleaner. Unfortunately, the brown stain has penetrated the cellular structure of the ceramic shaft material and cannot be easily cleaned away.

The trouble begins

In frustration, the engineer then proceeds to the local hardware store and requests a stronger cleaning material. Frequently, he uses solvents such as 1, 1, 1-trichloroethane, toluol, M-E-K and denatured alcohol. Although these chemicals do an excellent job of dissolving oxide, an unfortunate side effect may occur, in which the bonding material used to hold the oxide onto the mylar backing of certain tapes is dissolved. Also, the exposed epoxy surface around the pole piece on some of the newer tape heads may be softened and eventually removed with repeated exposure to certain solvents. This causes the leading edge of the pole piece, which is normally lapped smooth with the head surface, to protrude and abrade the tape as it passes.

To add to the problem, the cellular structure of the ceramic capstan readily absorbs the cleaning chemical, so evaporation may be slow. As subsequent cartridges are played, the chemical may then be squeezed onto the tape surface and become trapped within the layers of the cartridge's tape pack. Even while the cartridge is stored, these chemicals can attack the tape surface and binder material. The next time the cartridge is played, oxide shedding is apparent. After more cleaner is applied to the capstan shaft and heads, the cycle is renewed.

Preventing further damage

What is the solution for all this? First, use only isopropyl alcohol or inert cleaners, such as freon TF (made by Miller Stephenson). Second, inspect the heads and pinch roller of each machine for evidence of any possible damage.

Evidence of tape damage does not necessarily mean that the cartridge is unusable. If the problem is remedied early in the cartridge life, some loss of oxide may be tolerated without an appreciable loss of performance. However, when the tape surface appears well worn, reloading or replacement is the only alternative.

The effects of various cleaners differ with respect to various tape types. Unfortunately, however, it is not always true that a type of tape that was unaffected by exposure to, say, denatured alcohol, one year ago will never be affected by the same chemical. This degree of unpredictability exists because some tape manufacturers occasionally vary the ingredients used in bonding and other areas of manufacture.

Therefore, the assertion that, "We've always used methanol and have never had a problem," may not be safe in all cases.

Editors note:

Some stations have reported success in cleaning ceramic capstans using a soft cloth and a liquid cleaner, such as Formula 409 or Windex. Care should be taken not to apply too much cleaner – whether it be isopropyl alcohol or any other type – to the capstan shaft. Excessive amounts of cleaner can run down the shaft and into the top motor bearing assembly, resulting in premature failure. The capstan should also be given sufficient time to dry following cleaning before the machine is used again.

Continued from page 6

transmission chain—the diplexer. The purpose of a diplexer is to accept outputs from the visual and aural transmitter power amplifiers and combine them into one signal to pass to the antenna. Several types of diplexer are in use, and for those VHF stations whose system requires dual feedlines to the antenna, e.g., a batwing design, there apparently will be no problem. Some adjustments to broadband the aural circuits in the transmitter will solve some of their problems. Stations that use a notch diplexer with a single feed to the antenna face much more.

All of the answers are not yet in, but for notch-diplexed VHF and UHF high power and LPTV installations, the solutions are all expensive. The degree will be determined by:

- can a pre-distorting correction network be used;
- should the diplexer be retrofitted; or
- should the diplexer be replaced?

The ballpark diplexer replacement cost, according to various manufacturers, could vary from $25,000 to $40,000, depending on the station's assigned frequency and power level.

Plan on a new exciter. Upgrading the exciter might prove valuable anyway, as AM stereo broadcasters have found. Some AMers reported listeners calling to congratulate the station on the new sound. Ironically, some cases involved stations who had only tuned the transmitter and directional array properly and had not yet activated the stereo exciter. Adding humor, too, is the fact that the listeners were hearing the new stereo from monaural receivers. Proper tuning and general cleaning up of the act are advised, just the same.

Going step-by-step

A station operating in stereo does not have to simultaneously use the separate audio program (SAP) and professional channels provided by the Zenith/dbx method. Therefore, it follows that a progressive approach might be possible. Assuming the exciters, yet to appear, are appropriately modular, you could add the stereo capability now. In the future, begin SAP operation, and eventually add the professional channel for cueing, transmitter telemetry, utility management or other subcarrier applications.

The same approach to STLs at noncolocated stations should be possible. Many STL systems come with vacant slots for additional subcarriers on the microwave link. With main channel, stereo, SAP and engineering channels and perhaps the transmitter remote control data, the STL may be overloaded. If so, an application with the FCC for an additional STL frequency allocation could be necessary.

In master control and around the studio, the amount of change and cost will depend upon the extent of the stereo programming. If only network feeds are planned, minimal crosspoints on distribution and master control switching might be required. If local stereo production and cine/VTR playback are expected, then many more changes loom ahead, including distribution, switching, additional cabling and, perhaps, a new audio control console.

One more major item remains for all properly operated stations. The parameters of the system are critical, making monitoring a must. Major monitor manufacturers plan to have units available soon, some with special designs for MTS, others making alterations to current units for the additional capability. We guess that a $10,000 price tag *should* cover this must-have item.

Bypassing the diplexer problem, but considering the other items just mentioned, one guess is that a minimum ballpark figure for the conversion will be about $30,000. If the diplexer is involved, immediately add $25,000 to $40,000 increment. Consider the programming situation and ask yourself if immediate conversion is logical.

Diplexer dilemmas

Notch diplexers are intriguing constructions of tuned coaxial lines and cavities. To explain how they operate, however, it is easier to think of 3dB couplers and series resonant circuits. Each unit is manufactured for a particular channel frequency and is designed to handle at least the licensed transmitter power output plus an overhead safety factor. Each is designed to be an integral part of the system.

The action of a 3dB coupler is to split the incoming signal into two parts, each equal to half of the input. Half, in this case by ac-theory rules, is actually 0.707 times input signal level. In addition, one output appears to be a straight-through feed without phase shift. The second output exhibits a $\angle -90°$ shift.

Referring to Figure 1, if $1V\angle 0°$ is applied at port A1, then a straight-through output at B1 is $0.707V\angle 0°$. The second output at D1 exhibits a phase shift and is $0.707V\angle -90°$. No signal appears at C1.

In the notch diplexer, we connect two 3dB couplers in cascade, as shown in Figure 2. Considering only the visual signal as an input to the

system at A1, the output B1 is applied to A2 of the second section. As before, a straight-through signal appears at B2 and is 0.707 times the 0.707V input, or 0.5V∠0°. A second output from B2 appears at D2 and includes the phase shift, 0.5V∠−90°.

The shifted input appearing at C2, 0.707V∠−90°, travels straight through to D2 for 0.5V∠−90°. A shifted output appears at B2, 0.5V∠−180°. The signals at B2 are added, but the phase differences cause the outputs at B2 to be cancelled. At D2, the signals add (0.5V + 0.5V) to get 1V∠−90°. In the TV station, the feedline to the antenna is connected to D2. Aural will be applied at B2, and the connection at C1 holds the *reject load*.

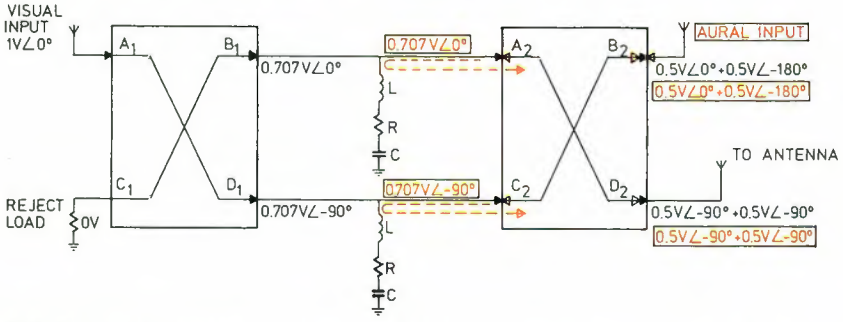

Figure 3. Cascaded 3dB couplers with LRC aural cavities, showing visual and aural (in red) action.

In Figure 3, the aural cavity has been included diagrammatically as an RLC series resonant circuit, tuned to the aural carrier frequency. Any visual signal RF energy at 4.5MHz above the visual carrier is removed through this series-tuned connection. This isolates the aural transmitter power amplifier from the visual amplifier.

For the aural signal from B2, the series circuits (cavities) form short circuits, which, appearing at the end of a quarter-wave transmission line, cause all the aural RF to be reflected back into the right portion of the drawing. However, the right portion is a 3dB coupler. Energy into B2 is split, as the visual signal was, with a resulting 0.707V level at both ∠0° and ∠−90° phases appearing at A2 and C2, respectively. However, when each is reflected back through the coupler from the cavities, the result is again a cancellation at B2 of the 0.5V∠0° and ∠−180° components and an addition at D2, resulting in 1V∠−90° aural. The cavities again perform isolation between the two power amplifiers.

For stereo operation, the notch may be the problem. Notch cavities are high-Q circuits, and in older units may exhibit a bandwidth that cannot pass the newer wideband FM information. Until now, the Q allowed the ±25kHz deviation to pass easily. But if the Zenith/dbx system is implemented fully, with SAP and engineering channels, deviation will surely reach the ±73kHz point. G. L. Best, Harris Corporation, Quincy, IL., suggested in his presentation at NAB-'84, that the bandwidth of older systems was approximately 1MHz, but the new mode will require perhaps a 2.4MHz bandwidth to pass the signal. There is no simple adjustment to make the notch wider.

As a tuned circuit, the notch cavity already causes some phase distortion, called *group* or *envelope delay*. When a wider bandwidth signal is applied, the distortion becomes even greater. It shows in received pictures as smeared color, displaced color or ghosting.

From the manufacturers

Of several manufacturers contacted, each had a different solution to the diplexer dilemma. Comark indicated a probable retrofit service plan, in which the station multiplexes the aural signal into the visual amplifier, while the diplexer is returned for retrofit. During the multiplex operation, visual power must be reduced. That will effectively reduce signal coverage. Other manufacturers also suggest that perhaps visual impairments to the received video will occur, and so go the ratings!

Micro Communications is studying the pending problems to determine what action, if any, is needed. Di-Electric Communications, diplexer suppliers for Harris, plans to have retrofit kits available, but admit the fix cannot be accomplished in the field.

Harris, meanwhile, says that stations should attempt stereo without any diplexer change, assess the results, then act accordingly. (Will viewers, disgruntled by possible bad results, understand the dilemma?) If the diplexer is too great a problem, Harris also suggests that the retrofit concept, which adds two additional aural cavities, is a major surgery on the unit, and due to conceivable expense, may be counterproductive, i.e., a new diplexer, designed for MTS use, is preferred.

RCA, like Comark, builds their own RF plumbing. In their latest G-line transmitters, they feel that a pre-distortion compensation unit will deal with the diplexer phase distortion. On older systems, however, they are currently studying possible answers.

A caveat

The properly constructed transmission system forms an operating unit. All manufacturers warn that altering any one part may subsequently produce undesired results, the major one being SWR-producing mismatches. For the sake of efficiency, a low SWR from the least possible mismatch must be maintained. Therefore, just changing the diplexer could spell big trouble. Before you do anything else, talk *at length* with your transmitter manufacturer to get his suggestions for your particular situation.

On the Next Scan Line...

What is ICPM? It exists now and may result in incoming calls for proper maintenance.

new products

Battery products

Alexander's Tri-Analyzer checks and recharges up to three battery packs simultaneously and automatically. The Sequential Smart Charger recharges six packs, one at a time, automatically. A Triplex Smart Charger takes less than two hours to simultaneously charge three battery packs.

Circle (215) on Reply Card

Record care system

Three components from *Hunt EDA, Ltd.* form a record-cleaning product that helps reduce record damage and noise. The Mk6 brush uses carbon fiber filaments to get dirt out of grooves. A leading mode stylus brush catches dirt before the stylus grinds it in. Solvent P helps to remove record surface contaminants.

Circle (216) on Reply Card

Sony Broadcast at NAB

Joining the ½-inch format family is the Betacam multicassette system. Four playback decks allow automated programming, with up to four events without recycling, from a 40-cassette library. Random access is available through an RS-422 computer interface with keyboard entry and a video display unit.

BVP-360 represents a studio camera design centered around ⅔-inch mixed-field Saticon or Plumbicon tubes. Light enough for possible field use, the 38-pound camera provides Y/R-Y/B-Y components for up to 7500 feet of triax with a TV-24 multicore cable version available.

The BVP-150 ENG camera offers a 650-TVL resolution with a 57dB S/N ratio. Digital centering is standard among the automatic controls. Outputs include NTSC for 1- and ¾-inch recording with components for ½-inch Betacam recorders.

A developmental time-compression multiplexing system allows microwave ENG linking of component video to the studio. A prototype coder-decoder ties a Betacam format camera and recorder together.

High Definition Production uses the new electronic cinematography camera with 25mm mixed field Saticons, digital registration and image enhancement, auto setup and fiber-optic cable option. Additional products for HDVS include a 120-inch diagonal projection system; monitors with a 5:3 aspect ratio; 1-inch VTRs; digital down-converter to provide NTSC signals; digital noise reduction unit; and a production switching system for eight RGB inputs, with wipes, dissolves, chroma-keying, titling and color backgrounds.

Newsmaker, the BVW-2, is designed for ENG use in high-risk environments. The 9-pound camera, including lens, battery and cassette, is a low cost, 1-piece unit that is compatible with Betacam products. Only one audio track and no time-code provisions are available.

Sony Tape Division introduced the K-series U-Matic format cassette. The formulation improves video sensitivity, S/N ratio, headwear, print-through, dropout and still-frame characteristics.

Level-matching interface

Replacing the HH 2x2, the *Valley People* HH 2x2B balanced level-matching interface is capable of boosting −10dB signals to a nominal +4 or +8 line level output. Features include a stereo attenuator section, electronically balanced outputs and supplied external power source.

Circle (217) on Reply Card

Phono preamp

Micro-Trak introduces the ST-11 phono preamplifier with a distortion rating of 0.05% or less and noise level that is typically −72dB. A wall-mount transformer powers the system, which includes 600Ω transformerless balanced outputs, with headroom to +22dB over the 0 output level.

Circle (218) on Reply Card

Inexpensive automation

TDS and EQS series computer programmer modules from *Weisel Technologies* allow the Commodore VIC-20 and C-64 computers to control semi-automation systems with existing cart machines, reel-to-reel decks, network cue sensors and your audio console.

Circle (219) on Reply Card

Equipment cart

The *Tektronix* K117 Instrument Shuttle organizes instruments and accessories in a self-contained unit that is easily moved from one location to another. Constructed of Lexan FL1000 structural foam, the cart supports up to 120 pounds.

Circle (220) on Reply Card

Receiver/modulator

Designed for CATV and SMATV use, the *Electrohome, Ltd.* SR24 satellite receiver and SM36 modulator offer in-house distribution possibilities with SAW filter technology in both units to improve adjacent channel interference.

Circle (221) on Reply Card

Aviation headset

Airman 750 from *Telex* uses foam-padded headphone receivers that rest on the ear with a noise-cancelling electret microphone on a boom to stay clear of peripheral vision. Total weight is 4 ounces with cord and plugs.

Circle (222) on Reply Card

Analog/digital multimeters

Series 70 meters by *Fluke* provide a numerical digital display of the measurement along with a 3200-count LCD bargraph analog display, all in a hand-held package with overload protection and high-density plastic case.

Circle (223) on Reply Card

Hybrid modules

The AFH-2000 hybrid circuit module from *Advanced Fiberoptics* includes both transmitter and receiver systems that allow up to 10km lengths of 100μm core fibers.

Circle (224) on Reply Card

ENG mixer

Three 9V batteries or a 12Vdc source powers the MX-1001 portable audio mixer from *Comprehensive Video Supply*. Three inputs may be switched for line or mic level with phantom powering to 54Vdc. A 1kHz tone, LED peak indicator and VU meter are included.

Circle (225) on Reply Card

people

Ralph E. Nichols has been named vice president, engineering, at ADDA Corporation, Los Gatos, CA, manufacturer and marketer of digital TV equipment. He was formerly vice president, engineering, at Actrix Computer Corporation, San Jose, CA.

W. Tom Beams has been named to the new position of vice president and chief operating officer at Aurora Systems, San Francisco. Beams was formerly with Ampex. Since 1980, Beams held the position of general manager, Ampex Disk Products Division.

Paul McGoldrick has been appointed manager, systems engineering, at Moseley Associates, Goleta, CA. McGoldrick has a strong background in field systems and project management with such companies as Harris and EMI.

Alan Bridge has been named national sales manager, and **Sheila Holmes-Ross** has been appointed as manager, video sales, both at Aurora's San Francisco headquarters.

Norman Leong and **Warren Lamm,** graphic designers at station KRON-TV, San Francisco, received Emmy Awards for their work on the Aurora/100 videographics system at the Northern California Emmy Awards ceremony March 31, 1984, in San Francisco. Leong won in the category of *Outstanding Individual Achievement: Animation,* while Lamm won an Emmy for his achievement in *New Graphics.*

AM stereo

Continued from page 4

cated that they were currently operating in stereo, or had ordered stereo transmission equipment. That leaves 88% of the stations in the United States still broadcasting in mono.

The top three reasons cited in the NRBA survey by station managers and engineers for not converting to stereo operation are as follows:

- "There is no perceived audience interest in AM stereo."
- "We cannot make the investment required to convert to stereo operation."
- "We are holding off broadcasting in stereo because of the marketplace confusion that exists at the present time."

The NRBA survey results are based upon a questionnaire mailed in mid-April to every AM radio station in the United States. By the cutoff date, 26% of the stations had responded to the survey.

Kahn questions surveys

Leonard Kahn, president of Kahn Communications, has questioned the usefulness of recent industry surveys of AM stereo system usage. He said that merely comparing the total numbers of stations using particular AM stereo systems (Harris, Kahn, Magnavox or Motorola) is unfair because it does not take into account the audience being served by each system.

Kahn said, "It is ridiculous to compare (small market) 1kW stations to major market stations." He added that the Kahn system, "has the largest number of major market AM stereo stations in the United States, and our stations have almost twice the total listenership of any of the stereo systems."

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C-QUAM is a registered trademark of Motorola, Inc

RCS-1V

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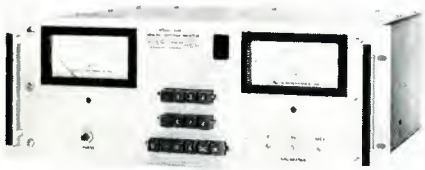

DAM-1/AAM-1

The Digital and Analog Antenna Monitors measure the parameters of directional antenna systems. Readings are: relative current; and current ratio and current phase to a reference antenna. The DAM-1 accepts samples from 12 towers with a ± 1° phase and ± 2% current accuracies displayed on digital readouts. The AAM-1 can monitor up to 8 antennas with ratio and phase measurements displayed on front panel meters.

AMC-1/FMC-1

The only modulation control systems which provide a completely closed loop around the transmitter. The Amplitude and Digital Modulation Controllers sample actual modulation levels after the PA output network assures precise adjustment for optimum modulation levels. Both the AMC-1 and FMC-1 keep count of overmodulation bursts for signal control through a linear attenuator.

RG-3/RG-4

High output/super sensitive Receiver/Generator. The Receiver/ Generators combine a two-watt RF output and a correlation detector circuit that virtually eliminates interference problems. The RG-3 operates in the 500 kHz to 1.65 MHz frequency range while the RG-4 operates in the 100 kHz to 30 MHz range. Both can be used with the OIB series bridges for accurate null detector readings.

APC-1

Your insurance against over- and under-power operation. The Automatic Power Controller continuously monitors the transmitter output power, making automatic power adjustments via the transmitter loading control. The APC assures proper power levels at all times.

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6730E/6740B

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TCA/TCT

Simplifies antenna current and phase sampling. TCA Ammeter Systems provide accurate, modulation-free current readings on a variety of meter types. Torodial Current Transformers provide current and phase samples, and are available with three output voltage ranges, as well as high voltage models.

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HELP WANTED (CONT.)

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AGGRESSIVE BROADCASTING FIRM is accepting resumes and applications for Chief Engineers. We are a rapidly expanding corporation and need talented, aggressive, "hands on" engineers who understand and can maintain state-of-the-art computerized equipment. Salary commensurate with experience. Good benefits, etc., send resumes to Dept. 612, Broadcast Engineering, P.O. Box 12901, Overland Park, KS 66212. 7-84-3t

MAINTENANCE ENGINEER for established and expanding N.Y. production and post-production facility. Must have at least 2 yrs. experience maintaining 1" and ¾" VTRs, Grass Valley Switchers, CMX and BVE 5000 editing systems and Ikegami cameras. Knowledge in digital technology and video systems in general a plus. Excellent benefits. Salary commensurate with experience. Send resume to: International Production Center, 514 W. 57 Street, NYC, 10019. Attn.: Henry Bornstein. 8-84-1t

SERVICE MANAGER: Leading Florida video communications company is looking for an exceptional individual to fill this key position. This is a rare opportunity to build a first class service department from the ground up. Responsibilities include systems installation, bench work and service department management. Must be experienced in maintenance of ½", ¾", 1", 3-tube cameras and digital equipment. Knowledge of systems timing, theory and troubleshooting is a must. Excellent salary plus company benefits in a beautiful Florida location. Please send resume to: Dept. 615, Broadcast Engineering, P.O. Box 12901, Overland Park, KS 66212. 8-84-2t

OEM & NETWORK SALES MANAGER. We are a leading manufacturer of electro-optical tubes and devices for broadcast, network, industrial and military markets. We now have a position available for a sales manager to take over the OEM and network account responsibility. You will be selling advanced state-of-the-art pick up tubes and charged coupled devices and cameras for industrial applications across the USA. The ideal candidate should have a minimum of 4 years of college education in electrical or electronic engineering or a physics degree. Experience in selling to the broadcast industry would be an advantage. Experience if closely related may be substituted for the educational requirements. We offer an excellent salary, comprehensive benefits, company car, bonus scheme, and an opportunity to excel with a company enjoying a rapid growth. Relocation assistance would be provided for the right candidate. The position is based in our Elmsford, New York office. Please send resume with salary history to P.O. Box 482, Elmsford, NY 10523. An Equal Opportunity Employer M/F. 8-84-1t

STUDIO MAINTENANCE TECHNICIAN: Top ABC affiliate is seeking an experienced technician to maintain studio and E.N.G. equipment. If interested send resume and salary requirements to Manager of Engineering WTVN-TV, 1261 Dublin Rd., Columbus, OH 43216. 8-84-1t

CHIEF BROADCASTING ENGINEER: Northern Illinois University has an immediate opening for a Chief Broadcasting Engineer to design, install, and repair state-of-the-art color television studio and field equipment. Candidate must be able to trouble shoot both analogue and digital communications equipment. Minimum requirements are a BSEE or related degree. Successful candidate should have a minimum of three years experience in television operations, installation and maintenance. Excellent benefits. Position available immediately. Send resume including salary requirement by August 20, 1984, to Northern Illinois University, Personnel Office, DeKalb, IL 60115-2878. AN EQUAL OPPORTUNITY/AFFIRMATIVE ACTION EMPLOYER. 8-84-1t

TV ENGINEERS (2): Responsible for the operation and maintenance of state-of-the-art, broadcast quality equipment in new Telecommunications Center. Salary competitive, excellent fringe benefits. For complete job description and application send resume to: Marshall E. Allen, Head, Educational Television Services, Oklahoma State University, Telecommunications Center, Stillwater, OK 74078. Deadline August 31, 1984. An Affirmative Action/Equal Opportunity Employer. 8-84-1t

VIDEOCASSETTE DUPLICATOR/TECHNICIAN. Experienced duplicator for growing cassette duplication facility. Experience operating VCR's all formats, TBC, 1" and related equipment. Equipment maintenance a plus. Send resume and salary to Multivision, 161 Highland Ave., Needham, Massachusetts 02194. 8-84-1t

BROADCAST SYSTEMS ENGINEER: North San Diego County (California) broadcast equipment manufacturer looking for engineers to manage large-market custom studio projects. Applicants must have broadcast engineering experience with studio wiring and design achievements, and must work well with people. Some travel required. Salary dependent on experience. Send resume to: PACIFIC RECORDERS & ENGINEERING CORP., 2070 Las Palmas Drive, Carlsbad, CA 92008, Attn.: Gary Stigall. 8-84-1t

GENERAL MANAGER, SALES/SERVICE OFFICE—MIAMI. Major European, TV equipment manufacturer is opening U.S. office in Miami. Experience in management and direct sales essential. Send resume, in confidence, to: Delmark Corporation, 502 E. Buffalo Ave., Santa Ana, CA 92706. No telephone calls, please. 8-84-1t

DISTRIBUTOR SALES MANAGER, SALES/SERVICE OFFICE—MIAMI. Major European TV equipment manufacturer opening U.S. office. Experience in distributor sales in the broadcast industry essential. Send resume, in confidence, to: Delmark Corporation, 502 E. Buffalo Ave., Santa Ana, CA 92706. No telephone calls, please. 8-84-1t

AUDIO VIDEO SYSTEMS AND SALES COMPANY looking for national Sales Marketing Manager. Must have 10 years experience in sales and marketing for professional and industrial audio-video equipment in Southern California. Send resume to: Dept. 618, Broadcast Engineering Advertising Department, P.O. Box 12901, Overland Park, KS 66212. 8-84-1t

TV MAINTENANCE ENGINEER. Repair and maintain color broadcast equipment. Experience plus FCC general class license required. Apply at WXXI, 280 State St., Rochester, NY 14614. (716) 325-7500. 8-84-1t

One of the nation's leading AOR's in Oklahoma City is looking for an aggressive, innovative Chief Engineer to work with topnotch equipment. Applicants should have 2 years college or technical training, 1 year practical experience and general license. Excellent benefits package including educational assistance. Send resume and salary requirements to DuWayne Pongratz, Director of Engineering, Surrey Broadcasting Co., 3438 N. Country Club, Tucson, AZ 85716. An Equal Opportunity Employer.

ASSISTANT EXECUTIVE DIRECTOR FOR ENGINEERING AND OPERATIONS. Fifteen years' experience in broadcast engineering; or, ten years' experience in broadcast engineering and bachelor's degree in Electrical Engineering. Experience must include five years in a supervisory position. First Class or General Class FCC license is required. Send resume to Dept. 610, Broadcast Engineering, P.O. Box 12901, Overland Park, KS 66212. 8-84-1t

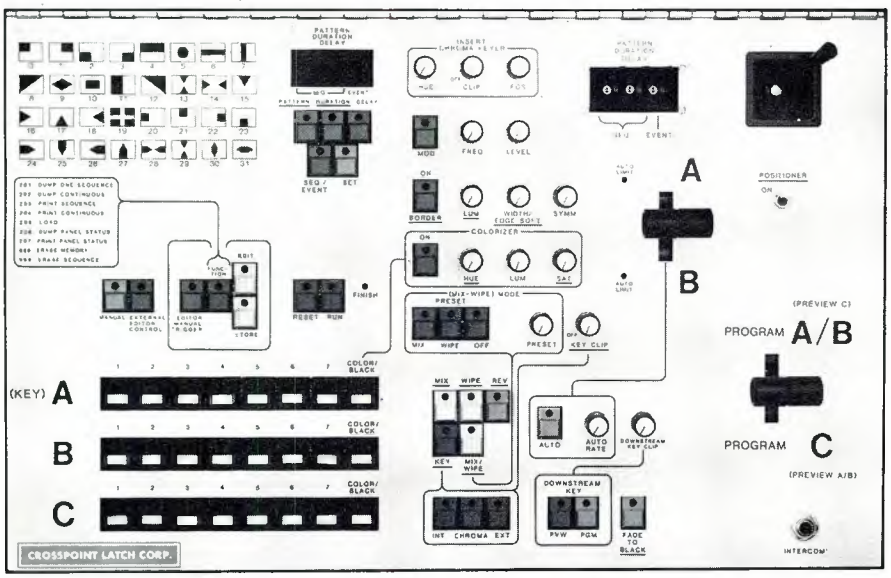
AUDIO TECHNICIAN—Subsidiary of major European audio manufacturer seeks technician for expanding Technical Department. Position at Nashville headquarters facility requires QC and repair of professional tape recorders, mixing consoles, and associated equipment. Excellent benefits. Salary based on experience. Please send resume to: Studer Technical Dept., Studer Revox America, 1425 Elm Hill Pike, Nashville, TN 37210. 8-84-1t

FIELD SERVICE TECHNICIAN—Major audio equipment manufacturer seeks experienced service technician for expanding operations at New York City field office. Position involves installation and field servicing of professional audio recorders and associated equipment. Excellent benefits. Salary based on experience. Please send resume to: Studer Technical Dept., Studer Revox America, 1425 Elm Hill Pike, Nashville, TN 37210. 8-84-1t

THE 6109 IS NOT SMART

It will do exactly what you ask — neither more nor less. It gets full marks for obedience and power, none for intelligence.

Consider the basic switcher. It has **32 patterns, bordered** wipes, pattern modulator, a good built in **RGB chroma keyer,** a **downstream keyer** with edge, **mix-wipe,** internal and external key, **fade to black,** automatic preview and a unique **test mode** which removes all guesswork from system timing. The switcher can perform a mix to a masked key. Each knob or switch on the switcher is dedicated to only one function. When you operate a knob or a switch you always know exactly what you are doing. You never have to wonder what it happens to be delegated to. You cannot accidentally change the color of the downstream keyer, when you think you are adjusting the border. The positioner operates as a true positioner, not a rate controlled device — the pattern does not keep moving after the positioner stops.



Two simple options are available. The **second chroma keyer** may be either RGB or encoded, with a front panel adjustable delay line. This second keyer allows a wipe or mix behind the chroma key, and a mix over the chroma key. **It is also possible to chroma key over a chroma key.** The other option is genlock with an **INTERNAL SYNC GENERATOR.** This genlock unit has two levels of **AUTOMATIC CHANGE-OVER,** in case of signal failure. If the genlock input fails, the 6109 automatically switches to External Drives; and if those fail it automatically switches to its internal SYNC GENERATOR. **If you need intelligence, read on.**

INTELLIGENCE WITH THE MICROPROCESSOR OPTION

The 7209 is **VERY INTELLIGENT,** and that is putting it mildly. It thinks ahead of you. **IT IS A PLUG COMPATIBLE OPTION FOR THE 6109.** If your next move is obvious, it performs it for you, and lets you know it has done so. If you forget to enter something, it flashes the appropriate lamp. If you ask it to do something, it automatically goes into the correct mode and executes it. The ability to make selected changes to stored data is very important. The 7209 has an **EDIT** mode which allows you to **RECALL** a stored event, and then make small changes (or large ones for that matter) simply and rapidly. It even gives you a second chance. It is possible to discard the change and return to the original configuration. **TRY THIS WITH ANY OTHER MAKE OF SWITCHER.**

POWERFUL EDITOR CONTROL

THE 7209 INTERFACES WITH MOST EDITORS, with several levels of interaction, allowing the user to store either all, or only the essential functions on the editor's edit list, while at the same time leaving other functions under switcher control. It lets the editor do what it is best at, and allows the switcher to do what the editor cannot. It gives the editor full control, partial control or no control, depending on your particular requirement for that edit. You drive the 7209 — it does not drive you.

The basic 7209 has a four event sequence. Since the computer controls everything on the switcher, it is possible to create sequences that are impossible to reproduce manually. For instance, while a pattern is moving across the screen, it is possible to change to color, width, size and symmetry of the border simultaneously, at the same time converting an unmodulated wipe to a modulated one. The 7209 is not just a "gimmick". It is designed to perform useful functions. In spite of its versatility, it is extremely easy to use, and prevents you from making mistakes. You cannot accidentally change a delay time, while you think you are loading a duration.

Several software options are available, such as a printer driver, 99 sequence storage etc.

Call or write for details, and for our very informative booklet on POST PRODUCTION.

6109 $5,950. 7209 $3,000.

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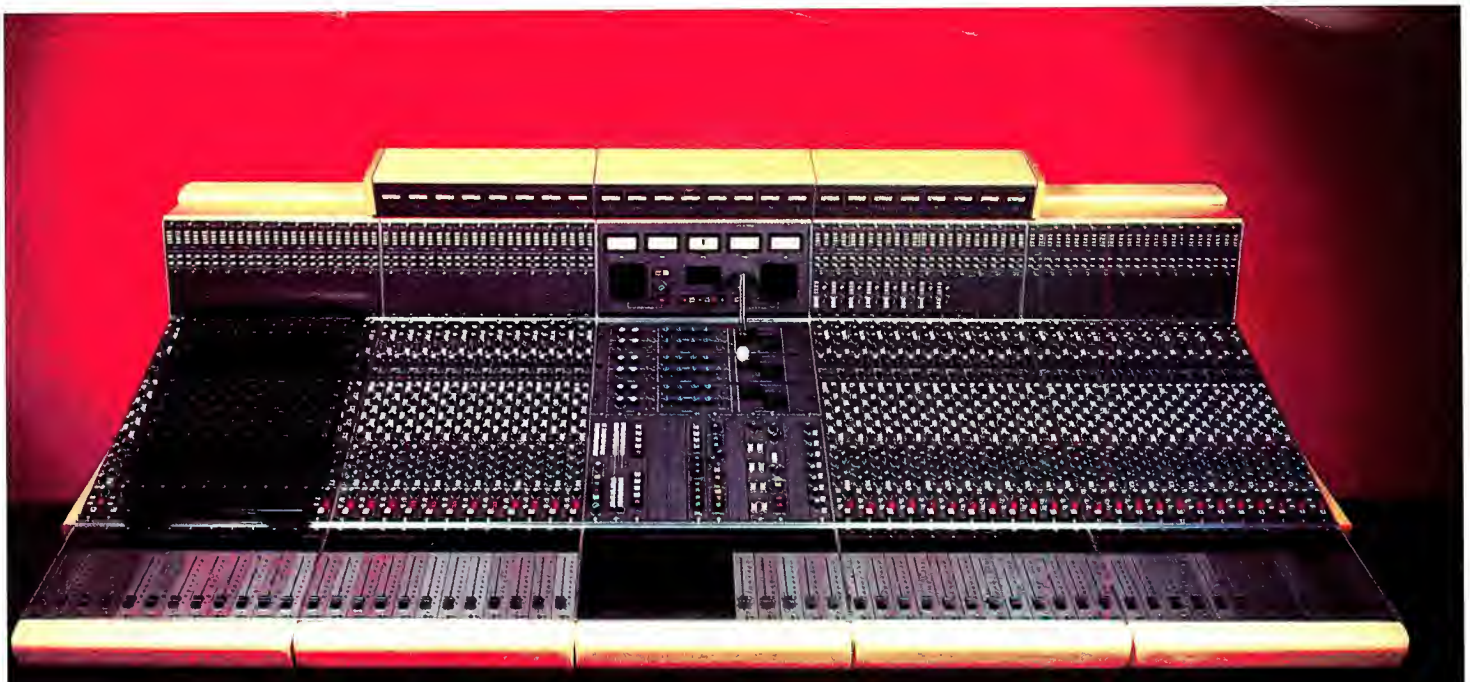

To create the finest television audio mixing console, you have to do a lot of listening.

Neve's 51-series for television production.

To create great audio it's important to listen to and satisfy the needs of your marketplace. We know all about great audio. Neve has pioneered almost every major innovation in audio mixing from computer-assisted Necam systems to Digital (DSP) Systems. And we're very proud of that distinction.

That's why when we created a system designed to meet the growing needs of video post-production, we listened very carefully.

The result is that now video production facilities can enjoy the same superior audio quality that recording and film studios throughout the world have enjoyed, plus special features designed just for television production.

Human Engineered: First and foremost, from the size of the knobs and layout, to the straight-forward signal flow and powerful sub-grouping, the Neve 51-series is always easy to use, yet gives you all the features you want and need.

Four Band Equalizer and Filters: Our formant spectrum equalizer is renowned as the most musical sounding in the industry. No one else has the "Neve sound." Plus effective, high pass and low pass filters remove noises often encountered in live television production.

Dynamics Unit: Each input module contains a highly-regarded limiter/compressor and noise gate, perfect for processing those difficult tracks in post production or for use in live recording, from dramatic shows to musicals and sports.

Multitrack Capability: The 51-series separately controlled direct outputs, pre- or post-EQ, make simultaneous multitrack and live recording a snap.

Because Neve listened, the 51-series is what the television industry wants to hear.

For further information, call Neve's Television Production Sales Department at (203) 744-6230 or write:

51
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