February, 1974/75 cents

BROADCAST ENGINEERING®

the technical journal of the broadcast-communications industry

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ECONOMICS– THE KEY TO THE FUTURE OF TELEVISION BROADCASTING

A pre-NAB Message to the Broadcast Industry From Michael A. Moscarello, President and Chief Executive Officer International Video Corporation

The opening of the NAB exhibit halls in Houston on March 17 will signal more than just a change in the approach to the annual convention.

It will also represent the beginning of a new era in the way broadcasters think and in their buying habits.

This new approach is not unrelated to changing times and developments in our economy during the past year. Competitive forces now have made price *plus* the performance of a product a greater consideration than performance regardless of price.

Further, with power and petroleum by-product shortages facing us, conservation takes its place along side price and performance as among the major factors a broadcaster examines before purchasing new equipment.

Certainly while not anticipating these problems in our economy we at IVC have been working on product developments that capitalize on new and unique approaches to broadcast television recording and that incorporate great operating cost savings for the user.

Our two major new offerings at NAB will be the IVC-9000 Broadcast Videotape Recorder and the IVC-7000 Studio Camera, both of which combine operating economies and low initial investment with dramatic new performance breakthroughs.

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IVC-7000 IVC-500A cameras have been the most widely used medium-priced cameras in the broadcast world. Over 200 have been placed in commercial broadcast stations alone in the past two years. At NAB we'll unveil a dramatically new studio camera, the IVC-7000, that will eclipse the performance of models offered by manufacturers of cameras in the $60,000 to $80,000 range—but at substantially lower cost. You'll be looking at unprecedented line resolution in both centers and corners. Signal-to-noise will be the highest in the industry. We'll have automatic color balancing as well as bias lighting. Before you add any more cameras to your studios, take a look at what we've come up with.

We submit that it is not necessary to be a billion or even a hundred million dollar company to be innovative in serving the broadcast industry with its two most vital ingredients — recorders and cameras. We're sure we can do it better.

We have something and we want you to see it. We've reserved more exhibit space at NAB than anyone else, with one exception. We don't want you to miss us.

Economics will tell the story of the future of television broadcasting. And we think we have the key.

M. A. Moscarello

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February, 1974 • Volume 16, No. 2

BROADCAST engineering

The technical journal of the broadcast-communications industry ®

in this issue...

About the Cover

The cover this month was taken at KQED, San Francisco. It's all part of the Jupiter 10 story on remotes from deep space. Photo courtesy of KQED and Joe Roizen.

Departments

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Robert E. Hertel, Publisher

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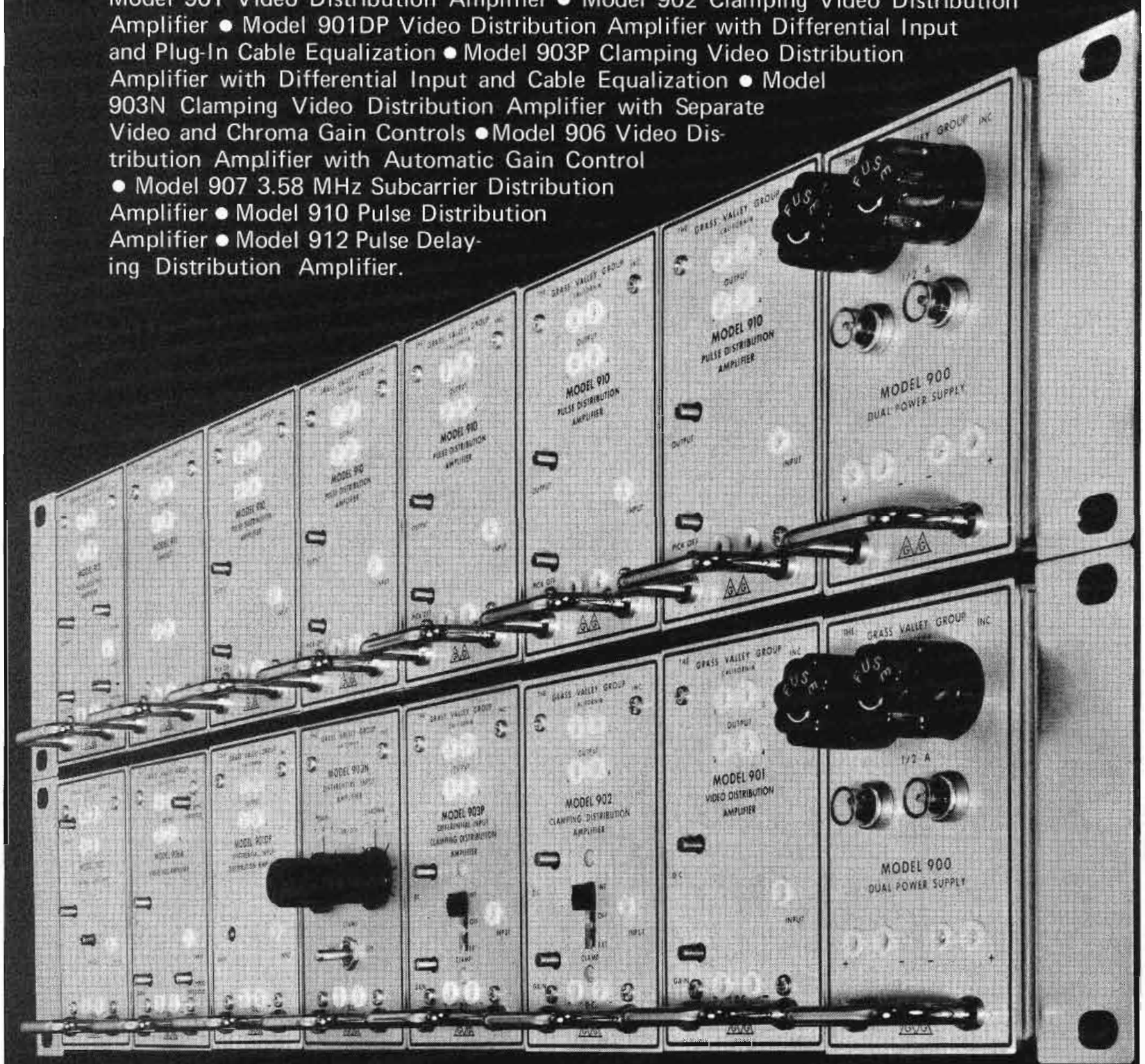

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Station to Station

Screeching Tape Not So Unusual

Station-To-Station is really an exchange column. It will include letters to the editor, requests for information, and operation and maintenance tips. We do pay for the operation and maintenance tips, but this is not a contest. After all, the real competition is in the marketplace, not in a magazine.

For 1974 - as with everything else - our payment rates will increase. All items used will be paid for at a rate somewhere between $15 and $50.

Last month we ran a number of "tips" items. And we'd do the same this month, but we received a number of letters replying to a problem mentioned in the November issue: screeching tape. There seem to be several approaches to the problem, so we're going to show a cross section of what we've gotten so far. Meanwhile, keep those maintenance and operations tips coming in. If you have a nagging problem, drop us a line and we'll let it be answered **Station-To-Station.**

Dear Editor:

I could have written the letter about screeching tape. My situation is almost the same as John Carlini's.

We have sent two reels to the lab of a well known tape manufacturer and as soon as they find it (they lost it!) maybe we will know if it was defective or what. It does seem strange that we have been running some of the same manufacturers tape side by side with that which screeches with no problem.

Our situation also came to light when we automated our FM station. And you don't just dump 10½ inch reels of tape with carefully recorded music on it in the wastebasket and forget it.

John says that his tape screeched after 20 months of service. Ours didn't take that long, maybe three to six months, but it could depend on number of times played more than age.

As a stop-gap measure we rigged up a piece of wire with a wad of cotton on it and let the cotton drag on the tape. When the screeching started we slightly dampened the cotton with water. I guess it's not good for the tape recorder but it stops the screech.

I would like to know the name and number of the tape John has found that will run without the screech.

Incidentally, when the screech gets intolerable for automation, we cut it in half and use it on 7 inch reel and use it OK in our AM operation.

Henry Hoffman, CE
WAVU-WQSB
P.O. Box 190
Albertville, Ala. 35950

Let's Keep It Clean

In regard to John Carlini's screeching tape problem, I am inclined to say accumulation of grit and grime on the pressure pad causing it to harden and become glazed over is causing the "screeching" sound.

Try replacing the pressure pad. I have, in an emergency, used a pocket knife blade to scrape the glazed portion off the pad. Five to one, this will eliminate the screeching.

Don't blame the tape, any brand—old or new.

Alvin Byars, CE
Cumberland Valley Stations
McMinnville, Tenn. 37110

Regarding John Carlini's letter on tape screech in the November issue:

We used to get this in a station I was at where we taped our talk shows for reference. I found that the slow speed, plus constant use of the same tapes, would encourage the noise. The remedy in that case was a thorough cleaning of the machine: tape guides, heads, capstan, pressure pads, etc. On higher speeds, there would be no problem.

My "home" recorder used to yell a lot, and I found the problem there was caused by vibration from tape movement over the heads which was being transferred to the pressure pad arms. I would either put graphite on the pads (rubbing them with a pencil), or change the spring pressure on the arms.

My thinking on tape recorders is: you can't clean them enough. Every day go over them, unless the tapes are really bad and you use the machines a lot...then clean them twice a day. This will probably not happen unless you work for a real cheap AM outfit where anything ¼" wide with oxide is considered suitable for air.

Thomas F. Carten
King's College
Box 1611
Wilkes-Barre, Pa.

The Finger Test

John Carlini is the first to mention the tape screech problem that I know of.

We at KFAX have been on a tape format for many years and have not had a problem until recently.

The test for this problem is simple. Pull the tape through your fingers and it will screech as it will do through the heads if it is the offending brand.

Programs that KFAX has had on the air for years are now coming through with "screech tape." We feel it is new tape at this writing, from an unknown source.

Some of the readers may be able to shed some light on this problem by finding which vendors are selling this tape and under what labels.

Paul White
ACE KFAX
1470 Pine St.
San Francisco, Cal.

Bearing Problems

In reference to the screeching tape problem in the November issue, I might have a solution. I had noticed the same problem, mainly an audible squeal causing

(Continued on page 51)

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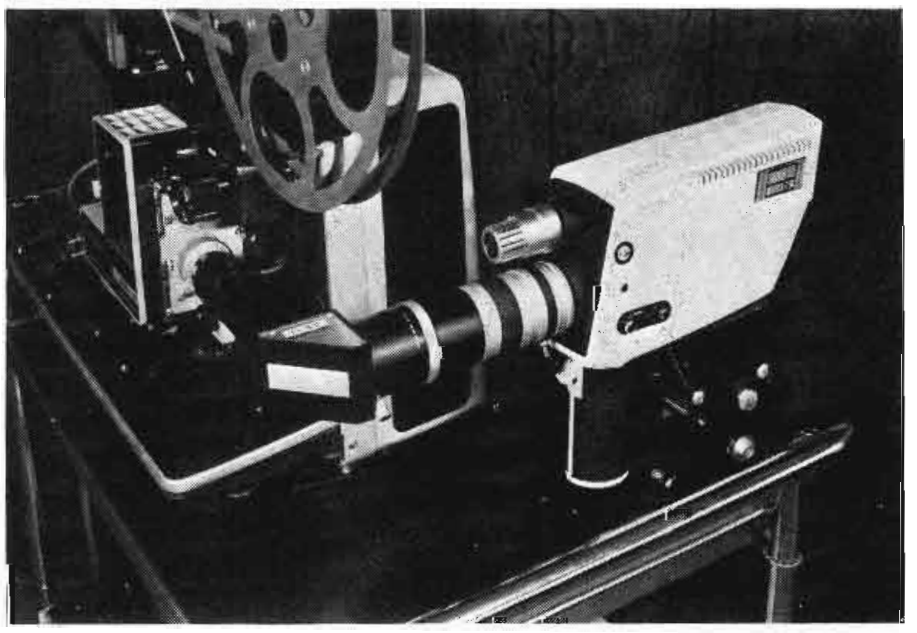

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DIRECT CURRENT FROM D. C.

February, 1974

by Howard T. Head

Commission Proposes Extension Meters

The Commission has proposed to permit the use of extension meters in circumstances where the operating position is separated from the station transmitter. This mode of operation would provide particular relief in those instances where the transmitter is not visible from the operating position.

Various restrictions on the use of extension meters are proposed. The transmitter and operating position must be in the same building, separated by no more than one floor or more than 100 feet; the extension meters must be readily observable from the operating position; and modulation and antenna monitors must be installed at the same location as the extension meters. Weekly calibrations are to be required with results entered in the maintenance log.

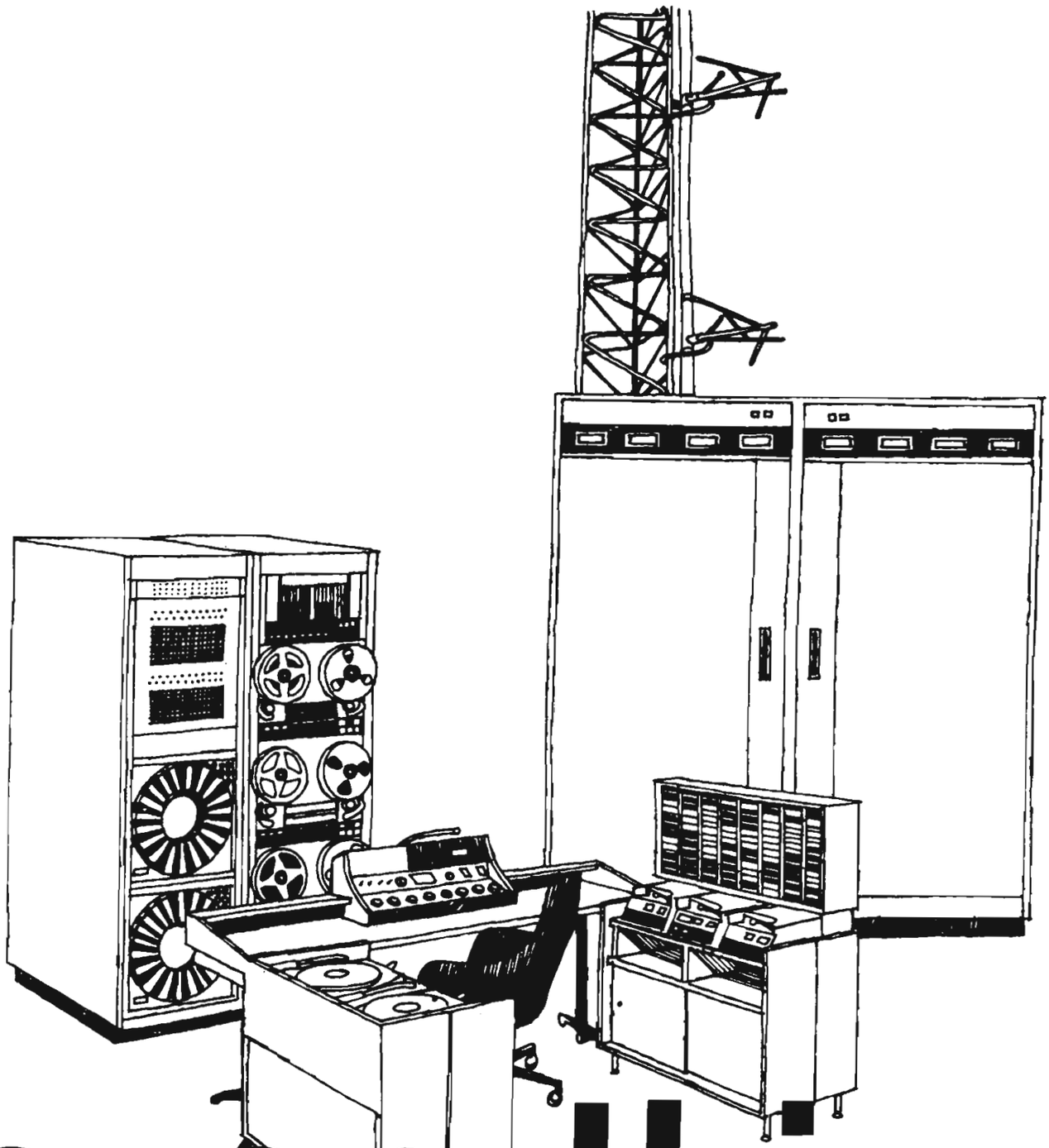
The new proposal would provide an end to many awkward situations where windows, mirrors, and closed-circuit television cameras have been installed to comply with the present regulations. In many instances, remote control authorizations would no longer be necessary.

Vertical Interval Reference (VIR) Signal Proposed for Adoption

In response to a petition by the Electronic Industries Association (EIA), the Commission has proposed new Rules permitting the insertion of a vertical interval reference (VIR) signal in the television waveform. This signal, which is described in detail in January, 1971 Broadcast Engineering, would provide a reliable reference for monitoring the luminance, chrominance, and levels of color video signals.

The initial studies and field tests of the VIR signal were made with the signal occupying line 20 of the picture. It is now proposed, however, to insert the VIR signal on line 19 of both fields. This would require that the VIT signal presently inserted by television stations operating transmitters by remote control be moved from the present lines 18 and 19 to lines 17 and 18. According to the EIA petition, these changes can be readily accomplished. In order for the VIR signal to be effective, it must be treated by processing and other amplifiers as part of the picture rather than the vertical interval.

Although the VIR signal is intended primarily as a transmission tool, it also has possibilities as a reference for automatic color correction circuits in color television receivers. Many present receiver designs rely on the phase and amplitude of the color burst, which is far from satisfactory in many cases.



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(Continued from page 6)

Changes in FM Translator Rules Proposed

In two separate actions, the Commission has proposed changes in the Rules governing FM translators. Responding to a petition by the National Association of Broadcasters (NAB), the Commission has proposed to restrict FM translators to the area within the 1 mv/m contour of the primary FM broadcast station. The Commission has also requested views as to whether the proposed Rules should be confined to FM station or whether it should be expanded to include all aural broadcast services. Also the question is the issue of whether non-commercial FM translators should receive special treatment.

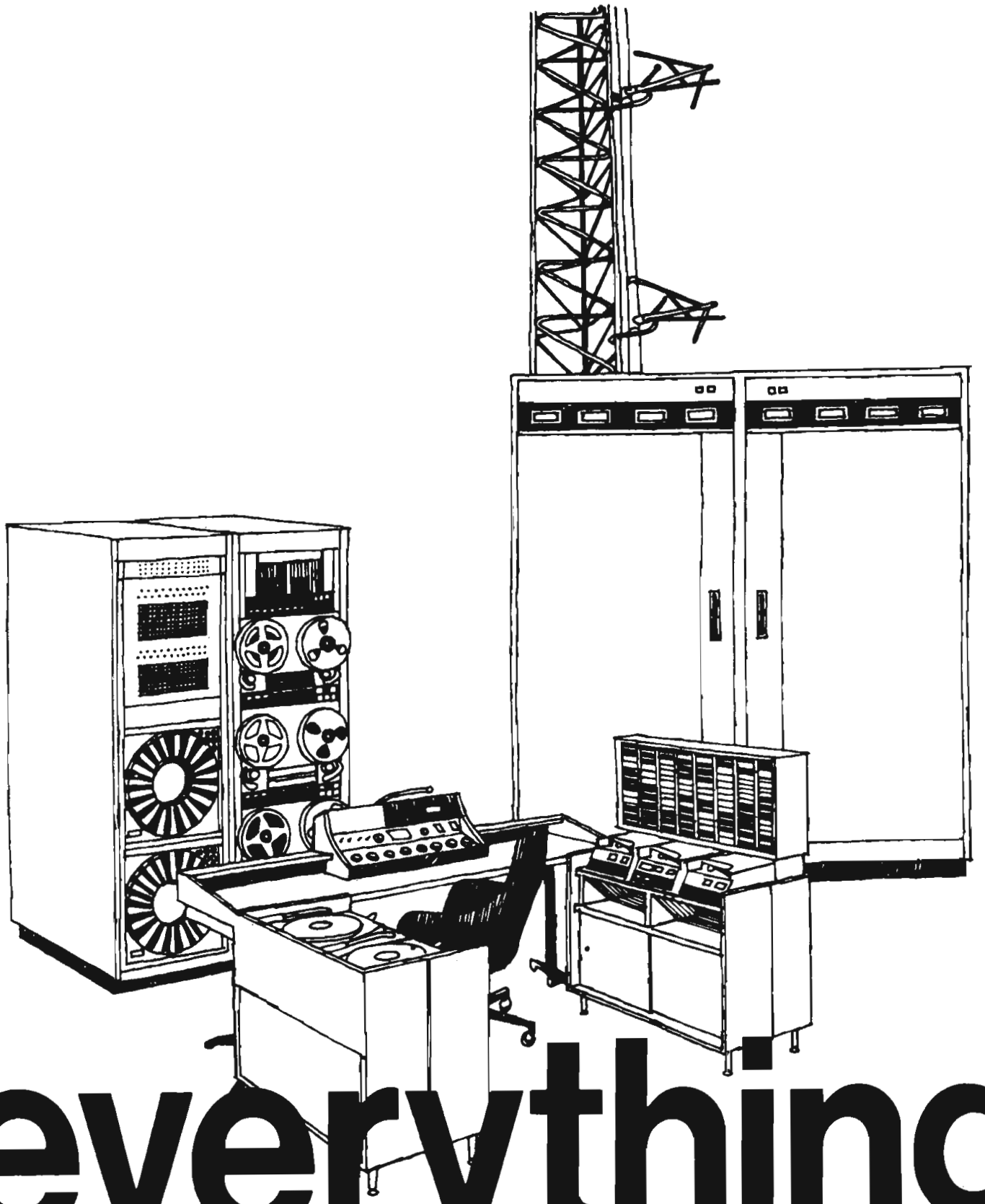
On the technical side, the Commission has proposed to correct an oversight in the technical rules governing FM translator and booster stations by permitting the use of both horizontal and vertical polarization. The present rules permit the use of either plane of polarization, but not both simultaneously.

FCC Rules Now Require Public Inspection of Television Program Logs

The Commission has adopted new rules requiring that the program logs of television broadcast stations be made available for public inspection and reproduction. Persons wishing to inspect the logs must identify themselves, indicate the purpose of the inspection and make an appointment with the station for the purpose. Where good cause exists, the television licensee may refuse to permit inspection of the logs. The new rules become effective March 1, 1974.

Short Circuits

A West Coast FM antenna manufacturer has proposed extensive changes in the Commission's rules governing FM transmitting antennas. Among other things, any antenna having less than ±4 dB circularity would be classified as a directional antenna....The Commission is placing increasing emphasis on minority hiring by broadcast stations, with particular attention to discriminatory patterns in the hiring of women. Federal inspectors from the Equal Employment Opportunity Office (EEO) are scrutinizing broadcast renewal applications....The Commission has declined to grant the application of a daytime-only AM station for fulltime operation on the claimed grounds of proposed 24-hour-a-day operation.... The Canadian Radio-Television Commission (CRTC) has imposed restrictions on the carriage of feature movies by Canadian cable television systems....The Commission has authorized the use of cable television relay frequencies on a secondary basis to transmit locally-originated program material to television translators.... I don't know art, but I know what I like: The Commission has informed a Florida College art professor that the Fairness Doctrine would not require that she be given an opportunity to express the view that abstract expressionism is the "first genuinely native style" in American art.



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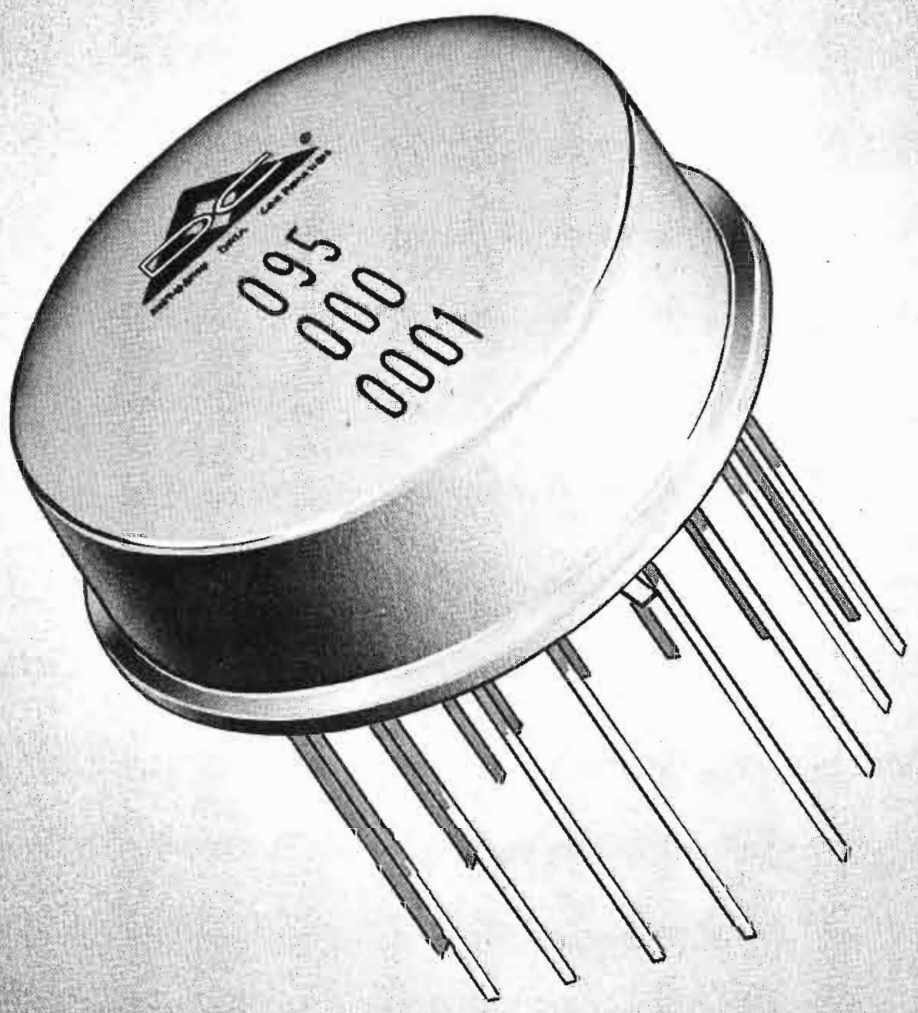

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INDUSTRY NEWS

Contacting UFO's Is No Laughing Matter

Some months ago Baltimore radio station WAYE attempted a unique and bold experiment that certainly must be a first for this industry. The idea was to attempt to contact aliens from outer space.

The station used its transmitter and antenna facilities, along with telepathic signals from their audience to hail down (or call up) visitors from outer space in the Baltimore/Washington corridor.

WAYE used the international Morse code to send their message: "We are members of the planet Earth. If you hear us, please answer." After each message, the station would remain silent for a brief period, waiting for an answer. This sending and waiting lasted for four or five days.

"The numerous sightings of unidentified flying objects throughout the nation caused us to make the attempt to contact alien spacemen, if they exist," the program manager explained.

He also remarked that when the governor of the state of Ohio reports sighting a flying object, it is no longer a laughing matter and some credence must be given to the possibility of our being visited by space ships from other planets.

No word was given as to what frequencies were monitored. Hopefully it was something other than the broadcast band.

In a follow-up report exclusive to this magazine, we were told that the only aliens who answered the WAYE coded message aimed at UFO's were more along the line of spaced-out than outer space.

The report said, "Ham radio nuts across the country went crazy deciphering the Morse code.

"We received numerous calls from ham radio operators across the country who picked up our message," said Frank Adair, program manager. "Some said they were from the 'Planet Marijuana'; some pointed out errors in the Morse code; some just called to say hello. None called from outer space.

"Of course we're disappointed," Adair admitted, "but just because no one answered doesn't mean no one is there...maybe next year they'll be ready to talk.

Epperson Wins NAB Engineering Award

Joseph B. Epperson, engineering vice president for the Scripps-Howard Broadcasting Co., has been named recipient of the 1974 Engineering Award of the National Association of Broadcasters.

The award will be presented during a luncheon at the annual Broadcast Engineering Conference being held in Houston, Tex., March 17-20 as part of NAB's 52nd annual convention. Epperson's selection was announced by the Engineering Conference Committee.

Epperson, a veteran of 46 years in broadcasting, is the inventor of the "Signal Range Calculator," an easy-to-use slide-rule which quickly shows the "Grade A," "Grade B" and "Principal City" coverage of a UHF or VHF television station as well as the field strength of its transmitter.

He's also the author of many technical publications and during World War II served as a radar consultant to the Pentagon.

Epperson has served as the top engineering officer for Scripps-Howard since 1956. The company, based in Cleveland, O., operates six radio and television stations in four states—WEWS (TV), Cleveland, and WCPO (TV), Cincinnati; WPTV, Palm Beach, Fla., KTEW (TV), Tulsa, Okla., and WMC-FM-TV, Memphis, and WNOX, Knoxville, Tenn.

He got his start in broadcasting in 1927 as an engineer at WNOX while studying for his degree at the

University of Tennessee. He was named WNOX's chief engineer in 1931 and seven years later became chief engineer for Scripps-Howard Radio.

Rejoining Scripps-Howard after World War II, he supervised the technical construction of WEWS, the first commercial TV station in Ohio.

Epperson is a member of the National Society of Professional Engineers and a fellow of the American Institute of Electrical Engineers. He's a past chairman of NAB's Broadcast Conference Committee and also has served as a member of its Engineering Advisory Committee.

SMPTE Meet Set For April 21-26

The dates for SMPTE's 115th Conference have been changed to April 21-26, it was announced by SMPTE Conference Vice-President Harry Teitelbaum.

The Conference will be held at the Century Plaza Hotel in Los Angeles, and will feature a full week of technical sessions on motion-picture and television technology. In addition, a 92-booth equipment exhibit is planned.

Extension Meters Taken In By Re-regulation

Re-regulation has finally come 'round to a long needed review of the Part 73 rule on reading transmitter meters, and how they can be viewed and read. This should be of special interest to small-market broadcasters.

Extension meters are meters connected by wire to a transmitter, which is close to the operator in his normal operating area. They permit monitoring of critical transmitter parameters from that position. The proposed rules would require instruments to be readily accessible and located close enough to the operator when at his normal operating location that deviations can

(*Continued on page 12*)

(Continued from page 11)

be observed from that location.

Comments filed in the continuing Task Force study on re-regulation of broadcasting contend that extension metering would be of great benefit, especially to the small-market broadcaster. The Commission has already modified a number of the rules including those concerning visibility of transmitters (FCC 72-1178, December 20, 1972).

The Commission said that the need for extension metering is most obvious where the transmitter and the normal operating location (such as a main studio) are close but are so separated that the transmitter cannot be seen from the normal operating location. It noted that many licensees have installed windows, mirrors and closed circuit TV cameras in a effort to comply with the rules, that sometimes the design of stations must be altered to meet the requirements.

The Commission said that while an alternative under the existing rules is to use remote control, with its attendant costs of installation and maintenance and its stringent performance measurements on directional antenna systems, broadcasters claim that extension metering would provide adequate safeguards for detecting excessive variations in critical operating parameters.

The Commission proposed to permit extension metering without prior authorization upon compliance with the following requirements:

- the transmitter must be located in the same building, not more than one floor away from the normal operating location with a path no longer than 100 feet between them.
- the extension meters must be close enough to the operator at the normal operating location that deviations from normal indications can be observed
- extension meters must comply with the same specifications prescribed for corresponding meters at the transmitter, and must be calibrated, not less than once a week, to ensure their accuracy, with the results to be entered in the maintenance log
- the modulation monitor and antenna monitor, if used must be installed at the same location as the extension meters
- and the transmitter must be installed so that it cannot be operated by unauthorized persons.

Cable TV Bureau Reorganization

Division chiefs have been appointed by the FCC to head the four operating divisions of the recently reorganized Cable Television Bureau.

Edward J. Brown will head the Research Division; Jerold L. Jacobs was named chief of the Certificates of Compliance Division; William H. Johnson is chief of the Policy Review and Development Division; and Jacob Mayer heads up the Special Relief and Microwave Division.

Brown, from Mineral Point, Wis., has been with the Commission since 1953, when he joined the Broadcast Bureau as a trial attorney in the Hearing Division. He later held posts as Chief of the Renewal Branch and as general attorney with the Rules and Standards Division before being assigned to work on cable television matters in 1965. He has been a supervisory general attorney with the CATV Task Force and the Cable Television Bureau. Brown is a graduate of the University of Wisconsin Law School and a member of the Wisconsin Bar. He practiced law in Wisconsin before joining the Commission and served in the U.S. Navy in World War II.

Jacobs, from Hewlett, N.Y., joined the Commission in 1968 as an attorney with the CATV Task Force, continuing to work on cable television matters with the Bureau when it was organized in January 1970. His assignments included work on comprehensive new cable television rules adopted by the Commission in February 1972. Jacobs is a graduate of Amherst College and Harvard Law School. He is a member of the New York and D.C. Bars and the American Bar Association.

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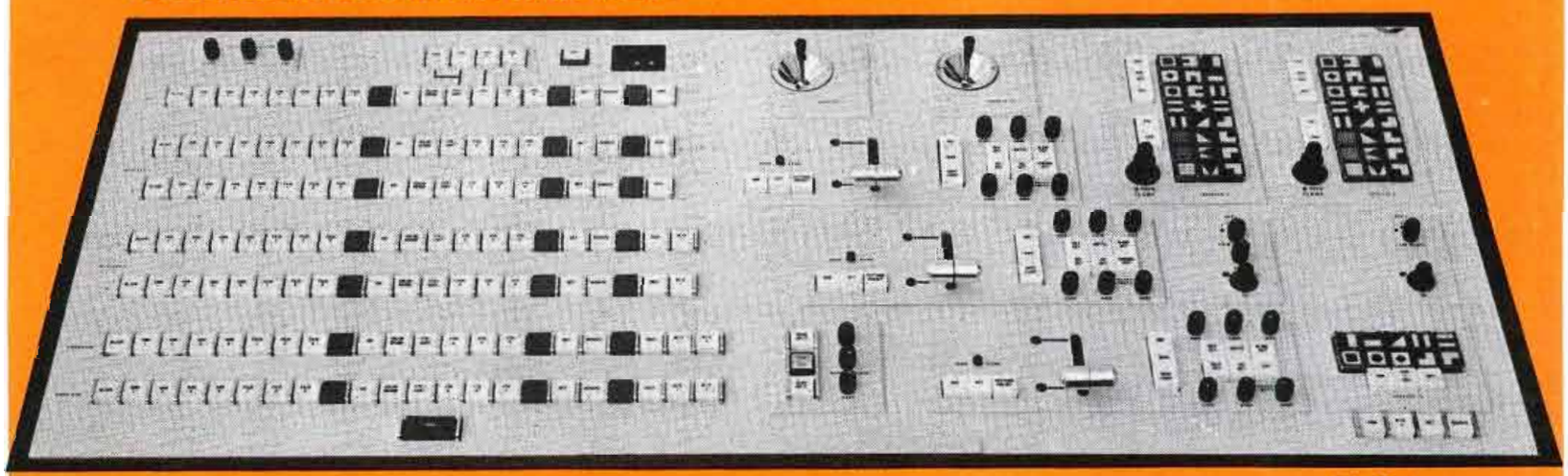

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Chapters In The Making

The following are locations for possible future chapters. Information on planned meetings may be obtained from the "contact" listed in each case. Persons interested in development of chapters in other locations, contact Virginia Doss, assistant secretary treasurer, SBE, P.O. Box 88123, Indianapolis, Ind. 46208. In some cases an SBE officer or director might be available to attend an organizational meeting to explain benefits of SBE membership and chapter participation. Such special arrangements can be looked into through SBE President James C. Wulliman, Manager, Engineering, WTMJ-TV, 720 E. Capitol Drive, Milwaukee, Wisconsin. To help in promoting a new chapter, also keep the SBE Journal Editor posted.

Location	Contact
York-Harrisburg-Lancaster, Pa.	Charles Morgan, WARM, Avoca, Pa. (717) 346-4646.
Puerto Rico	Bob Beurket, Asst. Ch. Engr, WRIK-TV, Ponce-San Juan, Telephone (809) 724-7575.
San Francisco	Robert Daines, CBS Labs, I Embarcadero Center, S. Francisco.
Cincinnati-Dayton, Ohio	John McNally, WCNW-WFDL, Fairfield (513) 874-5000.
Petersburg, Va.	Paul H. Bock, WSSV, Petersburg (804) 733-4567.
Youngstown, Ohio	Leno Leo Laner, NABET Local 47, 7447 Southern Blvd., Youngstown.
Albuq., N. Mex.	Guy Smith, ch. engr. KRZY/KRST, Albuquerque, (505) 266-5833.
Columbus, Ohio	Richard L. Walsh, WRFD Radio-88, Columbus, Ohio (614) 885-5342.
Quincy, Ill.	Lynd Carter, Tektronix, 3028 Lawrence Rd., Quincy.
Johnstown, Pa.	W. B. Martin, 70 Colgate Avenue, Johnstown, Pa. 15905.
Louisville, Ky.	Paul Kelly, WLKY; Charles Kendall, WKPC; Gil Lochner, WLKY.
Las Vegas, Nev.	Joe DeAngelo, 1536 Sombrero Drive, Las Vegas.

Annual Meeting Date Is Set

The Annual Meeting of the Society of Broadcast Engineers, Inc., will be held on the first Sunday of the NAB Convention in Houston, March 17th, according to James C. Wulliman, Manager, Engineering, WTMJ, Milwaukee, and President of the Society.

The actual time, hotel, and room at which the meeting will be held have not yet been determined. Members will be informed directly by mail of further details. Also, additional information will be contained in the NAB issue of **Broadcast Engineering.** A meeting of the Board will precede the Annual Meeting.

Insurance Benefits Up

Benefits for the High-Limit Accidental Death and Dismemberment Plan have been permanently increased by 15 percent effective October 15, 1973. This additional coverage, which has been added at **no** additional cost, will help to maintain the value of the benefits which have been eroded by inflation.

The Plan provides basic member benefits from $25,000 to $200,000 ($100,000 of which is available without regard to medical history). With the new 15 percent benefit increase, the various options now range from $28,750 to $230,000.

SBE members who elect to join the Plan are immediately eligible for the 15 percent benefit increase. Information on this Plan or any of the other coverages in the Insurance Program can be obtained by contacting the Administrator, SBE Group Insurance Program, 1707 L Street N.W., Suite 800, Washington, D.C. 10036, or telephone (202) 297-8030.

For Latest News See Direct Current page 6

SOCIETY OF BROADCAST ENGINEERS, INC
P O Box 88123 Indianapolis, Indiana 46208

Chapter Reports

Chapter 1—Binghamton, N.Y.
Chairman: Douglas S. Colborn,
Elmira Video,
Horseheads, N.Y. 14845

The members and guests of chapter 1 meet regularly, normally at the Owego, N.Y. Treadway Inn. Dinner at 6:30 PM normally precedes business and technical sessions. All are welcome.

Chapter 2—Northeastern Pa.
Chairman: Paul Evanosky,
WVIA-FM-TV,
Pittston, Pa. 18640

Members and prospective members gathered at the WVIA-AM-TV studios on Dec. 3rd for a short business session, annual election of officers, a general open discussion on varied technical topics and the annual Yuletide party. As a result of a good chapter year, the present officers were nominated and re-elected. They are: chairman, Paul Evanosky of WVIA-FM-TV; vice chairman, John Kowalchik of WILK; secretary, Charles Morgan of WARM; and treasurer, Milan Krupa of WPTS and WEJL-AM-FM. A new member added to the board of directors is Ron Lettieri, CET, avionics technician, Tobyhanna Amry Depot. Charles Morgan, who is also a national Director of the SBE, reported on recommendations for the grade of Fellow being accepted by the Fellowship Committee of which he was appointed chairman by SBE President Jim Wulliman.

Chapter 9—Phoenix, Ariz.
Chairman: Charles Deen,
KOOL-TV,
Phoenix, Ariz. 85003

On November 14th, 33 members and guests met at KPHO-TV. Tom Nielson of Ampex Corporation provided a comprehensive discussion on the ACR-25 Cartridge Video Tape; later KPHO engineers conducted a personal tour and demonstration of the unit. It was announced that the January meeting will be a joint meeting with the Tucson chapter.

Chapter 11—Boston, Mass.
Chairman: Ross B. Kauffman,
WCVB-TV,
Needham, Mass. 02192

On November 20th the chapter met at the studios of WGBH-TV to hear John Cheney of Comrex talk on the design and theory behind the practical use of wireless microphones, propagation, the frequencies available and their distribution, and various systems in use for wireless mikes.

Chapter 15—New York, N.Y.
Chairman: John M. Lyons,
WWRL-AM,
Woodside, N.Y. 11377

Chairman Lyons announced that attendance at meetings totalled nearly double the previous high total for any year in the chapter's history. The announcement was made at the Dec. 20th meeting at which officers for the coming year were elected. Reelected was chairman, John Lyons of WWRL-AM; vice chairman is Larry Strasser of WTFM; secretary-treasurer is Phil Harper of Gates Radio. Art Silver was reappointed program chairman, receiving the thanks of the chapter for an excellent year in programming. At the technical portion of the meeting Arno Meyer, president of Belar Labs, presented an interesting talk on AM, FM, and TV monitoring equipment, centering on the special features of Belar equipment in particular. Nonmembers have an open invitation to New York chapter meetings, generally held at the WQXR Presentation Theater, 229 West 43rd St., and to enjoy dinner before the meeting in the **New York** Times Cafeteria at that same address. Get further information from Art Silver, (212) 889-0790.

Chapter 16—Seattle, Wash.
Chairman: John A. Maxson,
KETO, Seattle, Wash.

The November meeting concerned the application of automatic operation through computers and other equipment in broadcasting and the effect on the technical work force. The second half of the program featured Danny Coulthurst International Good Music Corporation, who, along with design engineer Nick Solberg, described development of station systems for equipment control, logging, and memory storage, and the training of new and existing station personnel to handle the equipment. Also, at this meeting long-time FCC field staff member Peter Balyozian was honored, the event being just prior to his retirement. The December meeting was 12 noon at the Norselander Restaurant to hear a talk on "Care and Feeding of Plumbicons" by Bob Manahan, regional sales engineer for the Amperex Corporation. Bob was supported in his presentation by other Amperex people Bob Priebe and Ted Bode of the Robert E. Priebe Co. A professionally-produced, highly-interesting videotape on camera tubes was presented.

Chapter 20—Pittsburgh, Pa.
Chairman: Henry R. Kaiser,
WWSW,
Pittsburg, Pa. 15212

The November 15th meeting at Buddies Restaurant opened with the introduction of new guests. An informal program was held on "Pet Gripes", with Bell Telephone people volunteering to toss in a few gripes to start the ball rolling. The December 20th meeting featured John Romick of Tektronix who told about changes that have taken place in oscilloscopes during the past few years. Meetings of the Pittsburgh chapter are generally noontime meetings; information on future meetings can be obtained from Earlene Rutledge, WWSW Engineering Secretary, at 391-3000, ext 208-211.

Chapter 21—Spokane, Wash.
Chairman: T. O. Jorgenson,
KXLY-TV,
Spokane, Wash. 99201

The Spokane chapter continues meeting every Monday at noon at the Castle Restaurant. The November meetings covered the following topics: Installation of Waveguides on Towers, by M. Powers of Radio Rigging Service Co.; Operation of the TCR100 Cartridge Machine, A Report After 10 Months of Experience, by D. Pope of KXLY-TV; A description of the new Captioning for the Deaf on Television over KSPS-TV (one of the 12 stations in the U.S. equipped for this service by PBS, HEW, and NBS), by Ron Valley of KSPS-TV; Studio Light-

February, 1974

CABLE engineering

in this issue...

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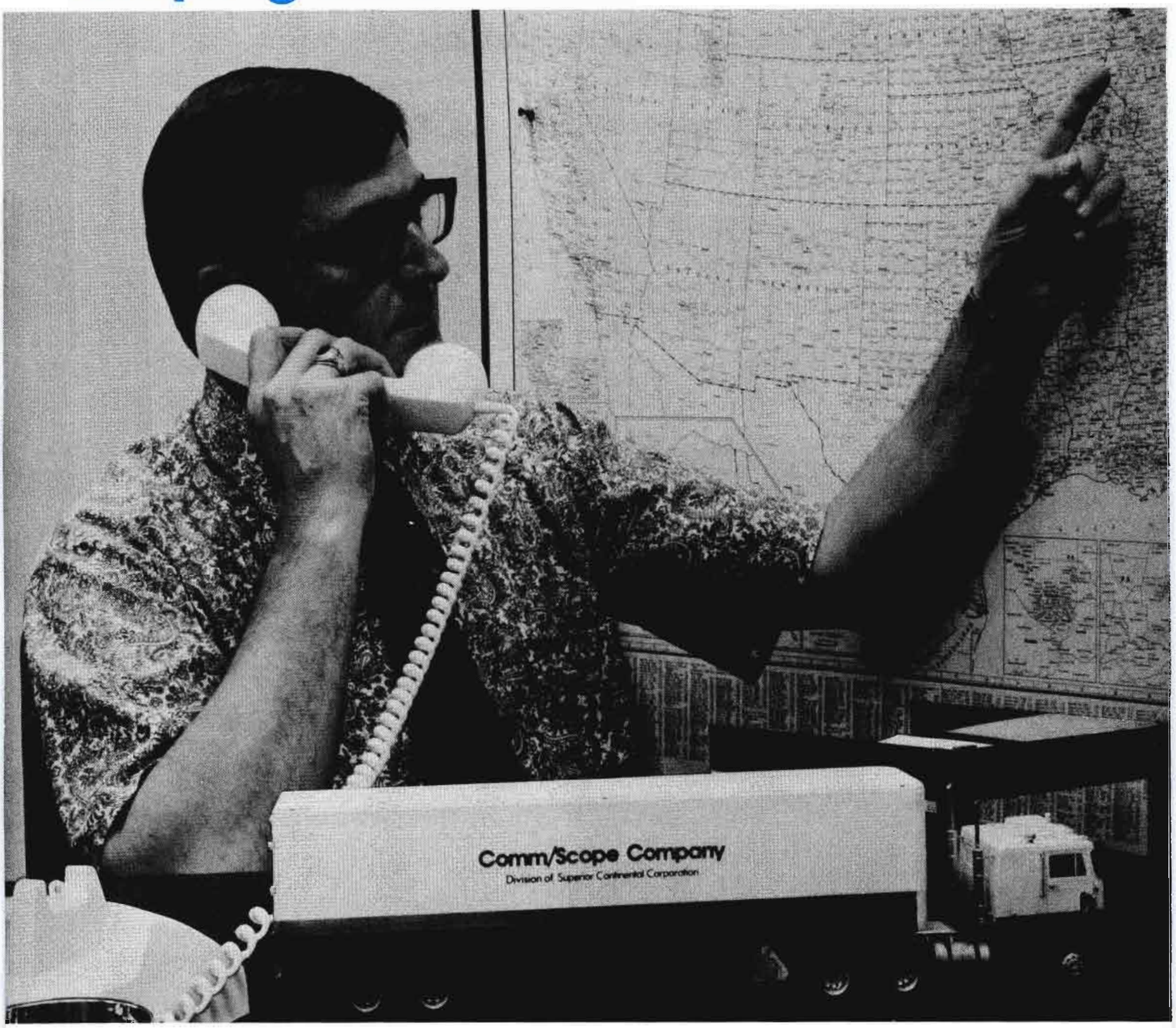

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Vertical Interval May Assist Color Quality

Revised rules to permit transmission of a test signal to be used to monitor color quality of TV programs have been proposed by the FCC. The signal would be included in a portion of the television signal received only by station technicians and not by the home audience.

The action is in response to a petition filed in May 1973 by the Consumer Electronics Group and the Broadcast Equipment Division of the Electronic Industries Association (EIA) and would amend Sections 73.682(a)(21), 73.676(f)(1), and 73.699 of the rules regarding special signals within the vertical blanking interval of the video television broadcast signal. The amendment would mean that a single line, in both fields, in the vertical blanking interval of the signal may be designated for exclusive use in the transmission of a Vertical Interval Reference (VIR) Signal.

The test signal was developed by the Broadcast Television Systems Committee of the EIA Engineering Department (BTS) as a tool by which engineers might determine the specific nature and magnitude of correction required to restore the color characteristics of a particular program. VIR was designed to be used as a reference for this purpose.

EIA noted that if the potential of the VIR signal is to be fully realized, its employment with virtually all program material must be encouraged and facilitated. EIA contended that an important step in this direction would be Commission action to amend its rules "to accord specific status to the VIR signal and to designate and reserve a specific place for its transmission in the vertical blanking interval of the video signal."

The Commission said that it shared EIA's belief that the general use of VIR by those involved in the production and transmission of color programs would result in greater uniformity in color characteristics, as among programs, in the viewer's receiver. The Commission stated that an important step in promoting and standardizing VIR use is the establishment of a specific vertical interval assignment for its transmission in the rules.

Interested parties have been invited to file comments on or before March 1, 1974, and reply comments on or before April 1, 1974.

Political Primer Available

NCTA has published a new guide for cablecasters, the **Political Cablecasting Primer.** The expandable guidebook contains an explanation of the U.S. House of Representatives Recording Studio dubbing facilities. Additions will be made to the booklet as they become available. Because of limited supply, however, they may be obtained only by cablecasters from Political Cablecasting Coordinator Brian Owens at NCTA, 918 Sixteenth St., N.W., Washington, D.C. 20006.

Part 3

Line Construction Techniques

By Kenneth Wayne

Electronic equipment installed into coaxial cable television systems is refered to as splicing. Essentially the cable is cut, a section removed, and an electronic component of the CATV system is inserted into the vacancy.

Splicing of coaxial cable is a relatively easy and simple operation and can be compared somewhat to plumbing. An average cable splicer can complete approximately one mile of line in a working day if he is familiar with the equipment and the connectors or fittings as they may be called.

Most electronics equipment comes complete with fittings, and although they can be ordered with a specialized type of fitting, they are all fairly standardized. It is necessary, of course, to follow individual manufactures instructions for the various pieces of equipment and fittings, as the length of the center conductor will vary, as well as the way the cable is secured by the fittings. Even when using the same brand of equipment throughout the system the methods for insertion may differ.

Some manufactures, for example, will require the center conductor in a bridging amplifier to be secured by a locking screw, while in their own line extenders, directional couplers, or taps, the center conductor may be simply a male-female union.

Therefore, it is obvious that it takes experience, patience, and foresight to splice a TV cable system well. It has been the consenses of opinion that the single largest reason for line failure is an improperly spliced system.

No Gadgets, Please

A nominal assortment of tools are needed to splice coaxial cable. There are numerous gadgets on the market to help you in your field but too many of them are just that . . . . **gadgets!**

Different cable manufactures and electronics manufactures have their own particular methods and tools available to put their equipment into use. This article will, therefore, confine itself to coaxial cable that is unjacketed ½ inch aluminum sheathed foam dielectric with copper center conductor.

The tools necessary for splicing this type of cable are: linemans pliers, conduct cutter, knife, screwdriver, and a couple of medium sized adjustable wrenches. The most important single tool being a cable forming device.

The cable forming device is used to make expansion loops in the cable in order to prevent connector pull outs which are caused by expansion and contraction of the cable due to temperature variations. The expansion loop provides for slack in the coaxial cable, increases the friction between the center conductor, dielectric, and aluminum sheath, thus consuming any lateral movements from span to span. These loops should be formed wherever equipment is spliced into the system.

Every system owner has his own ideas about how and where he likes to mount his equipment. The most practical method to date is to place amplifiers on the input side of the pole wherever possible, and to install double cable where necessary to place splitters or other equipment readily accessible at the pole, instead of, at mid-span or at cross-overs. I like to install directional taps on the left side of the pole whenever possible. Exceptions being, when it is also on the input side of an amp, over a street or intersection, or on a slack span.

Strand mounted equipment should be installed at a minimum of 18" from the pole and service drop span-clamps should be placed within the outer expansion loop to meet standards for climbing space.

Taps And Loops

To splice a directional tap, position the equipment 18" from the pole on the strand with the mounting hardware hand tight only. Cut the coaxial cable in the slack left by the cable installers in a manner so that the tap will remain 18" from the pole when the job is completed.

With a loop forming tool, make the expansion loops on both sides of the equipment or pole as the case may be. Start the bend a minimum of 2" from the cable support strap and leave a minimum of 2" of straight cable for entry and exit at the equipment. This is the absolute minimum. Six to eight inches is preferable for connections to the equipment.

After completion of the bends, slide the tap out of the way and with the conduit cutter, score the aluminum shield around the circumference of the cable at least ¾" from the ends of the cable. This will be determined by the necessary length of center conductor according to particular manufactures instructions.

Now with the linemans pliers, flatten the scored cable ends and then with a knife carefully cut through the dielectric. The ends can now be twisted off, exposing a length of center conductor ¾" long.

Again with a knife scrape off any of the dielectric that has adhered to the center conductor being careful not to damage the copper. Trim the center conductor to the proper length with the linemans pliers and the equipment is ready to be installed.

If heat-shrinks are being used, now is the time to slide them over the ends of the cable. Position the tap again at the 18" distance and slide the nut assembly onto the cable ends. Insert the center conductors into the body fittings and tighten the nut that seizes the center conductor to it's recommended torque. **It is imperative**

that opposing wrenches are used when tightening all fittings as the inner connections may be damaged by the fitting turning on its shoulder. After conductor seizing nuts are tight, tighten the packing nuts and then the equipment mounting hardware. Support any excessive lengths of cable with support straps and spacers and the job is complete.

Amps, power inserters, splitters and other electronic equipment are all spliced similarly. Locking screw seized center conductors necessitate opening of the housing to insert the cable and make the splice, but otherwise the procedure is the same.

There are a few short cuts that can be devised after gaining experience. Remember that a poor splicing job can be a system's worst headache. Extreme care is necessary when tightening connectors since too little can cause moisture to enter, loss of continuity, shorts, and flashing. Too much can cause the fittings to break, or crack, strip threads, or distort the cable, which in turn will also cause electrical irregularities in transmission of RF signal and line voltages. □

Changes At The FCC

Two commissioners and cable chief recently resigned within ten days of each other. The resignation of Commissioner Nicholas Johnson was expected since his term had officially expired in June. Johnson, a Democrat, had decided to continue at Commission in order to oppose White House FCC nominee James Quello, a Michigan broadcaster. Hearings on Quello nomination for Johnson spot were set by Senate Communications Subcommittee to begin late in January.

Commissioner H. Rex Lee unexpectedly announced his resignation effective on December 31. Lee, also a Democrat, is retiring after 38 years of government service. With the two vacancies, the seven member Commission will be composed of four Republicans and one Democrat.

Joining the exodus was Cable Television Bureau Chief Sol Schildhause, who had headed that special unit established in 1966 to deal with CATV and then went on to head the new bureau. He has been credited as being a primary force behind getting cable television moving. Said NCTA President David Foster, "It is with great sorrow that we see Sol leave the Commission. He's certainly been a leader in establishing cable as an industry." Most observers expect Deputy Bureau Chief David Kinley to succeed Schildhause.

OSHA Slide-Tape Presentations

Two slide-tape presentations are in preparation by the OSHA committee. The first is a general description of the OSHA regulations and what is required of each employer. The second details fire extinguisher requirements and vehicles. Orders are now being accepted for the first presentation: 40 slides—1 tape, NCTA members $15.00; non-members $35.00. Write NCTA, 918 Sixteenth St., N.W., Washington, D.C. 20006.

Free Cable Booklet

The NCTA Legal Department, in response to several requests, has acquired copies of the up-to-date FCC Cable Rules. They are available to members free, $1.00 for non-members.

The Legal Department also has for distribution to members a detailed memorandum which explains the new accelerated depreciation range (ADR) for CATV property and equipment. Both the memorandum and the Cable Rules are available from Aggie Gilespie at NCTA, 918 Sixteenth St., N.W., Washington, D.C. 20006.

Your Comments and Ideas Are Welcome At Broadcast Engineering

Exchanging Blue Sky For Green Dollars

By Kenneth Wayne

Blue Sky? You Bet!!! That's what system owners are offering the public. Shop by Two-Way TV! Get your meter read! Alarm your home against theft, fire, flood! Watch the best in sports, movies, theater! Fill the dial from channels 2 to 83 and look at everything from the "time to banannas"! Switch from "Cable A" to "Cable B" and watch, watch, watch!

Are we really going to produce what we have offered these communities to win our franchises? "Modular Bi-Directional TV"? "Public Access Channels"? "Better Quality Viewing"? Better Quantity Viewing? (Maybe we can change the name to QUANTITY TV) If we are, and some systems are trying, someone has to put up the money to buy that blue sky. Money is tight, so why not market what you have?

Cable Television is a service. In many areas a vital service as the customers have no other means of reception. True, in many areas CATV systems have competitors such as off the air rabbit ear reception or translators, but generally we can offer something extra that our competition cannot. The basic most economical extra in off the air reception areas and probably the most often overlooked is FM. Surprised? I was when I found out about it! Here we are trying to get everyone watching but no one to listen. I was under the impression that all systems had some sort of music available, but that evidently is just not the case.

We bring in extra channels from distant broadcasters via microwave at considerable cost. We have studios for local origination at considerable cost. We even have stock market quotations at more cost. The money keeps going out for the extras, but does it come back in? Are the customers really satisfied with what you offer? Do you have a large amount of extra outlets? Do your subscribers know what FM is? Do you offer FM? If you don't, why not consider it?

There are many ways to market signals to customers. The viewer who receives a fine signal from a translator often has a beautiful stereo and has never used the FM receiver. It could be cabled. The potential customer within the top 100 market may have an AM-FM clock radio that receives only AM and is loaded up with multi-path FM. It could be cabled. The doctor's office, bank, resturant, insurance agency, even the city clerks office can all be cabled. They all like to listen to music.

Of course, there are companies that are in the background music business. They supply the customer with a receiver or tape player and rent or sell the equipment and music. Many of them are first rate outfits and the service is reasonable and good. But you could also supply the same service with multi-station reception and pick up new subscribers and many new extra outlets.

For example, let's look at two systems 20 miles apart. The first is located in a canyon with seven translators and one local AM radio station. Six translators duplicate the three networks and cover opposite ends of the canyon. The seventh translator picks up an independant satellite 40 miles away for rebroadcast. Throughout the canyon, off the air reception is from good to barely watchable. FM is nonexistant. The cable system offers the three networks, the independant, two educationals, plus all-band FM. The FM is provided free to subscibers who pay the installation charge for the extra outlet. A one time only charge. For the bank, insurance agency, drug store, and others who desire the FM service only, they pay the standard monthly service charge for TV. But yet they only listen. The system is about 40 percent saturated with extra outlets in more than 25 percent of the cabled home.

The second system 20 miles from the canyon community is surrounded by mountains and is nesteled in a valley on the prairie floor. The only competition is the snowy independant 40 odd miles away. Some FM is available with quality receivers and mast mounted antennas along with the aformentioned AM station and a coujple of weaker distant AM stations. This system provides the same viewing channels as the first along with All-Band FM. The basic monthly subscriber rate is the same but has a slightly higher installation charge. There is also a charge for a FM outlet which is called only an extra outlet. Thus, a customer can have an extra TV or FM receiver connected to the cable as he prefers. This system is over 90 percent saturated and would be without the FM because there is no competion. Yet, the extra outlets in this system, most of which service FM receivers, are in approximately 20 percent of the cabled homes and that means extra income.

Now, getting back to the canyon system, we wonder what sells hook-ups. The banker isn't watching TV down there. He's adding the interest on our loan and looking at dollar signs. But he, the doctor, dentist, and the propriter of the sporting goods store are listening to FM along with the clients, patients, and customers.

The patients with the pulled tooth goes home, the novician wears off, he has a splitting headache. Does he watch the local origination news program from your studio? Very doubtful. Does he watch the Electric Company, Seseame Street, or The Advocates on the educational channels? Again doubtful. Does he turn on Cronkite or Chancellor or anything else? Probably not. But, he may turn on his cabled FM receiver to some soothing FM stereo music that he has available

via your all-band FM equipment.

This man is now semi-content, and that should make you happy, because its his monthly subscriber revenue that's paying your bills. It's his friends that hear your FM and hook up to your cable. It's your system that reaches its maximum saturation quicker and for so little amount of expenditure that its almost unbelievable.

Assuming the average CATV system has 12 channel capabilities and receives off the air signals, it is likely that there are several FM signals available along with the TV signals. These signals can be put on the cable for less than $500.00 (excluding the service drop) even with the fanciest of equipment. These average systems still use strip-amps, though most modern systems are now going to signal processors. This is still no problem when putting FM on the air as all the signals eventually go into a combining network to exit into the main trunk. Consequently, it is quite easy to insert the FM band into the cable system.

You'll want to put the best available signals possible on the system (not what you feel is the best music, as the customer's choice of music may differ from yours and it is for what he wants that he is willing to pay extra for), so it is necessary to use a good FM antenna. The signals received from the antenna could go directly into a preamplifier with the output of the pre-amp possibly going through a trapping network (to eliminate channel 9 audio and other unwanted signals), and then right into the combiner. You now have FM on your cable system which is in the 88 MHz to 108 MHz band between channel 6 and channel 7. There is no other equipment necessary other than the FM receiver belonging to your subscriber. Of course, you may want to mount several FM antennas to cover the 360° area around your antenna site, incorporate a tape machine with 24 hour background music, or process the incoming FM signals. Whatever methods employed to put music on the cable, and it should be there, you have customers on the other end that don't want the blue sky to watch, they want to listen.

Now again using the two cable systems as examples, one which charges for the FM and one which does not, how do we know that the customer with the extra FM outlet doesn't have a second TV hooked up instead and is not paying for that extra outlet? We don't! But we can eliminate the chance by installing a FM tap which passes only the signals between 88 MHz and 108 MHz. This removes everything but the FM band so it won't help to hook up a TV on that extra lead. On the other hand, it we want to charge for those extra outlets be they FM or TV, we simply install a hybrid splitter in the line. One output to the first set and the other to the secondary set. The full band from 5 MHz to 300 MHz is available and if the customer wants it on a TV he pays for it. If he wants it attached to his FM, he is still paying for it. This is extra income for your cable system. If you have 500 subscribers on your system, and only 10 percent want the FM at a nominal charge of $1.00 per month for the extra outlet, that is a gross income of $50.00 per month. In less than one year you have paid for head-end equipment! You have probably picked up additional subscribers because of the music and that all comes out to "Green Dollars" and not "Blue Sky"! □

NEW PRODUCTS

Portable Video Tape Recorder

AKAI America has introduced a new 11-pound black-and-white ¼-inch video tape deck that features automatic editing and can be used with C-mount video cameras.

Announcement of the unit, displayed for the first time in the U.S. at the NAVA show in Miami, was made by Frank Benson, director of video marketing at AKAI.

The unit, designated the VT-115 portable video tape recorder, will probably retail for around $2,500, although no final retail list has been determined, Benson said. The price includes AKAI's VC-115 C-mount camera with 8 to 1 zoom lens. The camera employs a built-in electronic view finder through which tape playback may be viewed for picture content verification. This eliminates the need for the three-inch instant replay monitor that is part of other AKAI black-and-white video tape decks.

The VT-115 recorder's automatic editing control allows scene by scene assemble editing and eliminates the momentary break-up of picture between scenes and assures smooth continuity of picture content, Benson said.

It is battery operated, utilizes a five-inch reel of AKAI's exclusive ¼-inch tape, and can be worn over the shoulder like a purse.

The VT-115 recorder can be used with video cameras that do not contain built-in electronic viewfinders and is equipped to handle AKAI's attachable 3-inch replay monitor.

For More Details Circle (85) on Reply Card

Miniature Field Scope

The availability of a portable, simple-to-use oscilloscope, designed for on-site checkout and servicing of TV, CATV, and radio broadcast equipment has been announced by **Telonic Industries, Inc.**

Weighing only 4 lbs., the new oscilloscope can be hand-held or hung from a neck strap, permitting the serviceman or technician to test electronic equipment without removing it from service. Conventional oscilloscopes, however valuable as service tools, are too heavy and fragile to be used in field service work. Normally, the equipment to be checked out must be removed and brought to an instrument service area. The use of the portable 'scope not only saves removal and re-installation labor, but also minimizes loss of productive time resulting from equipment failure.

The new oscilloscope measures 3.5" W by 5" H by 7.75" D and contains a 1.5" CRT screen that is enlarged to 2.25" by a snap-on magnifier. It is powered by an AC line or a battery

pack that permits up to 5 hours of continuous service before requiring a recharge. Controls have been engineered to make operation fast and simple in keeping with the field-use design.

Typical applications for the new "mini-scope" include its use in the testing and calibration of amplifiers, monitors, video and audio tape recorders, sync generators, cameras, encoders, monitors, monitors and video switchers. It is also valuable in cable system analysis, signal monitoring and as a dependable back-up for conventional 'scopes used in the service shop.

For More Details Circle (86) on Reply Card

Digital VOM

Digital VOM's are coming into more and more use in the broadcast industry, and here's one that will compete with the meter movement types. It's the **Fluke** model 8000A.

This meter includes the typical voltage and resistance ranges, and it also includes current ranges up to 2 Amps. Unique self-zero eliminates off-set uncertainty.

Option choices include rechargeable battery pack, printer output, deluxe test leads, HV probe, RF probe, 600 Amp AC current probe, dust cover, and rack mount.

For More Details Circle (87) on Reply Card

Compact Color System

A complete compact color television studio system including two one-inch color videotape recorders, a film chain camera, live studio camera, plus film and slide projectors, combined in a system five feet long and two feet deep is available from **International Video Corporation** for cable, closed circuit and broadcast television applications.

Called the IVC Diplexer Telecine System it can be located in a small room and placed flush against a wall since no rear access is necessary.

Pull out drawers hold two IVC-7000 or 800 series videotape recorders. An IVC color camera, a 16mm film projector, a 35mm slide projector, as well as tape and film storage space are included.

System alignment is easy, so it is practical to demount the camera for use as a live camera. Mobile studios will find it especially useful. Systems are already in use in over 50 shipboard installations.

The Diplexer, including an IVC 3-vidicon color camera with tripod and lens, two IVC-7000 color record and playback videotape recorders and all the necessary film equipment to provide a complete program and recording package, is priced from $22,000.

IVC manufactures and markets color television cameras and videotape recorders for broadcast, cable and closed circuit television markets and also produces a mass memory tape recorder for storage of digital information.

For More Details Circle (88) on Reply Card

Single Vidicon Color Camera

Hitachi Shibaden Corporation of America has announced commencement on deliveries of their new low cost color television camera designed for use in education, medical, cable origination, and numerous industrial applications. The camera utilizes a Hitachi-developed 1" FIC (filter integrated color) Vidicon tube and a special optical filter.

This unique design feature brings an advancement to performance, while at the same time, gives the camera compactness and weight advantages. The single tube design offers simple camera operation requiring no registration adjustment. Operating controls are limited to color-tone and electrical focus. Another advantage of the single tube design is the ability of the camera to withstand external shock without the loss of adjustment.

Being of studio design, the camera comes equipped with a camera control unit which allows single camera operation with the internal RS-170 sync generator or external sync for multiple camera operation.

The camera head features a built-in 3" electronic viewfinder which allows the camera operator to view the camera picture or an auxiliary video signal from a video recorder or production switcher output. A built-in neutral density and color temperature filter wheel allows for simple conversion from indoor studio lighting to outdoor sunlight.

The camera is designed to utilize a wide range of lens, including push-rod or cable-drive zoom lens. An automatic servo-iris option is available.

For More Details Circle (89) on Reply Card

Frequency Dividing Networks

Two new electronic frequency dividing networks in their Professional Series have been announced by **James B. Lansing Sound, Inc. (JBL)**. The models are 5231 for single channel and 5232 for dual channel applications.

The networks are designed for use with studio monitor or sound reinforcement loudspeaker systems where bi-amplification or tri-amplification is desirable. The use of electronic frequency dividing networks and multiple amplifiers results in a cleaner signal being fed from the power source directly to the individual loudspeakers of the system.

By dividing the audio spectrum before power amplification, treble tones are separated from, and unaffected by, bass frequencies. The result is more efficient utilization of available amplifier power. For example, a system consisting of 100-Watt low frequency and 50-Watt high frequency amplifiers will provide the same low distortion performance as would a single 300-Watt amplifier driving the loudspeaker system through a conventional passive frequency dividing network.

Direct coupling to the loudspeakers eliminates the insertion loss typical of most passive networks and also permits realization of the maximum damping factor available from a given amplifier.

For More Details Circle (90) on Reply Card

Color Keying Device

Technicolor's American Astrionics Division has announced the availability of Chromatech (tm), a special video processing device for superimposing two sources of NTSC video into one composite TV picture, without the undesireable halos and black outlines usually associated with chromakeyers. Chromatech is a new NTSC version of Technimatte, which has been in use for the past several years at Vidtronics, formerly a division of Technicolor.

Features of Chromatech include: the ability to cast foreground shadows on background scenes; the ability to see thru glass, Saran Wrap (tm) and smoke; and complete freedom from typical dark outlines around foreground objects.

The device will accept two input sources of NTSC video with a common synchronizing signal. The color keying signal that causes transitions between foreground and background is developed from the foreground video source in the form of RBG video. The keying signal can be preset to gate on any desired backdrop color

For More Details Circle (91) on Reply Card

ing for K Smith Enterprises, by Vince Hoffert, KJRB; and Transmission Lines Troubles, by Dave Green, of Green Engineering Company. Chairman "Jorgey" extends a welcome to all interested engineers to attend their noontime meetings.

Chapter 22—Central New York
Chairman: Mort Miller,
Syracuse, N.Y. 13210

In annual elections, held at the meeting of November 15th, the results were: chairman, Mort Miller; vice chairman, Gary Hartman; secretary, Glenn Hartley; and treasurer, Vern Nyman. A program on Weston Instruments consisted of a slide presentation and demonstrations on frequency counters and digital and analog multimeters by Joe Dillon, Charles Shilling, and Charles Leonard of Weston. John Baldwin of Baldwin-Hall conducted the program. SBE national Director, Al Chismark, told of plans to date on Broadcast Engineers Certification program. On December 13th, a 2-part program was held. John Lazarski, operations supervisor, and William Dannebrock, technician, both of AT&T in Buffalo, answered questions on the shift of network control operations. Also, Jerry Kolins of Professional Electronics, and C. Motta, of Consolidated Video Systems, demonstrated the new digital time-base corrector, the CVS504.

Chapter 23—Portland, Me.
Chairman: Roland A. Desjardines,
WCBB-TV,
Lewiston, Maine 04240

At a recent meeting, preceded by dinner at the Holiday Inn, Portland, Maine, Donald LeFebvre, Commercial Electronics, demonstrated his company's new Plumbicon camera for color telecasts. Weighing only 50 pounds, complete, it has a 50 dB signal-to-noise ratio at 50 foot candles, 600-line resolution, and usable sensitivity down to 15 foot candles.

Chapter 25—Indianapolis, Ind.
Chairman: Joe Missick, WISH-TV,
Indianapolis, Ind. 46202

On Nov. 13th, at WRTV Studios, Bob McGill of CBS Labs presented an interesting program on CBS new processing amplifer. He also covered the various audio devices manufactured by CBS Labs.

Chapter 26—Chicago, Ill.
Chairman: Bradley Anderson,
Univ. of Ill.,
Chicago, Ill. 60680

At the November 20th meeting, held at Streeterville Studios, thanks was extended to NABET Local 41 for its sustaining membership and support, and to ABC for assistance in preparation of meeting notices during the past year, and also to the ABE Credit Union for clerical assistance. At the meeting Preston Wakeland, Streeterville chief engineer, presented a program on audio recording. Refreshments were provided by Sonic Services. At the December 11th meeting, the chapter joined with the local SMPTE group for a meeting at the Kodak plant on (1) Use of the Trinoscope (VTR to Film Transfer); (2) New Techniques in Automatic Processing of Super 8 Sound Film, and, (3) 3-Channel Stereo for Theater and

(Continued on page 52)

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Conrac has the most complete product line of quality television monitors and related products in the world. Color, monochrome, high resolution, NTSC, PAL, SECAM, color matched phosphors, negative black-matrix shadow-mask CRT's. We've got them all, with the quality, dependability, and value that you've come to expect from Conrac during its 25 years as the leader in the business.

And now, with our new Primary Distributor network in 16 major market areas you can get immediate delivery on nearly any Conrac product. This means you no longer have to compromise on quality. Conrac has removed the last excuse for not owning the best. Check the listing at the right or contact the distributor near you for full details on the finest television monitors on the market.

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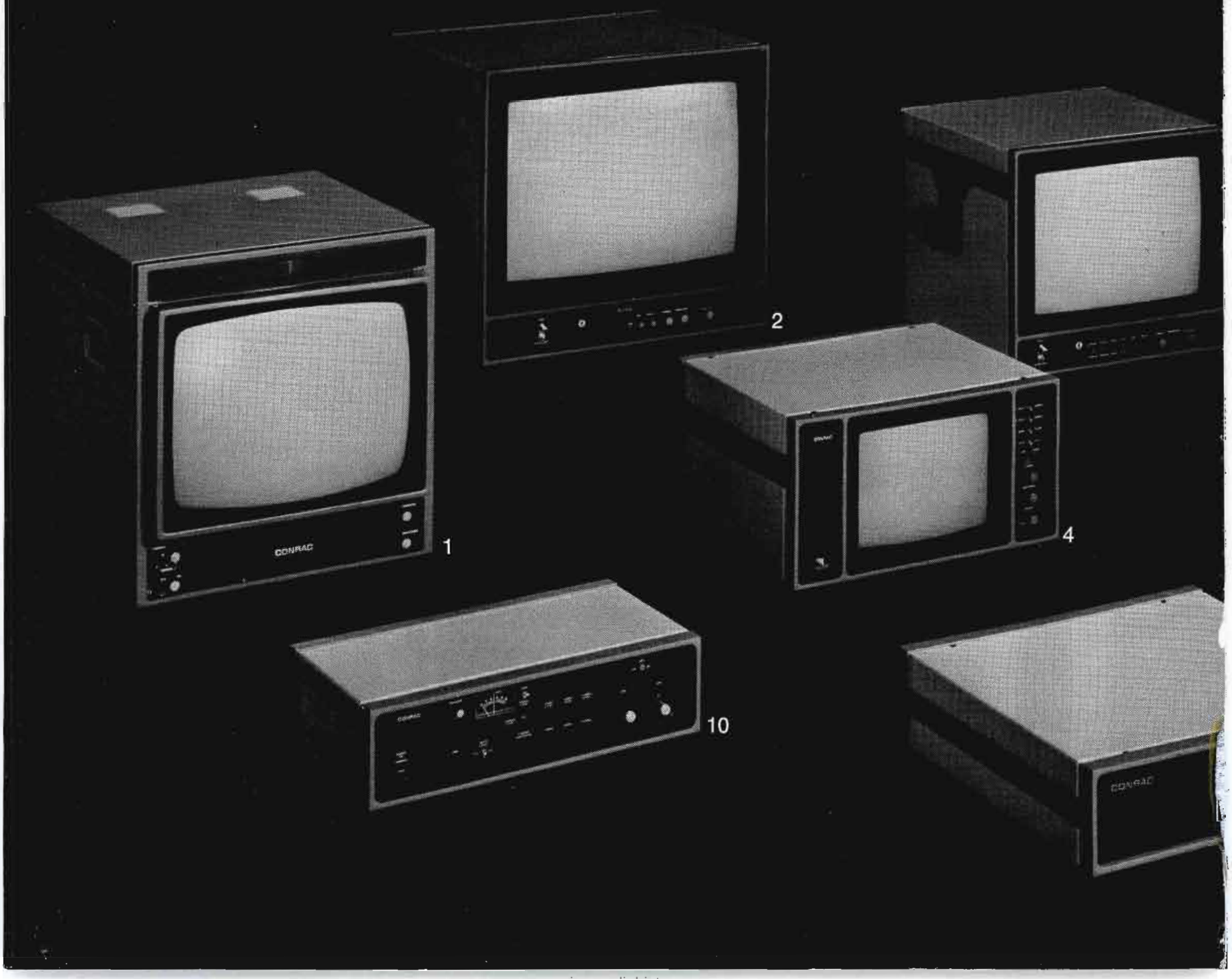
RHA Professional Color Monitors. Incorporating a 19 inch CRT with color matched phosphors, stable IC coding circuitry, and other advanced features, the RHA meets the most stringent international broadcast requirements. Designed specifically for use in master control and other critical areas, the RHA establishes industry standards for reliability, picture quality, and ease of set up. NTSC, PAL-B, PAL-M, SECAM, or RGB versions. Cabinet, yoke mounting, or rack configurations.

2 & 3
Large screen 25 and 19 inch 5000 Series Color Television Monitors. Feature negative black-matrix shadow-mask CRT's for improved contrast ratio and high brightness without loss of resolution. A moderately priced unit with pre-settable controls, designed for group viewing in auditoriums, classrooms, lecture halls, industrial training areas, preview rooms, and audience participation studios.

4
12 inch 5000 Series Color Monitor. A high performance monitor with single gun CRT that avoids the many compromises of converted receivers, yet sells at a modest price. Options include switchable horizontal and vertical delay for professional applications, and a Vector Output Module for external vector display of the Chrominance signal. Available in cabinet, yoke mounting, rack, or chassis versions.

5
RQA High Resolution Monochrome Monitor. Designed for medical X-ray, military applications, and document viewing. Features automatic and independent field-rate and line-rate sensing. Will lock on any field rate from 15 to 60 fields per second or any horizontal line rate between 15 kHz and 37 kHz. Fourteen, 17, and 21 inch CRT's available in cabinet, rack, chassis (all sizes), or yoke mounting studs (17 and 21 inch only).



6
DZA Professional Monochrome Monitor. Offers the professional television engineer a dependable performance-stabilized picture plus instrument test features such as horizontal and vertical delay for sync signal analysis. Supplied with a 14 inch CRT in cabinet, chassis, or rack mounted versions.

7 & 9
SNA Series Professional/Industrial Monochrome Monitors. General purpose monitors providing high reliability, ease of maintenance, and superior picture quality. Available with a wide variety of CRT sizes and mounting configurations: 9 inch, dual 9 inch, 14 inch, 17 inch, and 23 inch, in cabinet, rack mount, chassis (all sizes), or yoke mounting (17 and 23 inch only).

8
ENA Low Cost Solid State Monochrome Monitor. Designed for rugged continuous use in educational, industrial, and computer applications. Supplied with 9 inch, dual 9 inch, or 12 inch CRT's, in cabinet, rack mount, dual rack mount, or chassis versions.

10
1000 Series Audio/Video Receiver, VHF or VHF/UHF. A solid state receiver that provides professional quality demodulation of aural and visual carriers to use in monitoring, rebroadcast, recording or entertainment. Plug-in modules customize the 1000 Series for applications such as transmitter monitoring, CATV head-end demodulation, ETV or ITV off-the-air distribution, or VTR off-the-air recording. Console cabinet or rack versions are available.

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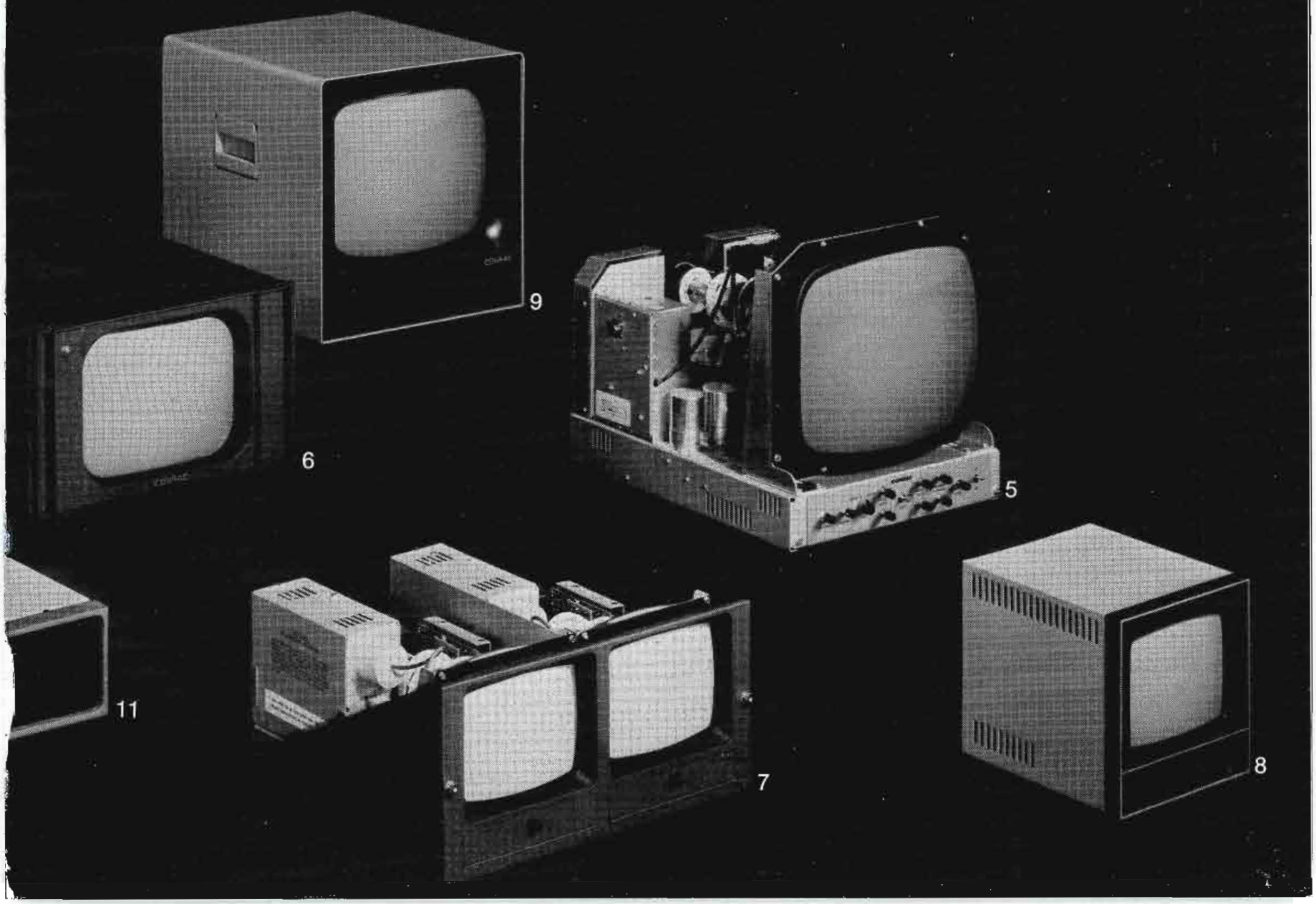
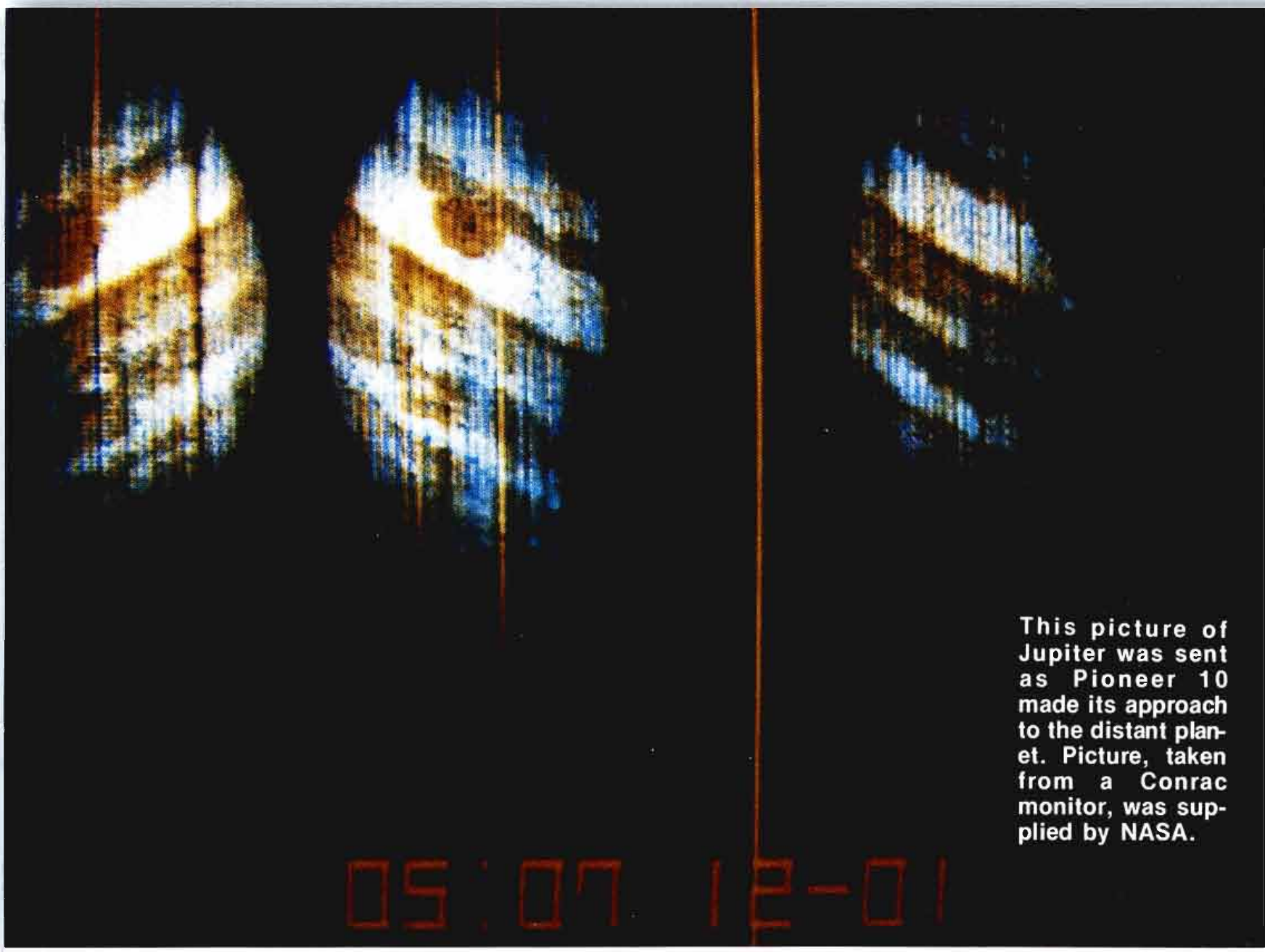




This picture of Jupiter was sent as Pioneer 10 made its approach to the distant planet. Picture, taken from a Conrac monitor, was supplied by NASA.

The 8-watt super remote of Pioneer 10

By Joe Roizen*

Pioneer Ten's Jupiter Encounter that has occupied the recent news media is a project that involved NASA's (National Aeronautics and Space Administration) world wide network of satellite tracking stations and a complex computerized television installation at the Ames Research Center in Mountain View, California. One of the most sophisticated color television cameras to come out of our space age technology is the core of the system, and has been sending back ever growing pictures of our solar system's 5th planet. To get some idea of the environment this camera must operate from, a few statistics are in order.

The video signals from the spacecraft traverse approximately 500 million miles on their way to earth. Even at the speed of light 186,300 mi/sec this takes 46 minutes. Command signals to Pioneer Ten require a 92 minute turn around time before verification of implementation is available. Thousands of commands were needed to aim and control the camera so that it could perform the many experiments that were scheduled for it.

Ground transmitters beaming up the command signals at 2.1 GHz used a nominal 20 kW power output, but had up to 400 kW in reserve. The 210 foot diameter dish antennas held the beam concentration to 3/10 of one degree. Signals coming back from Jupiter Ten were radiated by an 8 Watt transmitter in the same frequency range and arrived back at the tracking antenna with a power level of one quadrillionth of a Watt 10^{-24}. To recover and amplify this signal requires a special amplifier that operates in a -450°F mode. The super low temperature virtually stops noise generating electron motion in the solid state circuits so that the feeble signals from Jupiter could be raised to useful levels.

After recovery the amplified signals were routed to the processing computers at Ames Mission Control where they were converted to analog video signals and distributed to various recording and display devices.

*President of Telegen, a video consulting company located in Mountain View, Calif. Roizen also is our BE Video Editor.

The Color Camera

NASA's nomenclature for this two purpose device on the space craft was an Imaging Photopolarimeter (IPP). It was supposed to measure the brightness and polarization of zodiacal light in addition to making pictures. The camera weighs 9.5 pounds and consumes 2.2 Watts of power.

The most unusual facet of the color camera is that it uses the spinning motion of the spacecraft as one scan axis while stepping its lens/telescope over a viewing angle range of 141° to obtain the other axis. Jupiter Ten rotates at 5 RPM completing one revolution every 12 seconds. The telescope is a one inch cadiotropic imaging device with a funnel shaped light baffle with a dark mirror coating to exclude light scatter at its outer rim. Light from the image passing through the telescope is split into red and blue channels by a small prism with dichroic filters. Intensity measurements in 64 increments are made every 1/1000 of a second. These are called pixels and stored in the spacecraft memory banks. After each rotation the picture elements are digitized and dumped into the transmitter so as to clear the memory for the next scan. 508 pixels per scan be stored and the image is assembled in what appears to be thin vertical bands on an RGB or NTSC color monitor.

Since only red and blue information is available from the IPP, the green signal has to be synthesized by electronic means. A proportion of the R and B signals are used on an empirical basis. After comparison was made with ground based astronomical photographs and space observations as to the actual colorimetery of Jupiter, the formula for simulating green was developed and applied. Photomultipliers with a gain factor of approximately 10 million were specially developed by Bendix for the mission. Two are used, one in the red channel and one in the blue. The rest of the camera assembly consists of high density 9 layer circuit boards containing about 400 IC's which were selected for minimum power consumption and maximum resistance to radiation, one of the hazards of space flight.

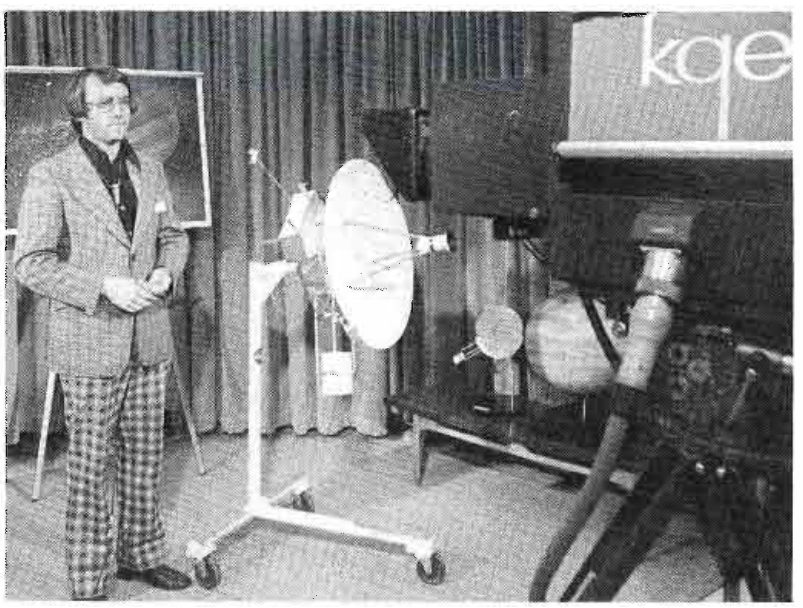
The IPP imaging system used a six step aperture wheel five of which were for light polarization experiments. In the picture mode a single aperture of pin hole proportions comes into play.

Mechanical scanning of the imaging optics is done by a stepper motor that position the telescope in steps of .5 mil radians (.03°). To eliminate problems of sealants and lubricants in this mechanism the stepper motor uses harmonic drive through a welded seal.

There are two modes of scanning. The camera can be set to any pre-determined space reference based on astronomical calculations and commanded to scan a selected area. The second mode, which was used more, depends upon a threshold detector in the camera to start the scanning action at the edge of a bright area, then continue until the other edge is traversed by one degree, then reverse itself and scans the other way.

Camera resolution is limited by the storage and transmission capacity of the system rather than the optical imaging section. Only about 30° of scanning by the stepping mechanism is used during a complete rotation of the space vehicle, the rest of the time is used up in storing and sending the information in a multiplexed sequential mode back to the ground stations. The maximum bit rate can be translated into a 508^2 sample array of slightly over one quarter of a million picture elements.

The camera was the result of a five year development project at Santa Barbara Research, Inc. in



Interest in Pioneer 10's mission was evidenced by the wide TV coverage given on the national news. This is Richard Threlkeld, CBS Science Editor, commenting on the event in a temporary TV studio, set up by NASA-Ames and equipped by KQED (a San Francisco educational channel). (Photo by Donna Roizen.)

Two mobile vans housing three Mark VII color cameras and a VTR 2000 were used by KQED to cover the Pioneer 10-Jupiter encounter. Pacific Telephone used several microwave links to couple signals from Mission Control to various buildings at the AMES center and to the outside world. (Photo by Donna Roizen.)

Southern California. The program cost $3.5 million and yielded four units, which were used for the first "thin scan" imaging of objects in outer space. While originally planned to provide only 10 pictures, the camera has exceeded 500 images at the time of periapsis (nearest point of the fly by) and continued to send pictures back as it left Jupiters vicinity.

TV Distribution and Coverage

Signals coming into Ames from the tracking stations are routed in RGB form to a magnetic storage disc that accumulates the image sequentially, but can display it in a simultaneous mode. The RGB output is encoded into NTSC and distributed by microwave to various buildings where Conrac 19 inch color monitors were set up for display purposes. A special color studio was set up by KQED, San Francisco's educational channel 9 for interviews with the scientists on the Pioneer Ten project and for TV news reports. All three networks and a variety of independant stations had news crews and prominent commentators on the scene during the critical period between December 1 and 3rd.

Periodic press conferences were held by the project team which included such well known space scientist as Dr. J. A. Van Allen, who expounded new theories or verified old ones as result of the data streaming back from the space craft. All the while Jupiter kept getting larger and larger on the monitor screens as the vehicle moved closer, finally filling the entire screen and providing image detail greater than any earth based astronomical telescope is capable of at the present time.

Pioneer Ten was launched on March second, 1972 and has taken 21 months to reach periapsis. It has traveled a curved path of 620 million miles and is estimated by Dr. Charles Hall, NASA project Manager to have achieved better than 50,000 miles per gallon of fuel at launch. It took 25 million man hours of labor which is equal to the time the US public uses up in watching the first quarter of the Superbowl. Dr. Hans Mark, Director of the NASA Ames Research Center estimates the 6 year cost of the Pioneer missions at $100 million or about 1/4 of 1 percent of the Federal governments expenditures on research and education in that period. Pioneer Ten was powered by two Radioisotpe Thermonuclear Generators (RTG) that produced 120 Watts of electrical current at 4 Volts DC. It took rigorous testing and an approval chain all the way up to and including President Richard Nixon before these RTG's could be installed and used in outer space. The space vehicle weighed 570 pounds at launch and carried eleven instruments for a variety of experiments. It also carried a cryptic plaque designed to convey knowledge of the Earth and its inhabitants, if it should ever land on a remote planet in outer space. The note in the bottle from a desert isle principle.

When Pioneer Ten achieved encounter on December 3rd, it was traveling at a Jovian gravity accelerated velocity of 82,000 miles/hr. and reached a maximum proximity of 81,000 miles from the cloud tops of Jupiter. The added momentum imparted to Pioneer Ten by Jupiters gravitational force will fling the spacecraft out of our solar system and will be the first man made object to do so.

Our space probe will send back information about a planet that was first seen by Galileo in 1610. It is a strange planet by earth standards, having over 1000 times the volume, but only 300 times the mass because of lower density. It rotates in slightly less than 10 hours, but takes almost 12 years to go around the sun. Since it is 484 million miles from the sun (we are 92 million) it gets only 1/27th of the solar energy we do. This was why Pioneer Ten needed RTG's instead of solar panels to generate electricity.

Next to the sun, Jupiter is the noisiest planet, bending the ears of radio astromers with varied radiation. It is the largest of the planets in our solar system with an equatorial diameter of 88,720 miles. This and the rapid rotation would make a 150 pound earthling weigh 354 pounds at Jupiters equator and 411 pounds at the poles.

The two greatest mysteries about Jupiter that have intrigued star gazers for years are the fact that Jupiter radiates two to three times more heat energy than it gets from the sun and the Great Red Spot whose color, brightness and presence varies from time to time. Perhaps Pioneer Ten will provide new and dramatic information about this unusual celestial body and its Galilean satellites as the flow of data is process and analyzed. □

Management Highlights

Some years ago this magazine carried a major article and follow-up information on remotes from space. The question at that time might have been, "So what does that have to do with commercial broadcasting?" We're still finding out how important space and satellite remotes can be. If we are to continue to take advantage of the technological advancements spilling over from NASA projects, we can't afford to file this event away as just an interesting news happening.

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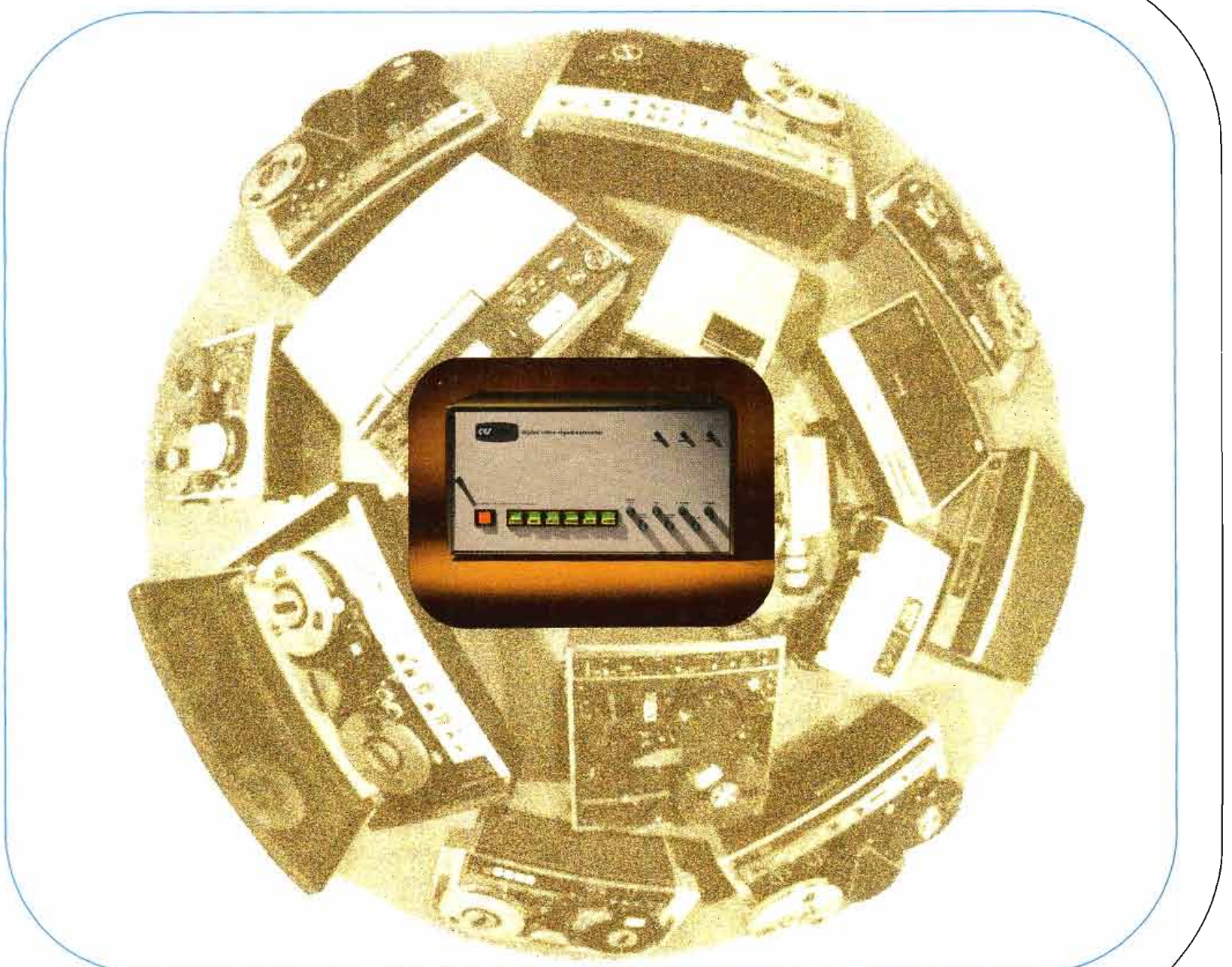
CONSOLIDATED VIDEO SYSTEMS TOTALLY WIPES OUT THE LANGUAGE BARRIER BETWEEN HELICALS AND QUADS.

INTRODUCING THE CVS 504. A SINGLE "UNIVERSAL" DIGITAL VIDEO SIGNAL CORRECTOR FOR ALL REASONS.

We know it sounds wild, but the new CVS 504 works with ¼", ½", ¾", 1" and 2" non-segmented helical VTR's. In color, it doesn't matter whether the signal from the tape recorder is direct or heterodyne.



For example, how about taking a Sony U-matic* tape and dubbing it up to a quad? Easily done with the 504's exclusive "color interlacer" switch. The result when played back on the quad will be phased interlaced color.

Or, how about taking an EIAJ ½" recorder and using it as a camera source locked to house sync. It's easy with the CVS 504 if the recorder has a capstan servo. Even if it doesn't, you can still drive a camera from the internal sync generator in the CVS 504 and do special effects between the recorder and the camera.

Come to think of it, there isn't very much you can't do with the CVS 504. Your CVS Representative is carrying a videotape with him these days that demonstrates most of the 504's features. Why not ask him for a look at the tape? Or, you might ask him for a demonstration. Or, just drop us a line. We'll send you some literature on the CVS 504.

It's some kind of time base corrector.

*TM Sony Corp.

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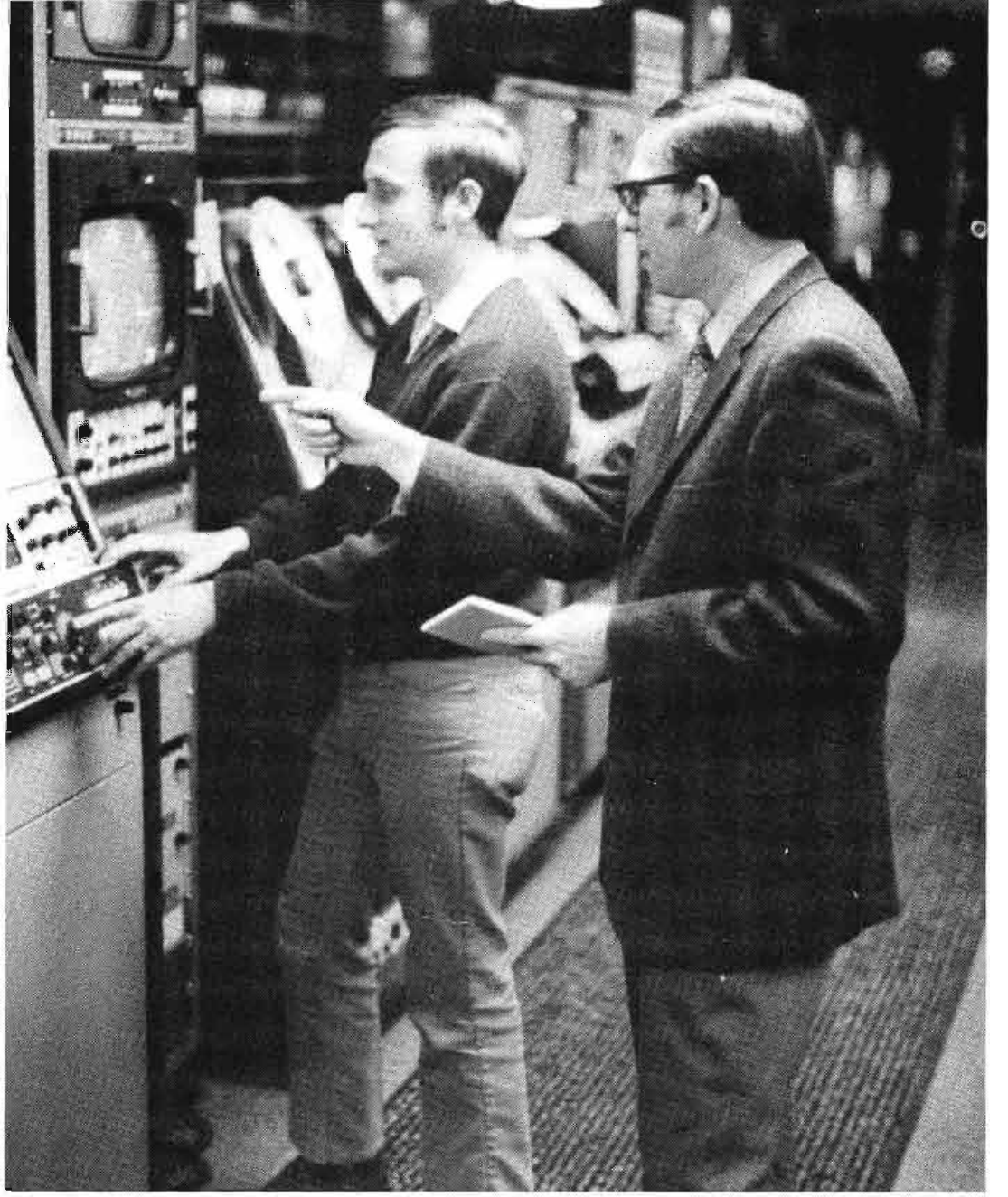

Lawrence Baker (left) editing a news feature with Dick Hammer suggesting inserts at WKYC-TV.

Efficiency breeds profitability

By William F. Baker*

A psychiatrist friend of mine told of a study conducted by medical students involving the blood pressure and heart rates of people who work at television stations. Much to the researchers' surprise, the people who registered as the most "uptight" during live television productions, those with rapid heart rates and elevated blood pressures, were the cool acting technicians and engineers—not the on-camera talent.

This says a great deal about those behind-the-scenes in the TV business. For one thing, technical people take their jobs seriously, knowing that a lot depends on the push of a button or the twist of a knob. Another frequently overlooked element in the role the technician and engineer plays is that more and more they are becoming a creative component of the television station team. As such, they can have an even greater effect on profit and loss.

*Executive Producer, WEWS, Cleveland.

New Talent Coming

Around the country there are new trends in hiring technical people. Some include the use of operators (people with non-technical backgrounds who just run equipment), leaving the repair and maintenance to a separate crew. Another is that with the advent of "fast-ticket" schools many new technical employees holding a license enter the market with no experience in broadcast engineering and are seeking jobs which will be creative ends in themselves.

Of course, there are the age-old problems of attitude discrepancies of men in the technical crews. There are those who are holding on because it's a job which allows them to work in an assembly-line fashion, making money for their weekend trips in the camper. Then there are those who come to work seeking the creative, intrinsic challenge of the job—the men who want to do more with their equipment than just keep it running.

On the videotape side, the operator is confronted with several problems—mechanical and psychological. Since most videotape editing at commercial stations is assembling, the operator is usually confronted with the reality that he has a technical facility (sophisticated electronic editor) capable of doing much more than he is often asked to do. Furthermore, since the operator is under constant time pressure, he tends to reject using the editor and instead does a fast-but-dirty job in the assemble or insert mode because it is a quicker method.

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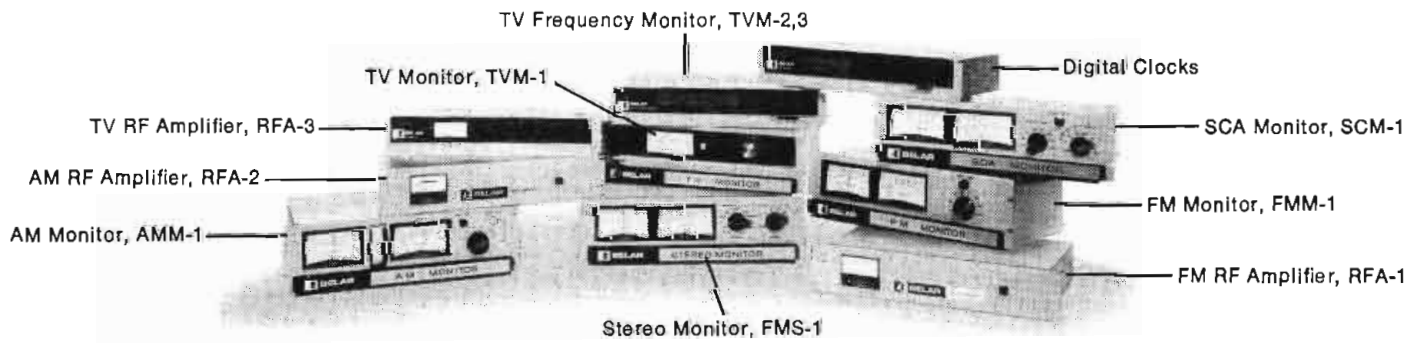

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Control Room team working up tape program production. Dick Roecker, technical director (foreground) and Hank Zbreski, audio man (rear).

Here Baker and Roecker discuss a "B" roll insert.

Frustrations are often caused by more than just pressure and facilities. A good videotape man knows that he can edit as fast and as efficiently as any film man, but frequently he is not given the creative latitude of his film counterpart. Over and over again director or station policy dictate that "B" rolls be run through a control room, making many passes necessary before the final program is properly produced. Often hours could be saved by just telling a videotape operator to insert the "B" roll himself. It would also be a great advantage and time saver, in most stations that do editing, to provide the operator with a small video switcher/fader, thus completely freeing a control room and crew from doing editing which can be accomplished in the videotape room by one qualified man.

Production Editing

As the videotape editor becomes more proficient, there is almost no task which is too difficult. Rather than using the original film, videotape is being used to edit news production pieces and mini-documentaries, to tighten commercials and to edit sporting events from full-length to a shorter-timed length since audio. Video can be edited together, so tape editing is often a faster, more efficient process. Oftentimes, stations dub almost raw newsfilm directly to tape for editing rather than using the traditional film techniques. But even as new applications for electronic technology become utilized, there are those stations whose manpower organizations do not keep abreast of these new developments, and subsequently one might find directors, technical directors and full crews continuing to be used in jobs which require only one good man.

This reticence to change can be dangerous from an organizational point of view because it is essential that a station be ready to cope organizationally with technological changes. The station must make money, and to turn a profit the engineering department must have determination and be vocal in the organization in order to find new and better ways of getting the job done. This might mean some rather unorthodox methods and personal reassignment, but such methods must be used if there is to be progress.

Granted that unions and large station operations offer tremendous barriers to personnel reassignment or change, but for an engineering department to maintain its viability as a creative part of the broadcast organization, it must do its part by operating in the most efficient possible way. This is good for the engineer in the long run too. The man who is constantly contributing creatively to the station's input will always be in demand.

In the process of getting men to understand that efficiency and profitability are vital, it is up to the chief engineer or supervisor to understand the psychological and operational needs of his men. Too often chief engineers simply schedule facilities, make decisions regarding new equipment expenditures, or negotiate contracts but are not conversant with the everyday operations of their own facilities. If the supervisor would occasionally walk through the control room and talk with the men to determine what is really going on as well as offer a few "job well dones," the chances for change would increase. This presupposes that the supervisor and engineer communicate well with one another.

Because station facilities are technically so advanced, it is not unlikely for a man to implement a very creative operation on his own which is never seen nor acknowledged by management or the technical supervisors. For instance, we know a man who edited down a three hour hockey game into an hour and a half without ever missing a play! The end product was so smooth, even the station management was unaware that it was highly edited. It would be ideal if technical supervisors were aware of such extraordinary achievement, giving it due acknowledgement. Such recognition is good psychology and helps set standards for others

to meet. Further, it invites individual initiative on the part of others at the station.

It's That Time Again

Another difficult but critical decision to be made by engineering supervisors and chief engineers is to place men on the jobs (but not necessarily the shift) they really want to take. Rotation is good because there are some positions nobody wants today. We are all familiar with the perennial complainers found at every TV station, but more often the majority of the men enjoy what they are doing, taking pride and a sense of accomplishment in their work, and are willing to deviate from the "book" to get the job done.

While most engineering departments understandably feel that all technical people should be compatible and able to work interchangeably with one another, anyone who has ever been at a television station for any length of time knows that some people are "more equal than others" on technical assignments. As equipment becomes more refined and the simple, mechanical and electrical functions become automated, the technician or engineer is free to become more of a creative talent or producer rather than simply a man who operates a machine.

This new personnel crisis which is taking place in the TV engineering world must be grappled with. It is exciting as well as encouraging to report that it is being dealt with effectively at many stations. The reality is that the engineer must assume this new role in order to keep the station viable. Gone are the days when a station could make money by simply being on the air. Today a station must be run as efficiently as any other business in order to survive. This includes all departments and engineering has never been immune.

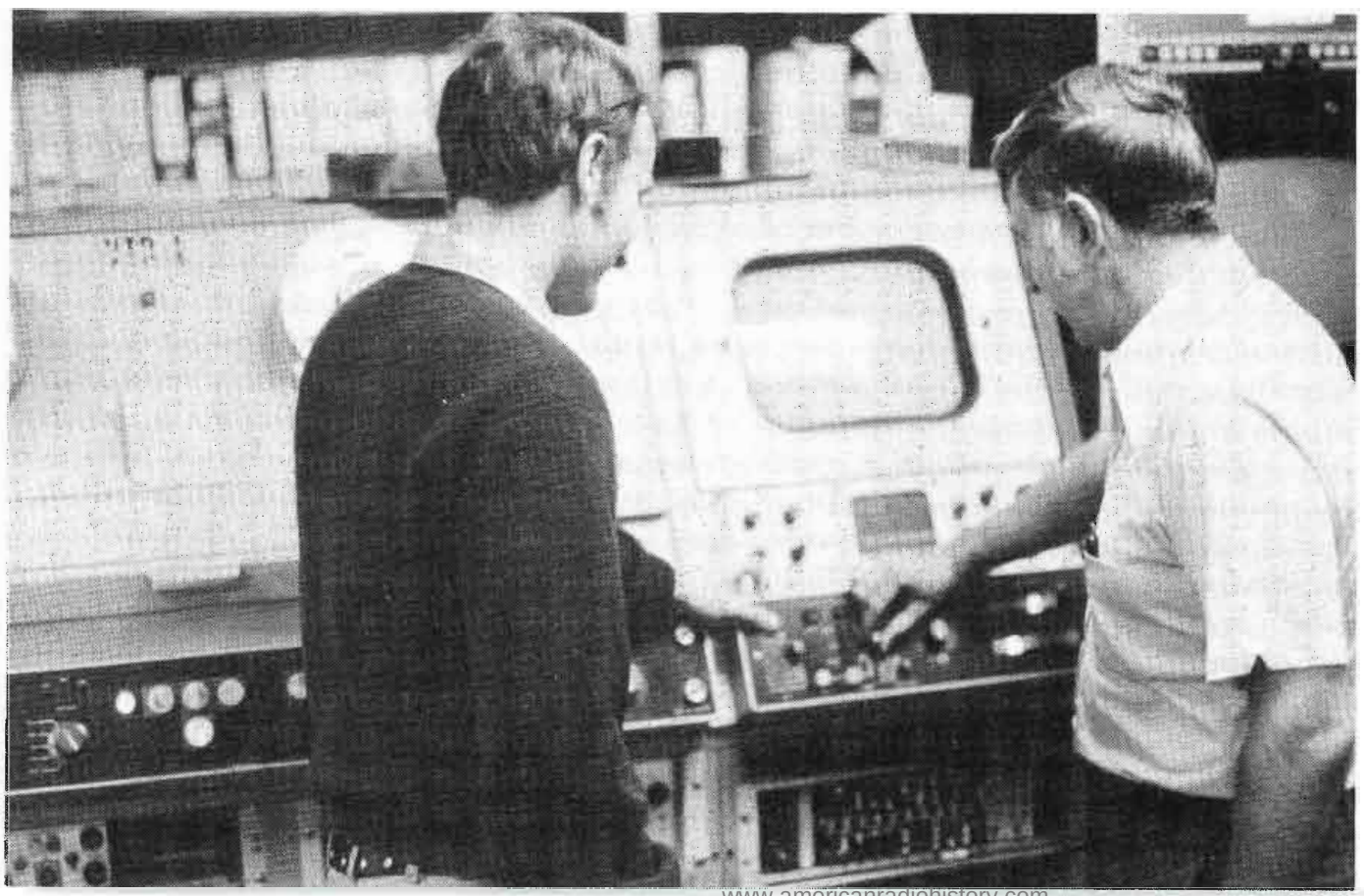
Let's Get Together

In order to maximize this creativity which leads to higher productivity and profits, engineering should be privy to definite guidelines and expectations. How many of us have watched people come into the control room delivering orders to the engineers to do this and that, only to leave three hours later with a product that could have been packaged in fifteen minutes if the engineers had been consulted initially. Clients, producers, talent and station management must be educated to consult with engineering representatives before any new production is attempted. The technical department should provide bright, understanding liaison representatives to help make it work. Such education will probably come slowly, but the more engineering extends a friendly hand, the more often it will be taken.

Efficiency must be constantly evaluated within engineering departments. For example, the videotape cartridge machine has been one of the greatest boons to television station operations, but few stations have set up an orderly program for the implementation of reel-to-reel to cart dubbing and the manning of the new machines. When commitment of funds for new purchases is discussed, guidelines for using the equipment must be set up. Also, the tendency at many stations to employ non-technical assistants to run such equipment, while having some merit, can be detrimental to the efficiency of the engineering department.

As equipment improves, so must the technicians' competence—not just in maintenance but in specialization and knowledge of exactly what he can do with his equipment. How many of us have been at stations where there was sophisticated editing equipment that no one really knew how to use?

This all boils down to the fact that engineering must hold up its own end of the profit picture. This can be achieved through trying creative techniques which would enhance the efficiency of operation. In order to implement this creativity, communications must flow readily between management, engineering and other departments. □



Baker checks VTR with Bob Sourek, Videotape Maintenance Technical Director. (All photos in this article were taken at WKYC-TV, Channel 3, Cleveland.)

A full-service phone system

part 2

By Mark Durenberger

After covering some construction tips, line switching controls and outgoing lines in the January issue, we'll move on to our second and concluding part of this series. In this part we'll discuss line switching, interfacing, and telephone mixing.

Line Switching

Now that we've got the line relays working, let's see what they do. We settled on a 6PDT P&B MH23D relay and since the sealed version wasn't available at the time, mounted ours for easy cleaning (Figure 7). Two contacts switch telco Tip and Ring (T,R) (see Figure 9). In the "Off" mode the T and R on incoming lines is connected to pre-delayed program feed for callers waiting in line. The T and R on the outgoing lines are normally connected through their relays to a desk telephone and switched away from the phone when put on the air.

When a relay closes, Tip and Ring are connected to the DC holding circuit, a choke with negligible reactance at audio frequencies but which holds up the telephone line. Non-polarized capacitance keeps DC from the isolation transformer primary (heaven forbid!). A third relay contact completes the station telco busy lamp control circuit (A, A1) through "Hold" switches.

A fourth contact provides the latch function, and sends a control voltage to the audio card and the tally-light driver circuit. Contacts five and six switch the audio side of the transformer onto the 600-Ohm bus and send it to the speaker-phone (terminals 19 and 28). We have been able, with this arrangement, to tie as many as three callers together with the announcer, with satisfactory results.

The "automatic-hold" portion of the system was not installed at the time of writing but is shown in Figure 5. A bridging transformer with good low-end response is employed. A non-polarized blocking capacitor keeps DC from the winding and the circuit is tied across the Tip and Ring of all incoming lines without affecting them. The 20Hz ring voltage as rectified drives the two relays through the transistors on the circuit board.

In order to put a call in "Hold" as we do, using the telco "Hold" relay, it's necessary to momentarily interrupt the busy lamp (A, A1) circuit while maintaining a "load" on the Tip and Ring, then open both circuits. This is done mechanically by the pushing of a hold button on a desk set. It's performed electrically in our main control system by the opening of the A, A1 circuit with the "Hold" buttons while a command is also sent for the slightly delayed release of the line relay. In the automatic-hold circuit shown here, we do it with a slightly delayed action of relay K2. This circuit is disabled under normal operation and is employed only when we don't have a producer on duty to screen calls.

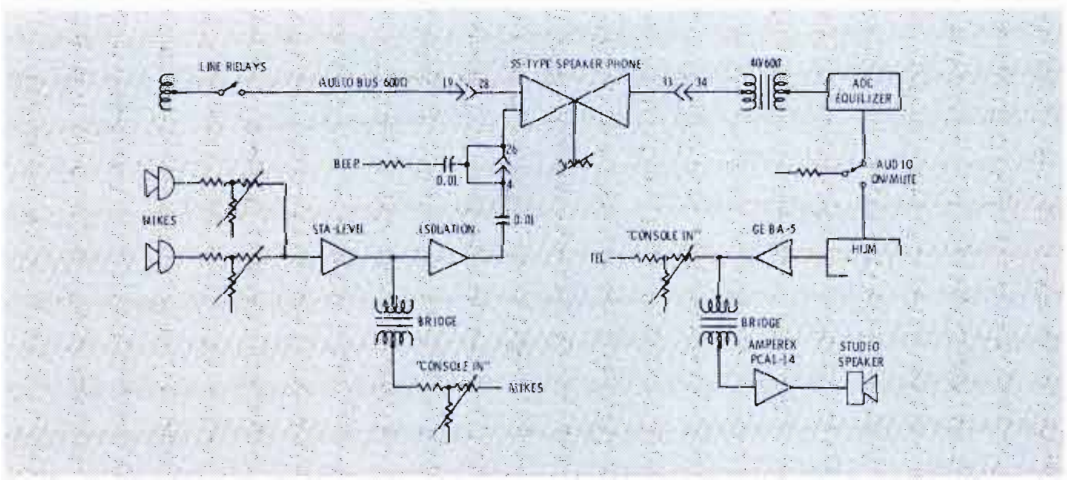


Fig. 10 Connections to Speakerphone. Transmitter furnished was disconnected (terms 4 and 26) and mike audio and beep tone connected instead. Volume control on original transmitter is still used. Speaker furnished was disconnected from 33 and 34 and connected **after** the average-level device. To keep feedback at a minimum, some high-end rolloff at input (4 and 26) is suggested. Small capacitor across those terminals should do it.

Interfacing

We use the speaker-phone type 55A and a recorder-connector KS-19645L2 as our interface equipment. All our telephone circuits appear properly color-coded at an AT&T standard connector block and are further extended to a standard 50-pin Amphenol plug to mate directly with the telephone company's normal business-phone cable installation. To provide status indicators, the lamps in the illumi-

nated switches (#330) are connected to the telco busy lamp circuits (designated 'L, LG').

Our attorneys interpreted the new rules as meaning we needed a "beep" tone at all times since they considered our delay system a tape recorder. So we used the beeper, but have shortened up the beep tone somewhat. One way of legal interfacing requires you to run Tip and Ring through the recorder-connector, and this drops the beep on the line in both directions. If you have other accepted means of connecting, and wish the beep to be heard by the caller but not on the air, try dropping the beep tone **only** onto the "send" terminals of the speaker-phone (Figure 10).

It should be pointed out that the Carter-Fone decision has allowed a lot more freedom in connecting **non-interfering** equipment to telephone company lines, but it's still imperative that you check with your local representatives before attempting an installation of this sort. And be sure to keep your connections standardized!

Functional

We mounted all switching equipment, the speakerphone, recorder-connector and a GE BA-5 modified to act as an AGC amplifier, in a standard equipment rack. The loudspeaker from the speaker-phone was connected **after** the BA-5 and gives us a much better average level in the studio. The entire audio path is shown in Figure 10. A status/test panel which we added allows us to bypass most of the relay-driver circuits or test-switch any relays that may be acting up. It also contains the audio distribution for the pre-delayed cue fed down the incoming lines in the "Hold" mode. The best way to feed these lines would be separate amplifiers for complete isolation from line to line but with the values shown you get pretty fair isolation...a small amount of ringing can be heard on adjacent lines in "Hold" but it's not objectionable.

We made some functional changes in the studio from our original unit (Figure 2). The dial was disconnected, we added the tally lights and lock-on keys. It's now necessary to dial a call off the air using a desk telephone flanking the unit. The moment that line is put on the air the telephone is disconnected from the circuit. At desk sets which display the incoming lines, a push-to-talk switch in the handset cuts the program cue being fed down the line so callers can be screened off the air.

Telephone Mixing

There are three generally recognized methods of putting a telephone call on the air combined with a local announcer and maintaining a reasonable degree of fidel-

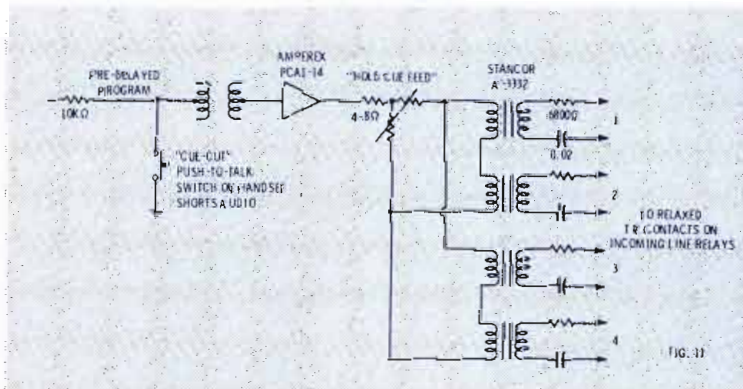


Fig. 11 Program feed in "hold". See text for values.

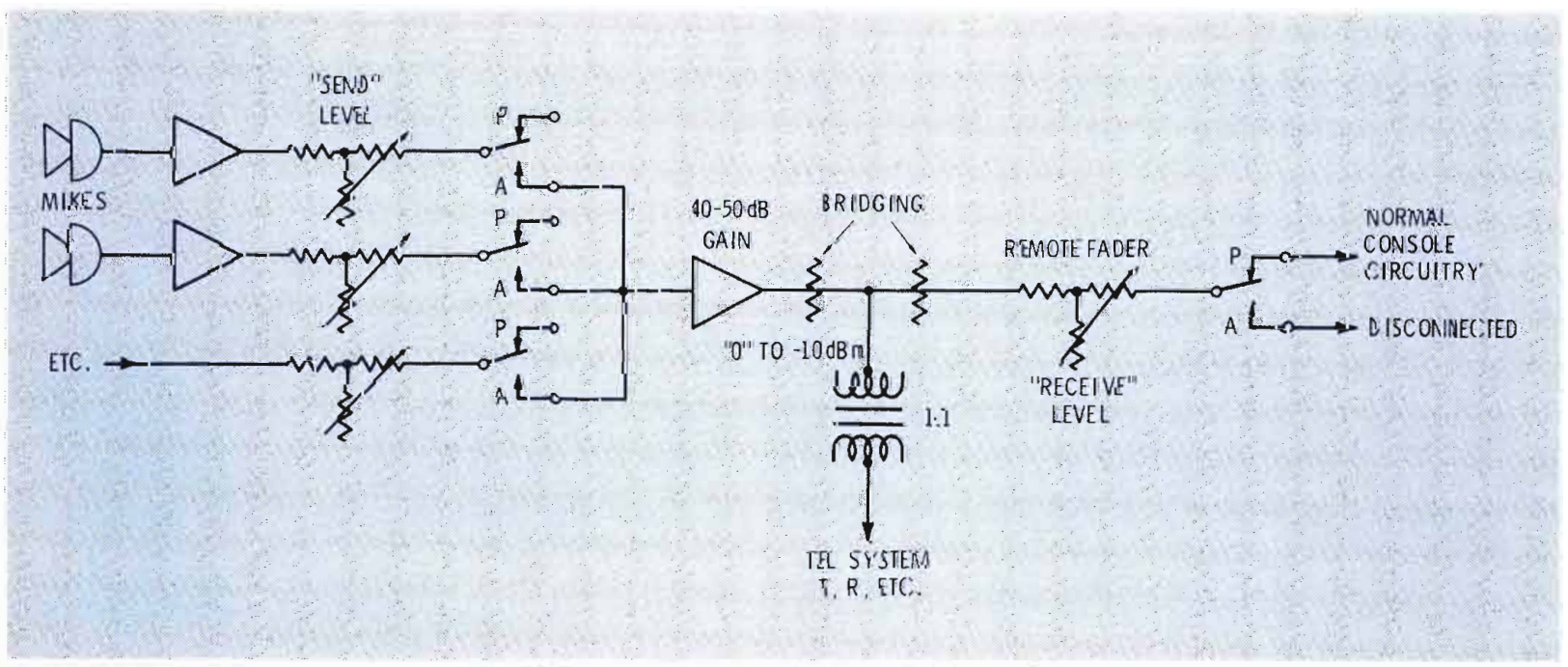


Fig. 12 Balanced-level method of telephone mixing.

ity The first of these is the "Hybrid" system which most efficiently utilizes specially-wound coils or high-quality matching transformers connected out-of-phase with the general aim of blocking mike audio from one path of the system. The actual method is its own greatest drawback...in bucking mike audio out-of-phase you create a phase-shift at both ends of the audio spectrum creating a sound which deteriorates from normal microphone quality. Furthermore while this method allows up to about 6dB better telephone-versus-mike level, to operate at highest efficiency you'd have to retune the balancing network for each call to match the reactance of that particular line.

There are plenty of arguments for both the speaker-phone and the "balanced-level" method of mixing. Both offer decent fidelity. The better over-all method...especially if used on a limited basis and on high-quality phone lines, is the balanced-level method. This system probably offers the best fidelity, is very reliable, but its chief drawbacks are that you're difinitely limited in the amount of audio you can send the caller unless you've got an operator riding gain 100 percent of the time.

And when operating normally, announcers and guests must wear headphones. And reactance of the telephone line **will** alter the audio quality under extreme conditions. If you're facing a great variety of calls, under widely varying conditions, on a 24-hour continuous basis, and don't have a man available to ride levels 100 percent of the time, you'll probably choose the speaker-phone.

This system directs about 10dB more audio toward the caller, provides good isolation between the telephone and mike circuits, and has pretty good AGC qualities. Its principal disadvantage is its one-way gating which allows audio flow in only one direction at a time. So while you'll always have the announcer on the air, he can usually outshout the caller. You can balance the unit so that whoever is talking first holds the gate, or in such a way that the announcer always "ducks" the caller. We tried it all ways...it's really a matter of station philosophy...and have ended up with a compromise...because of the compression added to the mike circuit the announcer has to work to override the telephone.

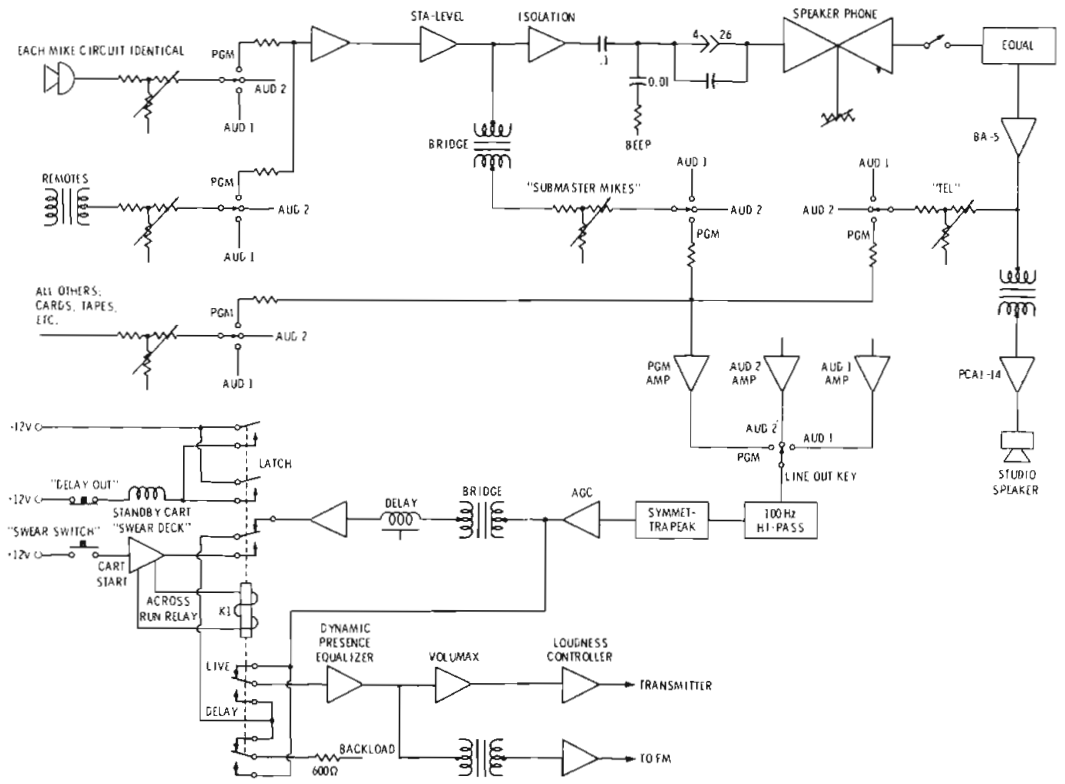


Fig. 13 Block diagram of the full-service system.

When the system is properly used, you'll not even notice the ducking effect...it's pretty fast. Both systems require some modification to station equipment and an additional amplifier (or more). Note the changes we made to the speaker-phone (Figure 10). We don't use the transmitter provided, although its gain control is mounted in the rack, but send mike audio and the beep tone together as shown.

Both pre-delay and on-air feed to the telephone is fed at about the same level (-2 to +4dBm). To allow the caller to differentiate between the "Hold" mode and when he's switched on the air, we installed a high-pass filter in the microphone transmit circuit. The change in audio quality alerts the caller...and also eliminates some of the triggering of the speaker-phone caused by low-frequency thumps in the studio, etc.

Most of the rest is pretty straightforward. Because the remote lines are connected to the mike submaster bus we can make a talk show "on the road" using a loop and a pre-delay cue circuit.

We originally operated 21 hours per day in delay, so the cartridge-delay method was chosen. We wound our own carts and changed them daily, although we got about three days' use from them. The standby deck allows very smooth operation in going into delay or in wiping an objectionable comment. A push on the Swear Switch starts this deck which plays a seven-second jingle directly on the air, and operates the live/delay relay if it isn't already latched. So there's never any dead air. And that's how we did it at WLOL...The Talk of the Twin Cities □

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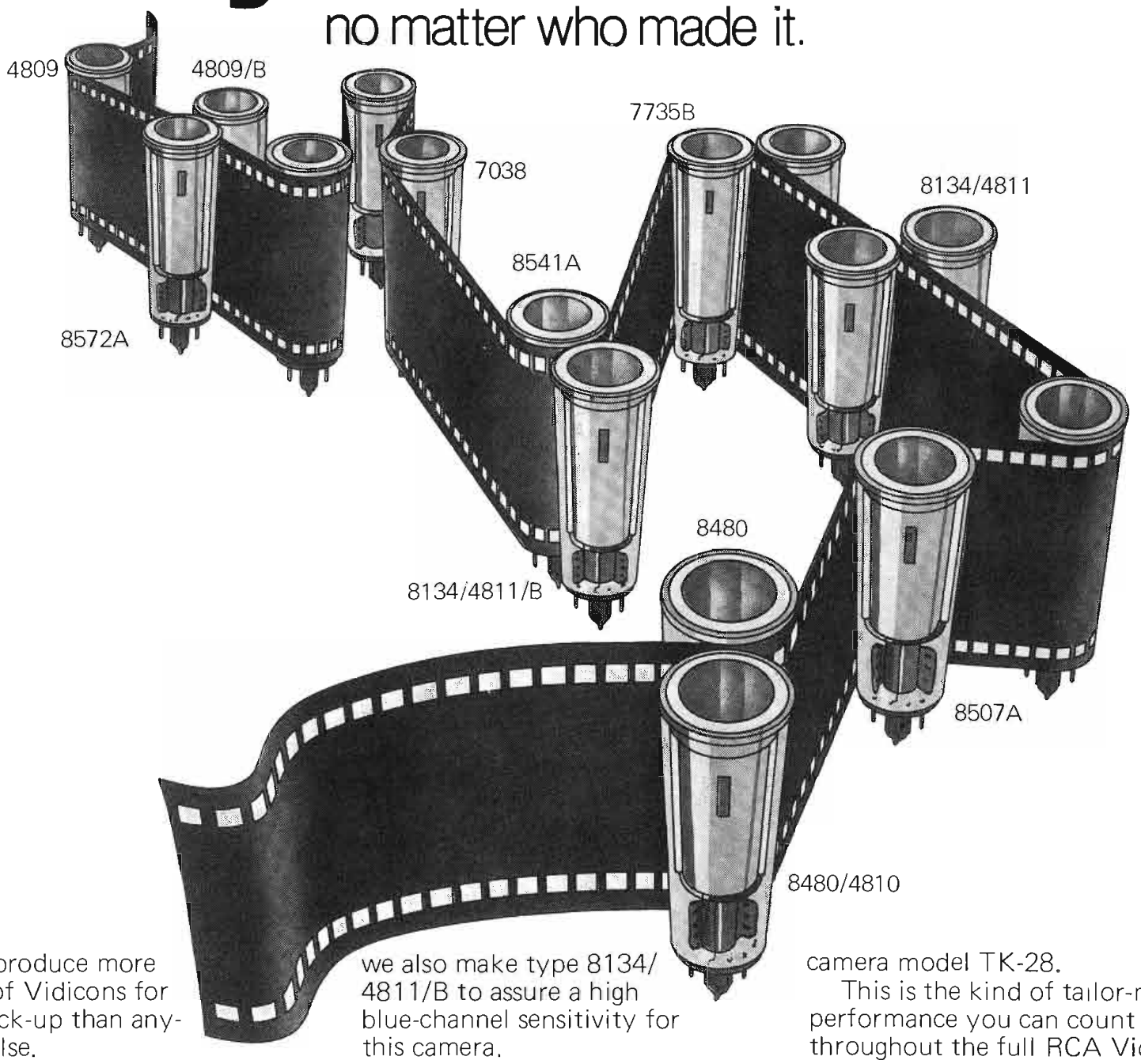

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Let's minimize those FM transmitter problems

WDAI's maintenance supervisor, Harry Priester, examines a synchronous AM noise reading prior to performing the annual proof.

By Glen T. Clark
Engineer, WLS Radio, Chicago.

During an FM equipment Proof-of-Performance, it is not uncommon for stereo and SCA crosstalk figures to be well within legal limits when measured at the exciter output, but fall short of the mark when measured at the transmitter output. This degradation is usually a result of phase distortion of the signal introduced by the transmitter itself.

While equipment sophisticated enough to measure phase shift at 100 MHz is beyond the scope of most broadcasters, a unique identity of the AM noise measurement makes it possible to indirectly measure these shifts and minimize them using equipment already on hand.

First, let us lay a little groundwork. Conventional AM noise is nothing more than an amplitude variation of the carrier at an audio rate. As in Figure 1, E_1 represents the carrier voltage, and E_2 represents the undesired variation.* The noise level in dB down is: $dB = 20 \times \log_{10} \frac{E_2}{E_1}$. Because the smaller number is the numerator, the solution will be a negative number. To meet the -50dB requirement set forth in FCC Rules Part 73.317(a)(5). E_2 must be less than 0.316 percent variation!

In the early days of FM broadcasting, maintaining a minimal AM noise figure was a primary consideration because of the primitive receiving circuitry available. In addition to detecting the desired frequency modulation, early discriminators were also very susceptible to amplitude variations. One

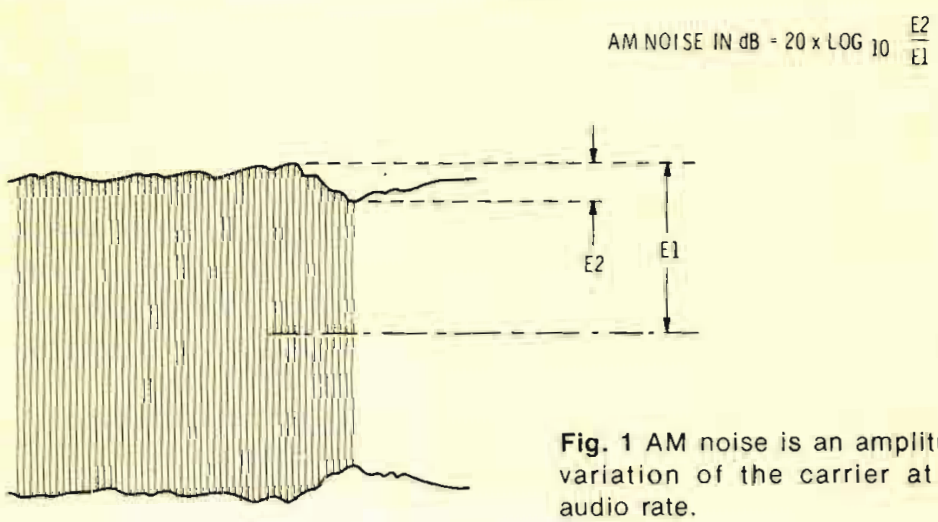
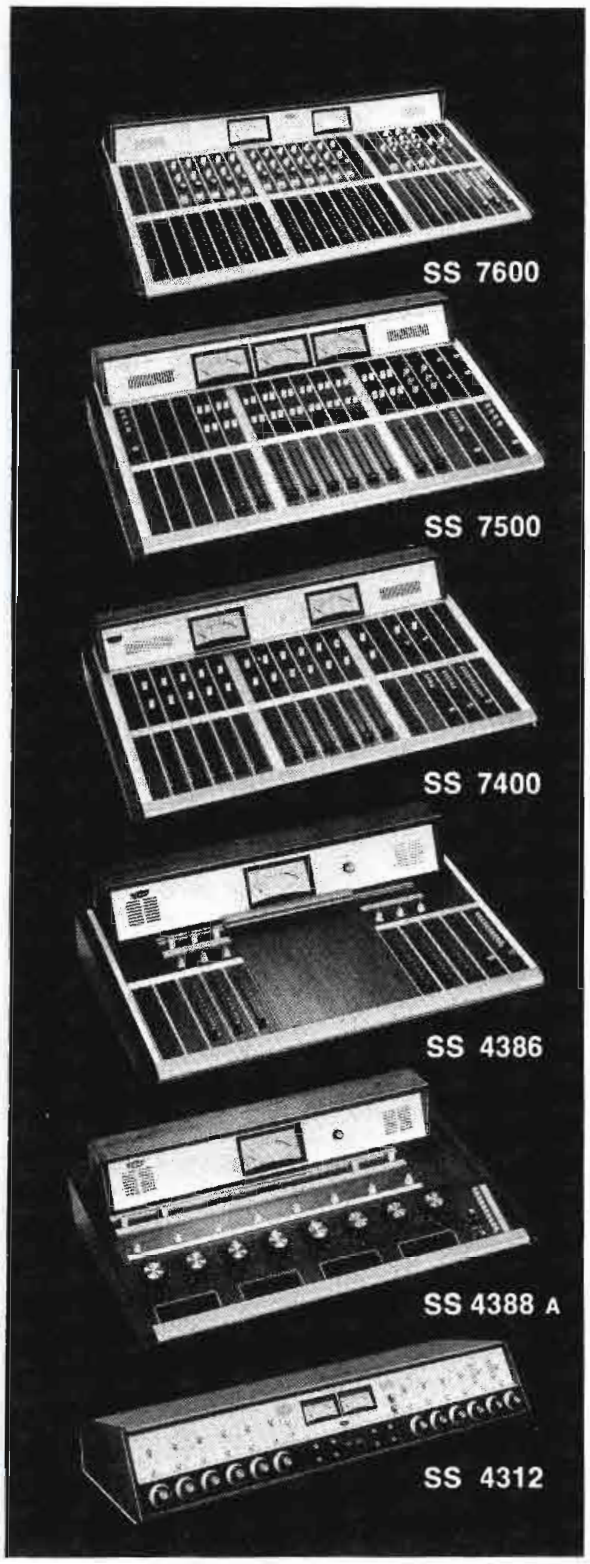


Fig. 1 AM noise is an amplitude variation of the carrier at an audio rate.

*Because of the extremely low noise levels involved, it is impossible to represent them graphically to scale. The noise or deficiency in each of the illustrations has been greatly exaggerated and they are relative only to each other.



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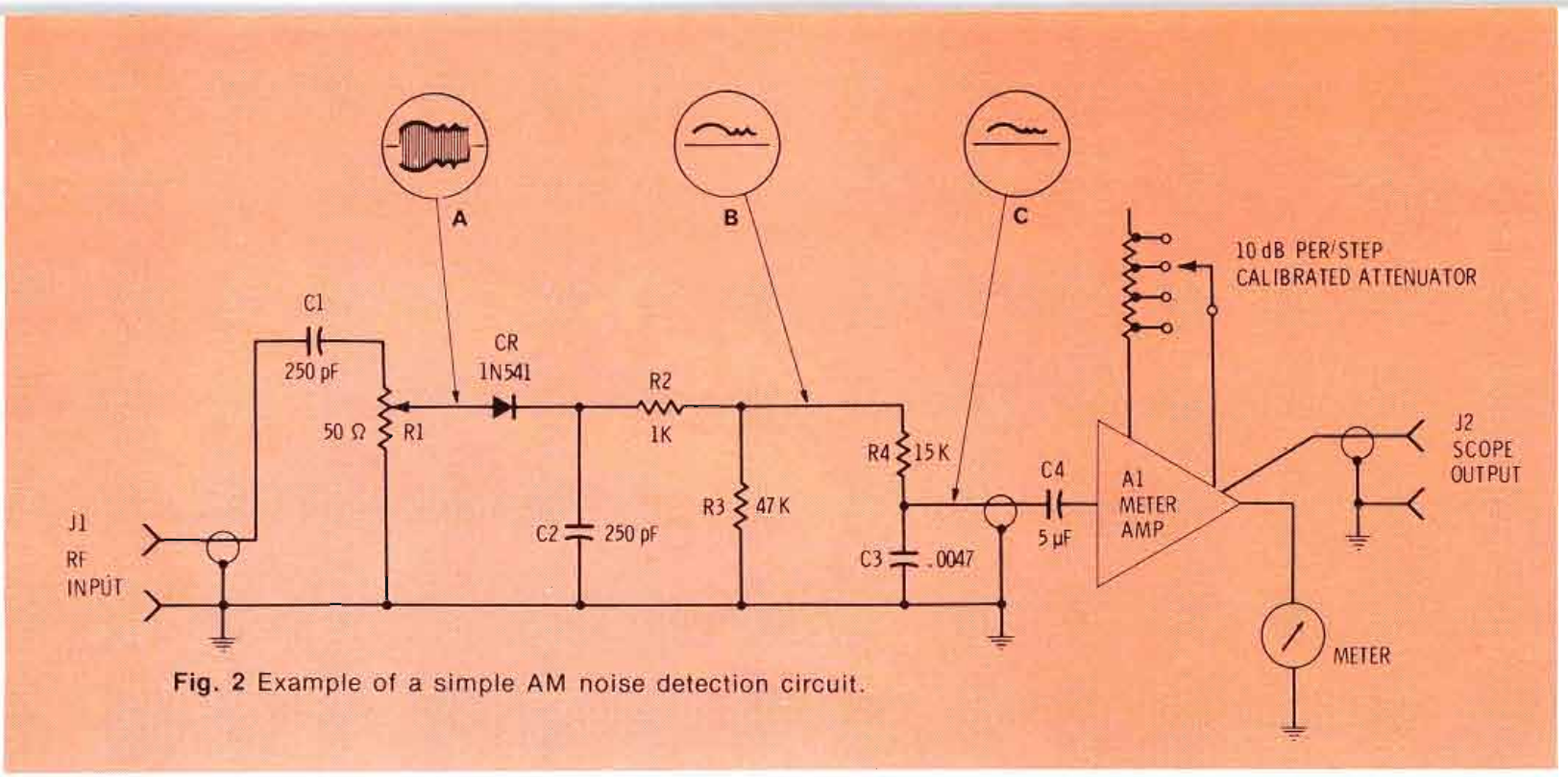

Fig. 2 Example of a simple AM noise detection circuit.

rough gauge of the quality of an FM receiver was the presence and number of AM limiters between the IF strip and the discriminator.

Today, advances in technology have made it economical to include effective limiting circuits ahead of the discriminator in even the cheapest receiver. As a result, one of the reasons for a stringent AM noise criterion has disappeared. However, the AM noise measurement still serves as an invaluable tool in diagnosing and correcting related equipment problems.

Detection

Figure 2 illustrates a simplified version of the AM noise detection circuit used in one popular FM monitor. Sampled RF is coupled into J1 from the transmitter. R1 serves as the termination to the sampling line and also as an input sensitivity adjustment. CR1 rectifies the RF signal, which is then filtered in C2. The RC constant of C2, R2, and R3 is chosen to be long enough to filter out all traces of the RF signal, yet short enough to pass all audio frequencies.

The "detected" audio is de-emphasized by C3 and R4, DC isolated by C4, and brought up to a usable level by meter amplifier A1. A 20 dB-per-step calibration attenuator is included within the amplifier and serves as a range selector. The amplifier output is then fed to a damped meter and to an oscilloscope output.

Notice that the high frequency components present in scope trace B are greatly attenuated in trace C, while the low frequency components remain in their original magnitude. The AM noise measurement is **de-emphasized** in this manner in accordance with 73.317(a)(5). The rationale behind this requirement is also somewhat dated: in early FM receivers, susceptibility to amplitude variation allowed any AM noise to appear in the speaker along with the desired audio. But because the discriminator output is de-emphasized, the high-frequency components, whether AM or FM induced, are attenuated. Thus, in order to get a meaningful representation of how the AM component affects the loudspeaker, the noise measurement is also de-emphasized.

Interpreting AM Noise

Problems encountered in obtaining a satisfactory AM noise reading under static conditions (on an unmodulated, frequency stationary carrier) can usually be routinely diagnosed and treated. Most are the result of variations of one of the PA supply voltages. **Which** voltage can often be determined simply by connecting a scope to the monitor's scope output and determining the frequency of the offending waveform. 180 Hz or 360 Hz suggests filtering problems in the B+ (for transmitters using 3-phase supplies). 120 Hz indicates ripple in the screen voltage or control grid bias. And most 60 Hz hum can be traced to an off-center filament ground.

After obtaining a satisfactory static AM noise figure, considerable additional information can be realized from a measurement of **synchronous AM noise.** Sychronous AM, sometimes misnomered as incidental AM, is the additional amplitude variation induced under the dynamic conditions of frequency modulation of the carrier. This is the result of the decreasing amplitude response of the transmitter toward the extremes of the passband as shown in Figure 3. As the carrier swings to either side of resonant center frequency, the power dips **in synchronization** with modulation, hence the name.

In any resonant LC circuit, $X_L = X_C$ at resonance. At frequencies above resonance $X_L > X_C$ and at frequencies below resonance $X_L < X_C$. Thus as the FM carrier swings with modulation to either side of center frequency, the plate load presented to the tube by its tank circuit is less than optimum. When working into other than an optimum load, the circuit efficiency drops, causing the power output to decrease. The amount of decrease or fluctuation depends on how great the excursion from resonant center frequency is, and how broadband the circuit is (its Q).

The greater the excursion from resonant center frequency, the greater the power decrease as can be seen in Figure 3. Likewise, the sharper the bandwidth of the resonant circuit, the greater the power decrease as seen in Figure 4. Figure 5 represents a tuned circuit which generates more synchronous AM than is necessary for its given

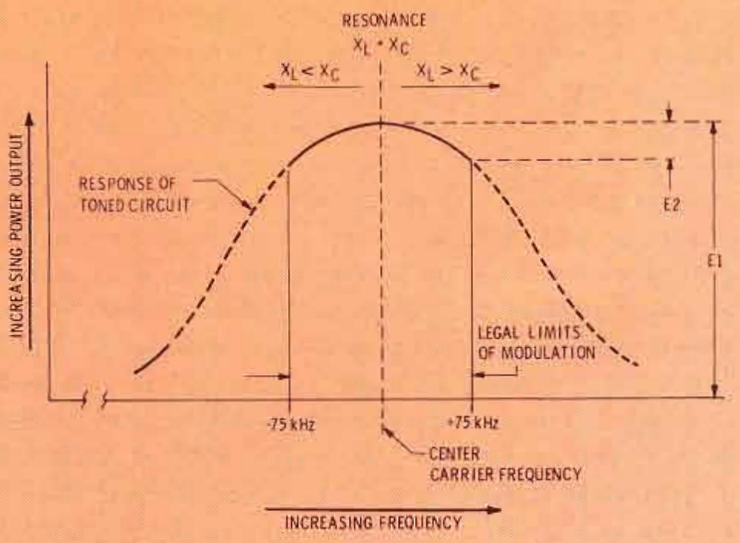

Fig. 3 As the carrier swings to either side, the power output dips in synchronization with modulation.

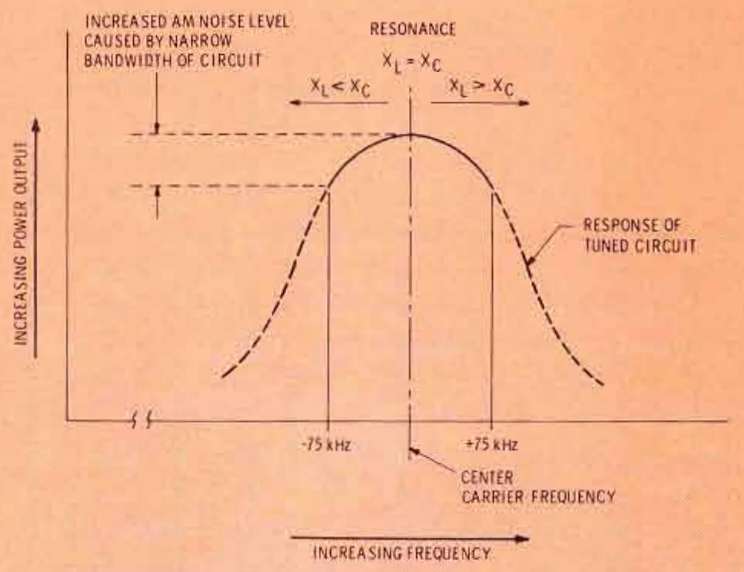

Fig. 4 The sharper the bandwidth of the resonant circuit, the greater the power decrease.

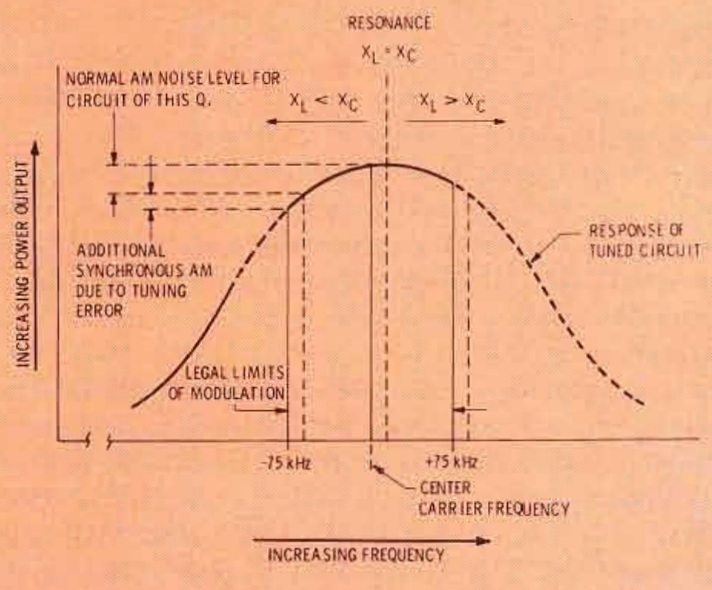

Fig. 5 A tuned circuit generating more synchronous AM than is necessary for its given bandwidth. When modulating on negative peaks, the carrier is well into the passband skirt where power falls off rapidly and additional AM noise is caused.

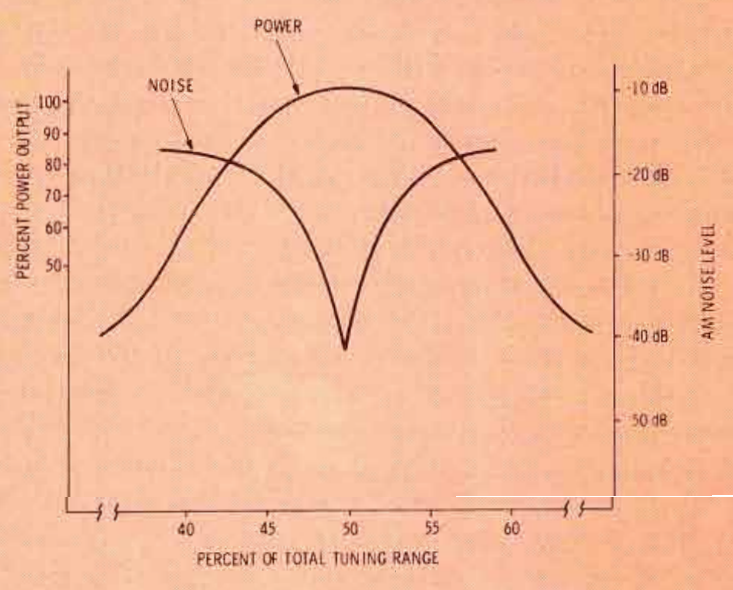

Fig. 6 The AM noise null and power peak of the stage normally will correlate.

bandwidth because it is resonant at a frequency above center carrier frequency. As a result, when modulating on negative peaks, the carrier is well into the passband skirt where power falls off rapidly, causing additional AM noise.

Where There's Smoke There's Fire

Synchronous AM generated as a result of any of these defects can cause problems on a "Where there's smoke, there's fire" basis. As the carrier swings to either side of resonant center frequency, the load presented to the tube becomes alternately capacitively and then inductively reactive. This varying reactance causes a corresponding varying phase shift within the tank

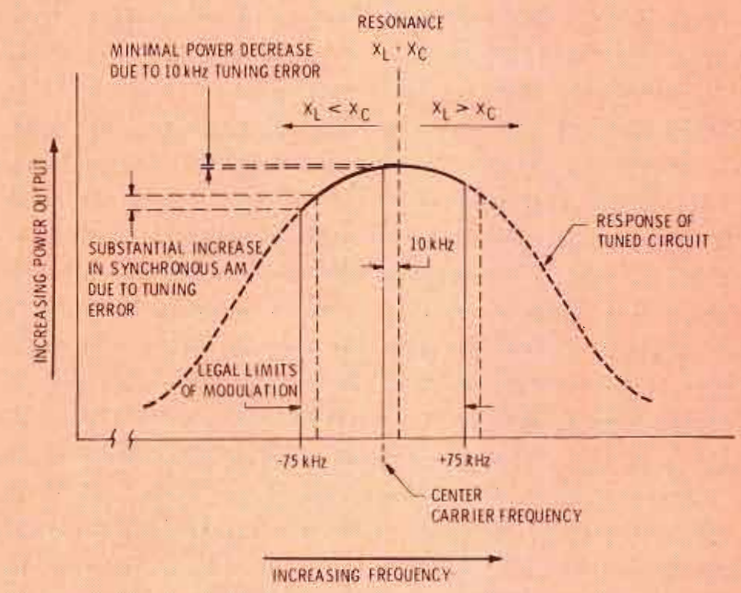

Fig. 7 When AM noise null and power peak correlate, the null will be more critical. The reason for increased sensitivity becomes apparent here.

circuit. A little exploration into network theory reveals that the degree of phase shift is a function of **how great the excursion from resonant center frequency is and how broadband the circuit is.**

From this line of reasoning, we can in most cases correlate increased synchronous AM with increased phase modulation of the signal. While we have established that most modern receivers are essentially immune to AM noise, the accompanying **phase modulation** is sufficiently similar to frequency modulation that it will be demodulated by the discriminator and show up as an amplitude deformation or **distortion** of the composite signal in the receiver.

Maintaining the prescribed stereo crosstalk figures of -40dB requires a precise balance of L+R to L-R and a very accurate reproduction at the receiver of the original composite signal fed to the transmitter. Any distortion of the L+R signal in the 50 Hz to 15 kHz range will show up as harmonics at higher frequencies. If these harmonics should fall into the 23 kHz to 53 kHz passband of the L-R subchannel, the main-to-subchannel crosstalk will be degraded. Likewise, either the L+R mainchannel or the L-R subchannel may show up in the 67 kHz SCA and supply your Muzak subscribers with a very unique blend of music.

This is the reason the Commission requires proof readings be taken at the transmitter output and will not accept measurements taken at the exciter output.

Tuning

As foreboding as this may all sound, tuning for minimum phase shift is actually quite simple. After tuning the transmitter in the normal manner, modulate with a 400 Hz tone at 100 percent, and set up the monitor (or external detector) to read AM noise. Decade down the monitor attenuator until an on-scale reading is obtained. Typically, this could be anywhere between -20dB and -40dB depending on how well the transmitter was originally tuned.

Now simply re-tweak each tuning control on the transmitter for minimum indication on the monitor. There is some interaction so this entire process should be repeated at least twice. It is not uncommon for a slight adjustment of a single control to make a 20dB change in indicated noise. Usually a dynamic noise reading of -40dB or better is ultimately obtainable.

The AM noise null and the power peak of the stage will normally correlate as in Figure 6. Both will occur at the same point; however, the null will be much more critical. The reason for the increased sensitivity becomes graphically apparent in Figure 7. The tank circuit represented is tuned 10 kHz above the carrier center frequency of the transmitter. This may result in a power output decrease of 1 percent or less, which is looking pretty close at your wattmeter. But it has already caused several additional dB of synchronous noise because the response falls off faster at the edges of the passband than in the center.

Occasionally the two points will not coincide exactly, due to an asymmetrical passband of the stage being tuned. In these cases tune for the noise null. If there is a wide disparity, however, some compromise will have to be made.

Most FM transmitter resonant circuits have only one variable reactance. Either a variable capacitor is used to resonate a fixed coil, or a variable stripline is resonated with a fixed capacitor. A few circuits may have both a variable capacitance and a variable inductance. In such instances, experiment with several different resonant LC combinations to obtain the best noise figure.

Antenna Problems

One final variable in the system is the antenna. Because the impedance presented by the antenna and feedline forms a major component of the PA tank circuit, any feedpoint impedance change within the bandwidth occupied by the modulated carrier will also manifest itself as a change in the PA tank. An antenna which is narrowband or tuned off-frequency, whether as a result of original installation error, lightning damage, or corrosion, will have the same effect as a mistuned stage.

While not desirable from a standpoint of efficiency and heat, a high VSWR will not necessarily pose a problem. It is possible to have a high VSWR which is uniform across the passband. Problems arise only when the VSWR changes over this interval.

The best method to verify suspected antenna maladies is to compare the dynamic noise figure attained when the transmitter is fed to the antenna with the figure attained when it is fed to a high quality dummy load. If the figures are similar, you may conclude that the antenna is in good health. If there is a wide discrepancy, the antenna bears further investigation. □

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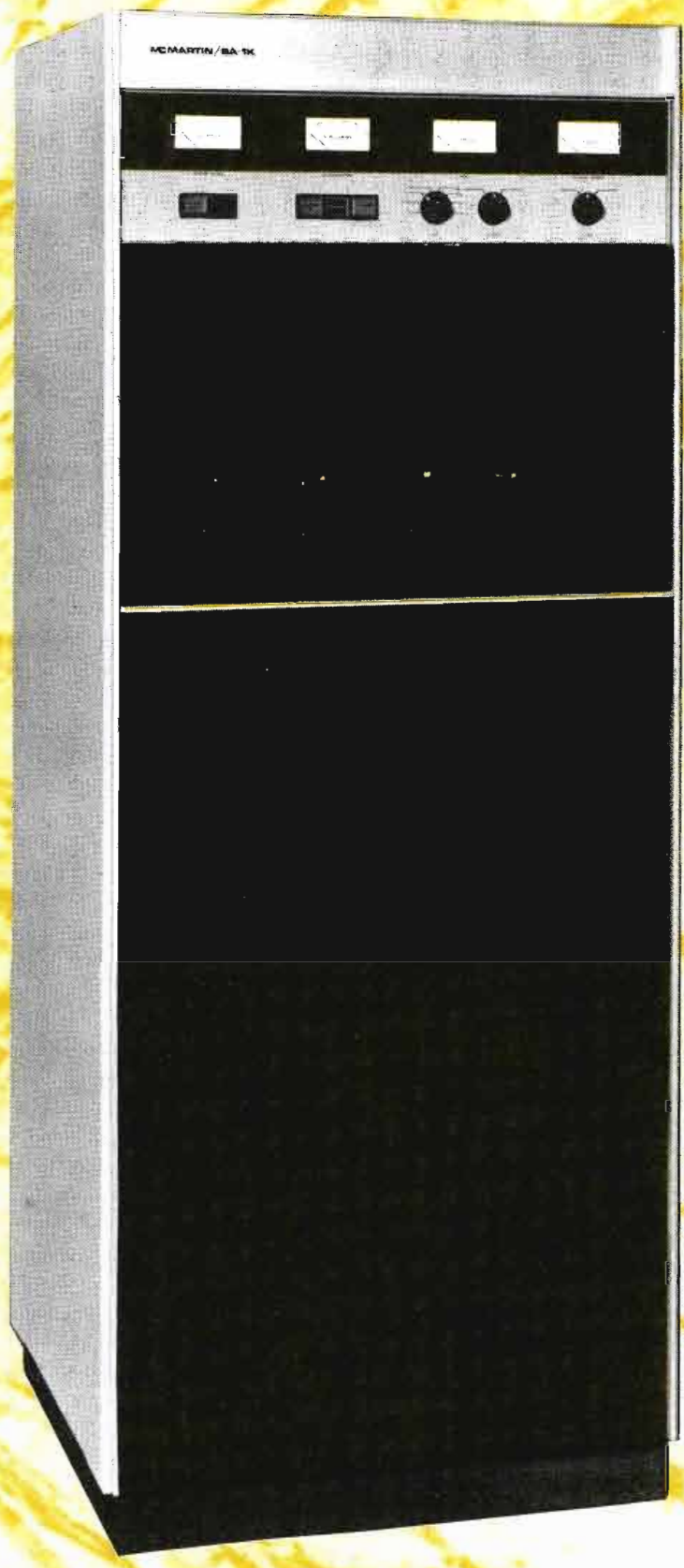

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The IC Op amp story

part1

By Walt Jung
BE Solid State Devices Editor

Much has been written concerning operational amplifiers. In fact, there are several books available which discuss their design and use from various viewpoints. However, the one type of work which has been conspicuously absent is a **user's** guide to op amps, particularly the IC variety, with their obvious attraction of size and economy.

Why not discuss IC op amps in terms of practical applications, illustrating use of a variety of standard devices in highly usable circuits which can be reproduced easily and adapted readily? Well that's what I've been doing for the past year or two, and the result is a sizeable stack of circuits and words which your editor and I hope you can put to good use. In "The IC Op Amp Story", running for the next few months in **BE**, we'll take an in-depth look at what an IC op amp is and in what it does, and, we hope, add appreciably to your knowledge on the subject.

Beginning with this part which discusses basics, we'll progress through various types of op amp circuits important to the station or studio. We'll not make any bold promises, but it's suspected by the time you've waded through this series you'll have enough under your belt to build a good measure of a studio's electronics, should you so desire, or better understand state-of-the-art circuits. So let's get on with the what, why, and how of it!

Operational Amp?

First, of all, you might justifiably ask, what does "operational amplifier" mean? Fair enough. The term originally came from the analog computer field, and was used to describe an amplifier which, just by changing external feedback connections, could be made to perform a large number of operations, with performance predicted by the **feedback components** rather than the amp itself. Thus feedback controlled in the desired manner is made to yield a desired function, with **little if any dependence on the amplifier characteristics.** This is the essence of op amp theory, the all powerful use of feedback.

However today's op amps fulfill a far broader scope of applications than analog computation functions and, although op amps are actually small systems, IC op amps can liberally be applied as **components** to fulfill an infinite array of tasks. The device has rightfully been called "the universal linear component".

At the base of the whole op amp picture is the so-called "ideal" op amp. Now, ideal conjures up an image of perfection in general, but in op amp language, it means several very definite things.

In Figure 1 we've pictured this ideal op amp, a general purpose amplifier with differential inputs and a single ended output. Never mind what type of circuitry's inside this triangle, for now we need only understand how it performs.

The ideal op amp responds only to **differential** signals, that is voltages applied between the (-) input and the (+) input, not voltages to ground. Thus both inputs will always be used, regardless of the application. The output signal is single-ended, and referred to ground. Thus bipolar (±) power supplies are used with op amps, and they are usually direct coupled.

There are five key parameters of the ideal op amp which are noted in the figure, but bear repeating here. They are:

1) The voltage gain is infinite .... $A_{VO} = \infty$
2) The input resistance is infinite . $r_I = \infty$
3) The output resistance is zero ... $r_O = 0$
4) The bandwidth is infinite ..... $BW = \infty$
5) There is zero input offset voltage ..... $E_O = 0$ if $E_{IN} = 0$

From these five characteristics, a set of axioms is developed which comprise the gospel of op amps. First, if the voltage gain is infinite, then an output voltage will be developed for an infinitesimally small input. So,

Axiom A: "The differential input voltage is zero". And, since input resistance is also infinite,

Axiom B: "There is no current flow into either input terminal." The third axiom arises with the application of feedback (see illustration)

Axiom C: "With the loop closed, the (-) input will be driven to the potential of the (+) or reference input."

These properties should be absorbed, as they can be used to deduce (or design) the operation of virtually any op amp circuit. In fact, we'll now look at three exemplary circuits which illustrate these axioms.

The Basic Op Amp Circuit Configurations

Although there are an infinite number of circuits using op amps, there are only two, possibly three really basic configurations from which they are all derived. These are the inverting, non-inverting, and the differential configuration; the latter a combination of the first two. Each of them have a few key features which are distinguishing.

Inverting Amplifier

The inverter is shown in Figure 2. In this circuit the (+) input is grounded, and the signal applied to the (-) input through input resistor Ri, with feedback returned from the output through Rf. Now, if you apply the axioms, you can follow through the simple algebra which leads to the key inverter characteristics. Of these, number one is that the gain of the circuit is $-\frac{Rf}{Ri}$. Or,

simply stated, the gain is equal to the ratio of the feedback resistor and the input resistor, and is inverting. Since the (-) input will be at the same potential as the (+) input (axioms A and C), it behaves as if it were actually grounded, and is a **virtual ground**. Since input and output sum at this point, it is also called a **summing point.**

With the right end of Ri at a virtual ground, the input impedance is simply the value of Ri. The current in Ri (Ii), sets the feedback current, If. And, importantly, If depends only on Ein and Ri, not Rf. This means you can reduce Rf to zero, and reduce the circuit gain to zero.

Modifications to the basic inverter are many; more input resistors connected to the summing point make a summing or a combining amplifier, either Ri or Rf can be reactive (usually capacitors) which yields differentiation or integration, or they may be non-linear elements such as diodes, transistors etc. We'll hit these as we discuss IC op amp applications later on.

Non-Inverting Amplifier

By grounding Ri and applying Ein to the (+) input, the non-inverting stage is generated, as in Figure three. Here use of the three axioms gives us a gain which is $\frac{Ri + Rf}{Ri}$. If not obvious from the math, you can note that Ein appears across Ri (axiom A + C). Ri and Rf are really a voltage divider with Ein at the tap. So, Eo must be greater, and the ratio of Eo to Ein (the gain) is the inverse of the voltage division.

The gain of this circuit cannot be reduced below one, because when Rf is zero (or Ri open) the output is equal to the input. The unity gain example is a special case of the non-inverting amp, called the "voltage follower"-the output follows the input in a 1/1 ratio. For any gain, the input impedance of the non-inverting stage is infinite (axiom B). This is true regardless of Ri and Rf.

Differential Configuration

If we combine the two basic stages, as Figure four, we get a configuration with two inputs, inverting and non-inverting. Signals may be applied differentially to this stage, and it has the inherent property of rejecting single ended signals applied in common to both inputs. This gives the circuit **common mode rejection,** useful for noise cancellation.

The algrebra on this one is a bit more involved, but boils down to a gain of $\frac{Rf}{Ri}$ when $\frac{Rf'}{Ri'} = \frac{Rf}{Ri}$. When this "magic" resistor ratio match is satisfied, the differential gain simplifies to $\frac{Rf}{Ri}$, and more importantly, the common mode gain (gain for a signal applied to both Ri and Ri') reduces to zero. Actually, the resistor network forms a bridge circuit, with the op amp looking at the bridge's output. The concept of zero input differential voltage to the amplifier (axiom C) will force the bridge output (Es) to be zero. So, if the bridge resistors are balanced, the amplifier output will be equal to the voltage at the bottom of Rf, or ground. This is why the common mode gain is zero when the ratios are matched.

For a slight mismatch in the resistors (such as typical manufacturing tolerances), the actual common mode gain may be calculated by using the non-ideal resistances in the gain equation shown. In practice, particularly for low gains, even a slight mismatch can ruin the bridge's rejection to common mode signals. At a gain of 1, for instance, a 1 percent mismatch in one of the resistors results in a common mode rejection of 46 dB. That is, the common mode signal is amplified only 46dB less than the desired differential signal.

Non-ideal Op Amp

Our discussions to this point have been quite idealistic, for as you certainly must suspect, there is really no such thing as an ideal op amp. Don't give up though, for although not precisely ideal, real world IC op amps do approach the idealistic model quite closely in many regards. It's in applying the ideal concepts to the practical world that the fun and challenges lie. In many circuits, errors and non-ideal properties can be controlled quite

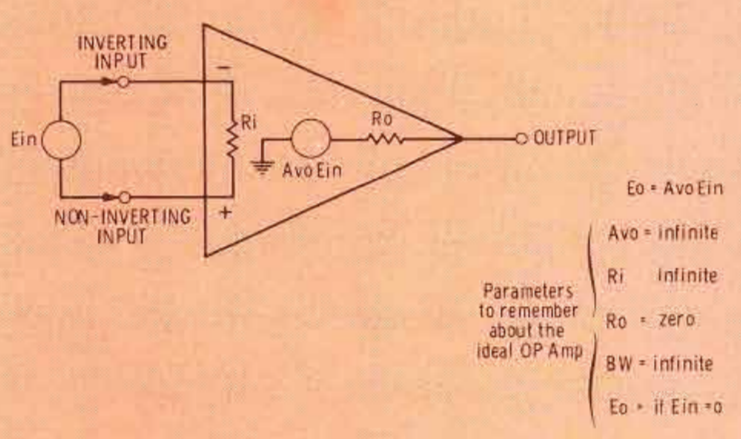


Fig. 1 Equivalent circuit for ideal operational amplifier.

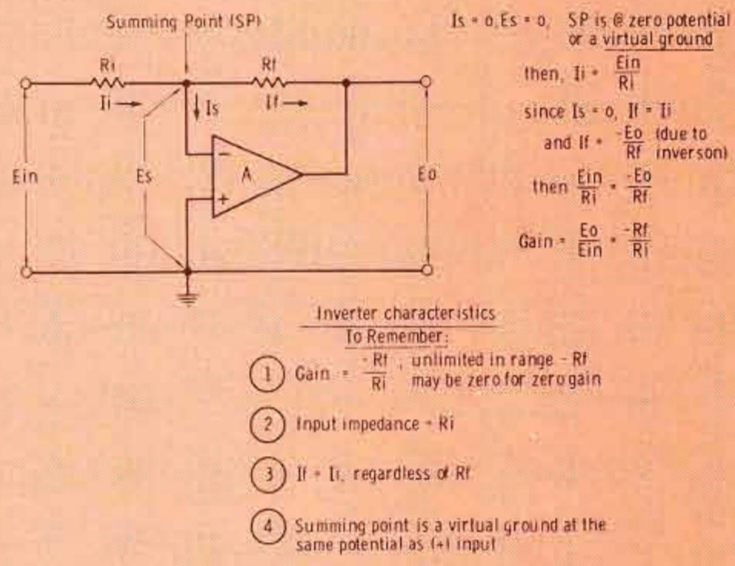


Fig. 2 The Op Amp inverting amplifier configuration

satisfactorily, to give remarkable precision. In fact, you may get precision which usually cannot be obtained by any other means.

Now, if we go back and take a look at the ideal properties, we'll see where the imperfections creep in and, generally, what they mean in practice. We'll talk in terms of typical IC op amp performance so you can get a feel of what the real world is like.

Open Loop Gain

The most important performance parameter of an op amp is its open loop gain, because for none of them is it infinite. In a feedback circuit, it is the excess, or loop gain (amount of feedback) above the working gain which determines the precision. Approximately speaking, you need 40dB of feedback for an error of 1 percent, 60dB for 0.1 percent, and so on. So, higher gain stages need more open loop gain to maintain adequate feedback. Typical general purpose IC op amps have gains of around 100dB (100,000), but their bandwidth is not infinite. In fact it looks something like Figure 5, a plot of gain versus frequency called a Bode plot. What it tells you is the available open gain over the operating frequency range. The plot shown is typical for general purpose IC op amps. Gain at DC is a full 100dB, but the 3dB point is only 10Hz and the gain falls off at 20dB/decade with increases in frequency, until at 1MHz the "unity gain crossover frequency", **ft** is reached. So, the high gain exists only at DC or very low frequencies.

This rolled-off gain characteristics is necessary, because the phase response of the amplifier must be controlled before feedback is applied-if not, it oscillates!

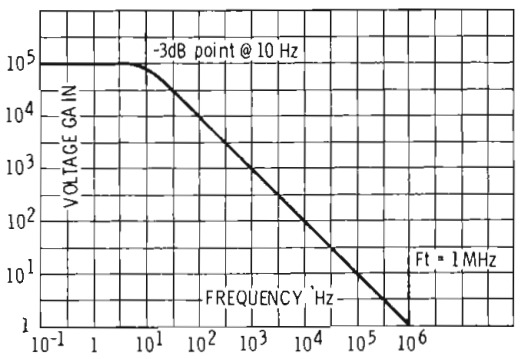


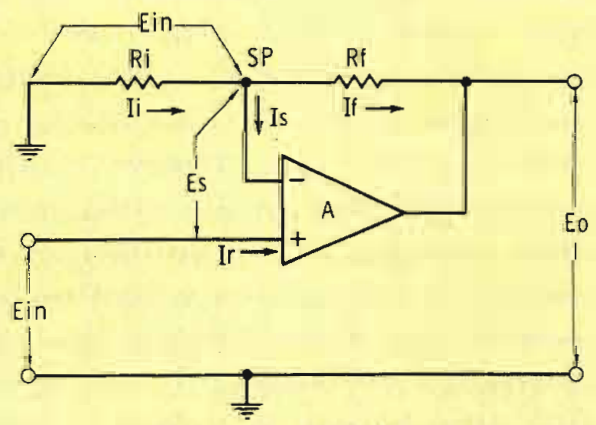
Figure 5

Input resistance of IC op amps is a parameter which can really approach the ideal. General purpose units like the 741 and 101/748 types run about 1-2 megohms of input resistance, but devices such as 103/308 types have 40-70 megohm input resistances, and FET input types such as the 8007 go as high as 10^{12} Ohms! The higher the amplifier input resistance, the higher the resistance values the amplifier can work from.

Output resistance in IC op amps is really not zero. Typically, it runs about 75 Ohms in the general purpose types. This does not normally create serious problems since load resistances are normally 10 or more times higher than this. Where appreciable power must be supplied, power IC types such as the 540 can be used, or buffers added to any other op amp.

Input offset voltage of an op amp is the voltage which is necessary between the input terminals to obtain a zero output. Ideally it is zero, practically you want it as low as possible. Typical IC op amps use pairs of well matched transistors as input stages, and have input offset voltages of several millivolts, the exact figure dependent upon the device. An example of a very low offset type is the 108A/308A, with a 0.5mV max offset voltage.

To evaluate different IC op amps for various applications, you'll need a working knowledge of their specifications. You'll get a lot more mileage from IC op amps when you know how to read and interpret a data sheet.



Non-Inverting Amplifier
Characteristics to Remember:

1. Gain = $\frac{Ri + Rf}{Ri}$, lower limit of unity gain where Ri = ∞ or Rf = 0
2. Input impedance = Infinite
3. If = Ii, regardless of Rf
4. Summing point follows Ein

Es = 0

Is = 0, Ir = 0

$Ii = \frac{Ein'}{Ri}$

$Ein' = Ein$
then, $Ii = \frac{Ein}{Ri}$

If = Ii

Eo = If (Ri + Rf)

Eo = Ii (Ri + Rf)

and $Eo = \frac{Ein}{Ri}(Ri + Rf)$

then,
$Gain = \frac{Eo}{Ein} = \frac{Ri + Rf}{Ri}$

Fig. 3 The Op Amp non-inverting amplifier.

Maximum Ratings

Maximum ratings are just what the name implies-the extremes of recommended operating conditions. For instance supply voltage is listed as ± 18V or ± 22V max, although ± 15V is considered standard. Some types go higher or lower, of course, and you can seek these for special situations. Operating temperature is the range of temperature over which the electrical characteristics of the device apply, generally 0-70°C for commercial devices.

Differential input voltage is a parameter to watch because some types can't take more than ± 0.5V safely, while others are limited to ± 5V. Types like the 741 and 101 family types can stand ± 30V without damage.

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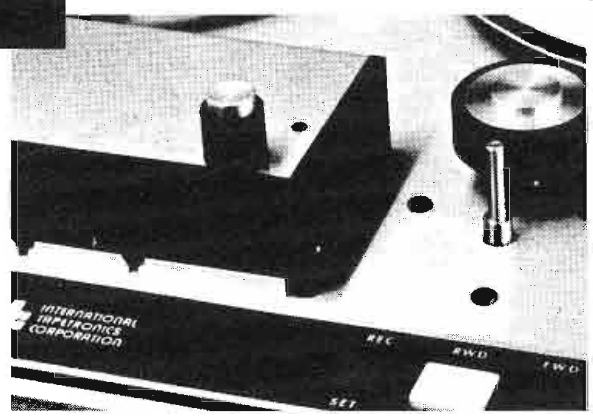

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touched upon, but specs on it need more interpretation. While the actual offset for a given IC may vary from one type to another, they can all be "offset nulled" for an equivalent input offset of zero. You can use the recommended procedure for the particular amp, or a general procedure for any amp, which we'll see later in the circuitry. Also, if you want low offset without paying excessively, stick to bipolar transistor input op amps. FET types do not match nearly as well for low offset, and so their cost rises.

Input Bias Current

Ideally we said op amps do not have any input current, but really they do. In general purpose units, its around 100 nanoamps or less, but types like the 108/308 get down to a few nA, and the 8007 goes down to 2 pA! A DC path for bias current must always be provided in an op amp circuit, and its good practice to make the DC resistances seen at each input equal to minimize the effect on offset voltage.

The ideal op amp responds only to differential signals, but real ones respond (a little bit) to common mode signals as well. Its **common mode rejection** tells you how much a given common mode voltage is to be reduced before it appears as an equivalent differential input. Typical numbers are 80 to 100dB in general purposes units, but special types like the 725 can go as high as 120dB. In other words, a 10V common mode input in an amplifier with 80dB of CMRR appears as a 1mV differential input.

An amplifier's common mode rejection is usually specified over it's full **common mode operating range,** the range of common mode voltage over which it operates within its specs. This range is usually ± 10V as a minimum.

Output Voltage Swing

This is simply the output voltage into the rated load. IC op amps are usually specified as ± 10V minimum into a 2K or greater load resistance. Short circuit protection is built into recent IC amplifiers, which automatically protects them against improper loading. Early types such as the 709 did not have this feature, and need a 220 Ohm resistor for protection.

Slew Rate

Although bandwidth has already been discussed, one aspect of IC amplifier frequency response which can be troublesome is slew rate. Slew rate is a "large signal" type of frequency response, a measure of how fast an amplifier's output can respond to big signal swings. It is given as volts of output change per unit of time, typically in volts/μ sec. General purpose types such as a 741 have slew rates of about 0.5V/μ s, but there are many ways speed can be increased-special circuitry, as well as specialized devices.

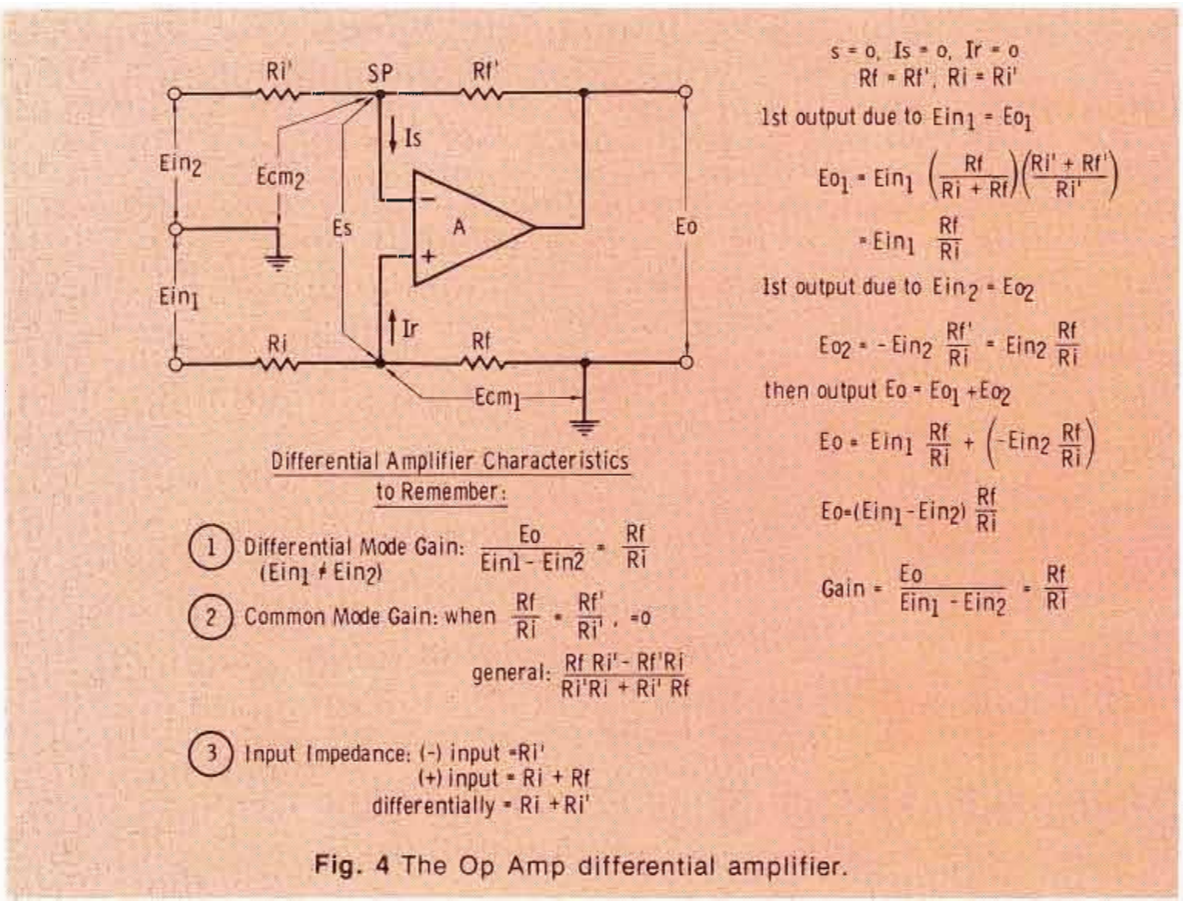

Fig. 4 The Op Amp differential amplifier.

IC Op Amp Types

There are a great number of IC op amp types, but the greatest percentage of uses can be fulfilled by the "general purpose" types we've been referring to. Actually, there is no hard and fast definition of a general purpose IC op amp, but it has come to mean a loose definition-it has a bandwidth of 1MHz, it operates from supplies from ± 5V to ± 20V without serious performance degradation, and it may or may not be internally compensated.

The best examples of general purpose amps are the 709, 741 and 101. Actually when you say "type" it takes in a family of related devices, taking in multiple packages and differing temperature grades. Thus a 709 type is available as a 709, 709A (tight spec) 709C (commercial), or 1537/1437 (dual type). Similarly, 741 types are available as 741's and 741C's, 747's (14 pin 741 duals) or 1558's (8 pin duals). 101 types are available as 101's or 201's (commercial grade), 101A's, 201A's or 301A's-different gradings of the 101A, an improved device.

Further, 741 and 101 types are similar in basic structure and in some instances may be used interchangeably. For instance, a 748 (uncompensated 741) is equivalent in many regards to a 101.

Sound confusing? Bear with us, and you'll see the differences.

Often, you'll need a measure of performance a standard GP type just won't provide. For this, there are the specialized types we've mentioned along the way. These op amps are designed for improved performance in one or more areas, such as bandwidth, gain, offset, power etc.

All of the types we'll be discussing in the following installments are standard types, readily available from a number of sources. In following months we'll take up op amp circuitry for signal generation, signal processing, audio circuits and some specialized functions.

We think you'll find it useful and look forward to having you along.□

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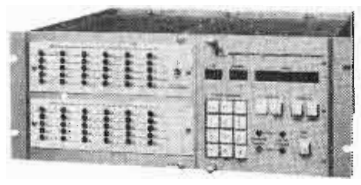

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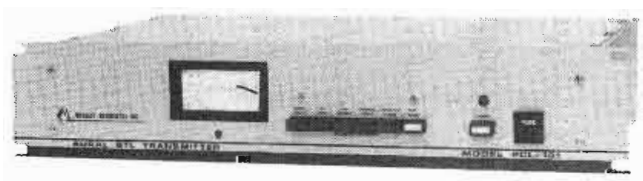

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TV station WCOL's chief engineer Donald Krol, foreground, and "sometime" producer-director for the closed circuit station aboard the USS Columbus at the control console ready to get the days programming underway.

SITE at sea

By Ed Burmeister*

In May of 1972, the Chief of Naval Operations, Admiral Elmo R. Zumwalt, approved a program to put closed circuit color television systems on all ships with a crew complement of guided missile destroyer size or larger which did not already have television on board. These systems were given the acronym SITE, meaning **S**hipboard **I**nformation, **T**raining and **E**ntertainment.

Although all of the Navy's aircraft carriers and a few of its cruisers already had closed circuit television, the SITE program will have put CCTV on approximately 140 more Navy ships by June 1975. This will mean that all Navy ships with a crew of at least 350 men will be using and enjoying closed circuit color television.

*Released to Broadcast Engineering by the Office of Information, Department of the Navy.

In formulating the SITE program, the Navy considered the following factors:

(a) The great majority of today's young servicemen, (18-25) grew up with television and consider it part of their normal everyday life.

(b) Television today is our most modern mass communications medium and is here to stay.

(c) Television has proved itself as a valuable tool for the dissemination of informational and educational and educational materials.

(d) Available recreation on board Navy ships at sea has always been very limited. Entertainment via CCTV can do much to fill this void.

(e) Ships with CCTV have proved that daily television is indispensable in the contribution it makes to shipboard morale and habitability. This is a most important factor in the present conversion to all-volunteer military forces.

(f) For commanding officers of ships, CCTV offers the most immediate, convenient, personal method of "passing the word" to all of the "troops" at the same time.

The first SITE color system was placed on board the guided missile frigate USS JOSEPHUS DANIELS (DLG-27) in January of this year. By the end of August 1973, 38 additional ships were equipped with SITE. One black and white system was put on board the USS LASALLE (AGF-3) last June prior to her deployment as flagship of the Commander, Middle East Force.

SITE is a basic, austere CCTV system designed to provide color origination from a central compartment on a ship via cable distribution to ten or more television receivers. It provides for the origination of a television signal from one of four different sources — 16mm film, 35mm slides, one-inch helical scan video tape, and a "live" camera.

The initial beauty of the SITE system is the fact that the basic equipment is not costing the individual ships one penny. Until the SITE program began, any Navy

JAMIESON COMPAC Two models conduct the standard ME-4 process: 16/8mm at 20 FPM, 35/16mm at 15 FPM.

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We introduced the Compac color film processor three years ago, and since then we've shipped more than one a week.

Now the popularity of this and other Jamieson processors is growing so rapidly that we have moved into a new plant, effectively doubling our manufacturing space.

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Someone you know owns a Compac. Probably a lot of people you know. Why not ask them about it. That's the best way to get an unbiased appraisal of its performance.

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☐ Please send me your brochure and data sheets on the Compac and other Jamieson processors, along with a list of some users.

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Scully Shows You How To Be Perfect Without Paying The Price.

As a professional, you want the finest in a professional recorder. The best sound reproduction possible. Simplicity of operation. Reliability coupled with ease of maintenance. And, you don't want to pay a fortune to get it. In short, you want perfection at a perfect price. You want the new 280-B Recorder/Reproducer.

Unmatched Performance.

By designing the 280-B electronics around the new high-energy tapes. The S/N ratio is perhaps the best available in any recorder at a comparable price. Up to 72 dB on full track .25" tape at mastering speed. A sharp 68 dB on two-track .25" and four track .50."

The 280-B also features more head room and an increased record level for maximum signal utilizing the high output tapes. And band widths are a very flat ± 2dB, 30Hz to 18 KHz. It all adds up to greater performance than you've ever been used to.

Quick, Simple Operation.

The more sophisticated we've made the 280-B, the simpler we've made it for you to operate. Our new OPTAC™ motion sensing system gets a new standard of efficiency in tape motion control. Now you can go from one transport mode to another without touching the STOP button. And enter and leave RECORD while the transports in PLAY. OPTAC™ and the 280-B's new logic circuitry make the exact moves for you at the right time.

Easy Maintenance.

New solid state circuitry and mother-daughter board architecture give the 280-B a greater reliability factor. They also make testing, repair and replacement easier. All signal electronics are in slide-out drawers. No more bending down and reaching around. Individual channel modules go in and out easily, too.

If the 280-B sounds too good to be true, wait till you hear it. And wait till you find out the price. We've made it very easy for you to get the best.

For more detailed information and prices on the 280-B, call or write: Scully/Metrotech, 475 Ellis Street, Mountain View, California 94040. (415) 968-8389. TLX 345524.

Scully/Metrotech

Recording Divisions of Dictaphone

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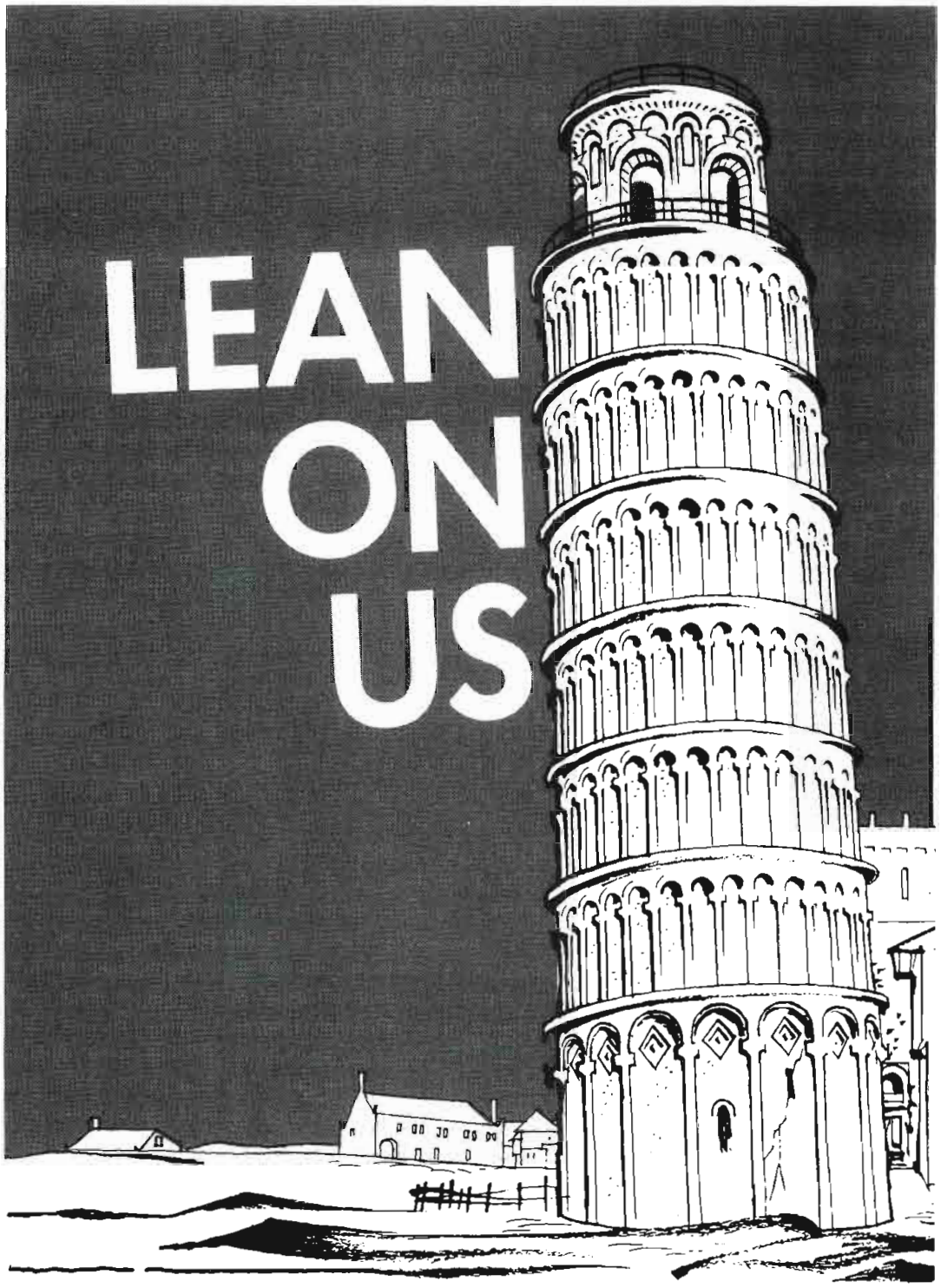
For More Details Circle (26) on Reply Card



The famous leaning tower of Pisa, central Italy, is 180 ft. high and 14 ft. out of the perpendicular – and still moving.

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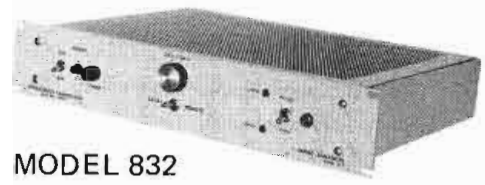
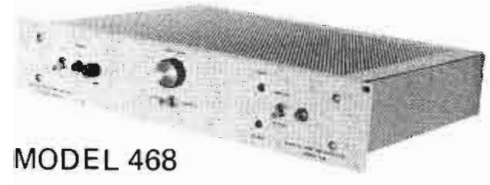
IMAGE ENHANCERS

MODEL 875

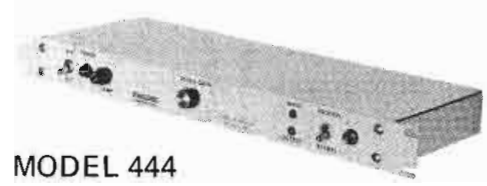
MODEL 852



MODEL 832



MODEL 468



MODEL 444

The AUTOMATIC MODEL 875 provides the best enhancement for color and monochrome television pictures.

No need to have your image look bad! Enhancement without a 1-line delay. DYNASCIENCES MODEL 852 – CONTOURS FROM GREEN is utilized for contour enhancement for a three tube color television camera.

Sharp Image! MODEL 832 – IMAGE ENHANCER features comb filter, sharpens color and monochrome television pictures.

Lean on the MODEL 468, VERTICAL APERTURE EQUALIZER to correct for loss of fine detail.

Your Image doesn't have to lean the wrong way! THE MODEL 444, VIDEO ENHANCER, increases the clarity of monochrome television pictures at a most economical price.

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ship desiring closed circuit television for information and entertainment purposes had to purchase the necessary equipment from its own welfare and recreation funds. All SITE equipment, valued at approximately $55,000 for each system, is being purchased with Navy funds appropriated at the Chief of Naval Operations level. Prime contractor for SITE is the International Video Corporation of Sunnyvale, California.

Since the equipment is being installed on each ship by the ship's crew, with technical assistance by TV engineers from the Television Audio Support Agency, the only costs that need to be incurred by the ship are for such items as additional air conditioning, cabling, or receivers. The first ten receivers are provided with each system. These receivers are placed in crew berthing compartments, wardrooms, chief petty officers quarters, first class petty officers lounges, mess decks, and other locations where crew-members gather during their off-duty hours. Ships have been using local funds to purchase additional receivers to provide extensive service throughout all living compartments. The RF system is capable of handling 100-200 receivers without additional amplifiers.

The SITE system was designed by the U.S. Army Television-Audio Support Agency, Sacramento Army Depot, in conjunction with the Navy Chief of Information, who was appointed by the Chief of Naval Operations as the SITE Program Sponsor, and with the technical cognizance of the Naval Electronic Systems Command. Factors considered in the design were reliability at sea, compactness, simplified operation, versatility and adequacy for ships with limited space and personnel.

Competitive invitations to bid were submitted to U.S. manufacturers under "Buy America" guidance. The International Video Corporation of Sunnyvale was then selected as prime contractor.

Basic equipment in each system contains two film chains, two video tape recorders, control/monitor console, and two RF modulators. One film chain consists of 16mm and 35mm slide projectors optically diplexed into a camera. The other film chain is a uniplexer. The uniplexer and diplexed cameras with reversable sweep can be removed and used as live cameras with lens change.

The two video tape recorders are mounted in drawers in the diplexer unit.

The control/monitor console consists of two 19" equipment racks with a small operating console table. For video, the control console houses a color live monitor/RF receiver, two black and white monitors, one waveform monitor, six input video route switchers, and two RF modulators (Ch. 2 and Ch. 4). For audio, the console houses a mixer, record playback two cartridge unit, switcher and monitoring unit. The control console also contains remote camera projector and VTR controls.

The two modulators facilitate simultaneous but separate programming. The ship could program a training film on Channel 2 and an entertainment film on Channel 4 at the same time. The second modulator can also be used as a back-up.

The threefold purpose of SITE is information, training and entertainment, in that order. Commanding officers can use SITE to brief crewmembers on important upcoming training exercises or operations; changes in the plan of the day; important Navy internal information including service benefits, changes in Navy policy or regulattions, the latest "word" from the Chief of Naval Operations or the Secretary of the Navy, new information regarding pay, leave, schools, etc. It is expected that many SITE systems will be used by the CO to conduct periodic "hot line" programs, wherein the viewer could phone in a question on almost any topic or submit a written question to be answered by the CO or his representative. Ship department heads or other officers can use SITE to relay information regarding their own departments or divisions. On deployments, SITE will be a valuable tool for the dissemination of port of call information, foreign customs, money, etc.

Each ship with SITE will be able to acquire a library of training films on such items as first aid, fire fighting, Navy regulations, basic seamanship, rules of the road, water safety, etc., and other films relating to specific occupations and tasks on board ships. Training can also be conducted by live lectures via SITE.

All SITE ships will be American Forces Radio and Television Service (AFRTS) television affiliates and when deployed will receive approximately 60 hours of television programming weekly through AFRTS-Los Angeles. This programming will contain regular commercial network programs (minus commercials), feature movies, DOD service information spots, etc. Although all TV programming now distributed by AFRTS-LA is on 16mm film, DOD is planning to begin distributing a good percentage of AFRTS-TV programming in color on one-inch video tape, replacing the kinescope service now provided to overseas units. Present planning calls for an eventual 50-50 balance between film and video tape. AFRTS-TV programming will be supplemented on SITE ships by Navy produced information spots.

Enlisted men who will be operating and maintaining the SITE systems are presently going through special courses at the Defense Information School and at Great Lakes. SITE operators will be Navy enlisted journalists who have been through the special broadcast course at the Defense Information School.

Maintenance technicians for SITE are being drawn from the interior communicationsman, electronics technician, or fire control technician ratings. A SITE system the same as those now going on ships has been set up at the Service Schools Command, Great Lakes, Illinois, and prospective SITE maintenance technicians are going through a special SITE maintenance course there. Instructors for this school received a portion of their training through the technical staff at the Defense Information School. One maintenance technician will be assigned to each SITE system. The full time operator and maintenance personnel will be assisted by volunteers from the crew.

Station to Station

(Continued from page 4)

the output to be distorted with a high-pitched screech superimposed on the programming material. The supply reel shaft had a bearing needing lubrication and after running for an hour or so, it started squealing, which made the entire deck vibrate, the tape vibrated and the audio quality was lost. I disassembled the supply motor assembly and gave it an overhaul. I have had no problems since.

Chris R. Murray
Dir. of Engineering
KRSP AM/FM Radio
Box 7760
Salt Lake City, Utah

Heat Is A Factor

This is in response to the letter of John Carlini in the November issue, "Screeching Tape Problem."

While I personally have yet to encounter a problem during normal running, I have experienced problems of this nature while editing. When cued to one particular point on the tape two or three times (which is normal many times in obtaining a precise point), it begins to stick to the heads and, when forced, emits a squeal which makes it quite difficult to determine that "precise" point.

While I am familiar with head lubricants and their use, they do not seem to cure the problem. We used the old 3M #131 and 111 for many years with no screech or squeal problems at all—we did use lubricant to preclude this possibility.

About the only thing I can figure is the possibility that the ultra-smooth recording surface of these newer types of tape adhere to the heads with the slightest bit of heat. But what to do to avoid this phenomenon is the question I also would like to have answered.

I have noticed that the problem is more pronounced when using a two-track machine than when using a full track. Heat does seem to be a factor.

Bob Davis
Independent Audio Productions
of Dallas
P.O. Box 38665
Dallas, Tex. 75238

Tape Lubrication

Regarding John Carlini's letter in the November issue: I too, suspect that the screeching tape problem is due to poor tape lubrication. Here are some observations I can make about the phenomenon after several years of using different types of audio tape.

Screeching is not necessarily audible—it is often pitched above the normal range of hearing, with the only clue to its presence during recording being a more sibilant sound on playback, with a ragged edge on the highs.

A tape that screeches on one tape machine while playing may not do so on another machine, but a tape that was screeching during recording will be distorted forever, regardless of whether or not it is actually screeching during playback.

I have found that most screeching problems come with using bargain tape. Also, among the bargain tapes, the ones colored black seem to be more prone to screech than the brownish variety.

Many reels of cheap, black tape I have used showed no signs of screeching until the supply reel was about two-thirds empty—this is probably due to increased tape tension as the supply reel's diameter decreases. These tapes usually give no sign of trouble at first, but after playing a dozen or so times the screeching starts.

Now, let's suppose that you have a tape that was recorded OK, but later on it starts screeching on playback, and the program material is valuable to you—how can you retrieve the audio without the screeching? Here is a temporary solution which has made it possible for me to copy material off screechy tapes. Apply powdered graphite to a cotton swab, and as you play the tape, hold the swab against the oxide side of the tape, just after it comes off the supply reel. Slowly rotate the swab as the tape carries off the powdered graphite, and after a couple of times around, dip the swab in the graphite supply to replenish. After a little practice you can determine how little graphite is necessary to prevent screeching. This procedure should enable the playing of the tape a couple of times for copying without screech. Be certain to thoroughly clean the tape machine when finished, to remove any residue of graphite which may remain in the head gap or on other parts.

Below are two paragraphs from the maintenance manual for a Scully model 280 (Scully 280 Manual) which may also shed some light.

"High frequency flutter, commonly called "scrape," or FM noise, is caused by longitudinal vibration of unsupported lengths of tape, and is generally in the 3 to 5 kHz range. It appears as an unpleasant background noise when mid-frequency ranges are recorded and reproduced. This FM scrape is materially reduced by the introduction of a small-diameter rotating member into contact with the tape as close to the heads as possible.

"A high frequency or scrape filter is located on the head assembly between the record and playback heads. It is an integral part of the tape lifter arm, and is in longitudinal contact with the tape when the tape lifter is inoperative."

Doug Booth, Jr., CE
WBYU
1001 Howard Ave.
New Orleans, La. 70113

(Continued from page 17)

TV. As a result of elections, Brad Anderson, Bob Churchill, and Jim Grinnel were reelected to chairman, vice-chairman, and secretary-treasurer, respectively. Ken Steininger, Don Holbrook, and Warren Schultz were elected chapter directors.

Chapter 28—Milwaukee, Wisc.
Chairman: Ed Wille, KEN-COM,
Milwaukee, Wisc. 53218

On December 11th, program chairman Bob Truscott of WITI arranged for Gene Bidun, Broadcast Audio Product Manager, RCA Broadcast Systems Division, to present a 2-part program: (1) Automatic Audio Signal Processing, and (2) Discrete Quad on Disc. Bidun, who is a member of the Philadelphia SBE chapter, followed 17 years of broadcast engineering experience with 15 years with RCA. In his first section, he included a discourse on a new design for peak limiting equipment utilizing LED indicators. He also covered the RCA system for producing four channels of audio information on a compatible disc with no algebraic encoding or decoding, as is common in other quad systems. The RCA method, instead, employs a 30 kHz subcarrier on each of the groove walls to produce the rear channel signals.

Chapter 32—Southern Ariz.
Chairman: Hobart J. Paine,
Tucson, Ariz.

This chapter, which started just a short time ago with 9 members, has now grown in size to 23 members. The November meeting was held at Lee Furr's Recording Studio. KZAZ was thanked for providing printed chapter stationery. A tour of the recording studios was provided including a demonstration of the 24-channel mixdown audio board and the 24-channel Ampex tape recorder, courtesy of Jack Williams. The December meeting was held at Shakey's Pizza Parlor, with family, friends, and guests.

Provisional Chapter—Southwestern Ohio
Chairman, pro tem:
John P. McNally,
WCNW & WFOL,
Fairfield, Ohio 45014

On November 16th a preliminary meeting for organization of a new chapter was held at the Clock Restaurant, Middleton, Ohio, with John P. McNally presiding. Members and potential members interested in future meetings may contact McNally at (513) 874-5000. At the organizational meeting, guest speaker, Don Curry, Senior Engineer, FCC, Detroit office, discussed current regulatory enforcement.

PEOPLE IN THE NEWS

American Data Corporation, an AIRPAX Company, has announced the appointment of **Russell Trevillian** as the Regional Sales Manager for the Southwestern United States. Mr. Trevillian is based at the new ADC Regional Sales Office in Houston, Texas. American Data has also announced the appointment of **Dave Spindle** as the Regional Sales Manager for the Southeastern United States and Puerto Rico. Mr. Spindle is based out of the ADC Headquarters in Huntsville, Ala.

William F. Jamison has been appointed Regional Sales Manager for LPB Inc. He will be responsible for sales/engineering advice in the states of Maryland, Virginia, Delaware and the District of Columbia .... **William Ebell** has been named broadcast video products sales representative for Ampex Corporation's Metropolitan New York territory .... **Robert B. Dyer** has been named Director-Operational Analysis of Cooper Industries .... Blonger-Tongue has appointed **Robert J. Dettmann** north eastern regional sales manager and **Jay F. Shapson** assistant sales manager.

John D. Jackson, General Counsel of American Satellite Corp. has been elected a Vice President, and **David A. Irwin** has joined the company as Counsel for Regulatory Matters .... **Thomas G. Needles** has been appointed executive vice president-marketing for Koss Corp .... **Emanuel Fthenakis** has been elected a vice president of Fairchild Industries and appointed Corporate Director of Communications and Electronics .... **Dave C. Lindsey** will assume direct sales responsibilities in Cohu's San Diego based firm's Great Lakes Sales Region.

Bob Dettmann

Jay Shapson

Tom Needles

Henry L. Tinker has been named vice president, operations, at International Video Corporation .... **Victor F. Donnelly** has been appointed vice president and controller of CBS Laboratories and **Dr. William E. Glenn Jr.** vice president and director of research .... Communications Technology Corporation announced the appointment of **Joe Ross** as a regional representative .... **John J. Guarrera** has been elected President of the Institute of Electrical and Electronics Engineers, Inc. (IEEE). (More...)

Henry Tinker

Victor Donnelly

William Glenn

Joe Ross

Russ Molloy

Dwain Keller

The Board of Directors of Cox Broadcasting Corporation announced six major promotions within the organization. The new appointments are **James M. Rupp,** group vice president and general manager, broadcast division; **H. Stewart Corbett, Jr.,** vice president-subsidiary operations; **Raymond J. Tucker,** secretary and treasurer; **E. William Bohn,** vice president-personnel and public relations; **James A. Landon,** vice president-planning and research, and **Alan D. Chunka,** controller and assistant secretary. The announcement was made by **Clifford M. Kirtland, Jr.,** executive vice president, who was elected president of CBC, effective upon the retirement of President J. Leonard Reinsch December 31, 1973.

Russ Molloy has joined WFMR, Milwaukee FM stereo radio station, as vice president and general manager.

Bob Jacobs

Gary Beeson

Bob Vendeland

Several new sales positions have been created at Dynair Electronics. **Dwain Keller,** who has held a sales management slot, is now Engineered Systems Sales Manager. Television Products Sales Manager has been filled by **Bill Killion,** who has been Advertising Manager. **Bob Jacobs** is now Director of International Sales. In addition to the newly created sales management slots, the position of New Products Manager has been filled by **Gary Beeson,** who has rejoined Dynair. **Robert N. Vendeland** has rejoined the company as Vice President, Marketing.

CATV

Javelin Electronics/Division of Apollo Lasers Inc., announces the appointment of **Robert H. Walker** as general manager . . . . **Alan Kernes** has been promoted to CATV Systems Department Manager at Anaconda Electronics . . . . National Cable Television Association President David Foster has announced the addition to the Government Relations staff of **Brenda J. Gore** . . . . The addition of **William F. Karnes** to its management team as vice-president-systems has been announced by TOCOM, Inc.

Gertraud "Trudy" Schmidt has been named Assistant Director of Research at General Cable Corporation . . . . **Kenneth H. Robinson** has been appointed Marketing Manager-Transmission Systems Products, Cablewave Systems Inc. . . . . A major management reorganization has been announced by Ameco, Inc. **Robert H. Wilson,** formerly Engineering Manager, has been named Executive Vice President and General Manager. **Joseph P. Moran** and **Paul D. Askos** have been appointed Vice Presidents of Operations and Marketing, respectively.

bookreview

Television was introduced into classrooms in the United States nearly a generation ago. Today its status and future are little more secure than they were in 1950. Why?

Classroom Television explores the strange past of television teaching at the hands of broadcasters, educators, foundation and government officials and publicists. The author, George N. Gordon, concludes that, while **broadcast** Instructional TV faces a dubious future, increasing use of videotape, pre-recorded and inexpensively produced local TV lessons should become near ubiquitous and indispensable teaching tools during the next twenty-five years, and will substantially affect the nature and quality of most of our schools tomorrow.

The author discusses realistically the equipment, uses and limitations of Instructional TV on all levels of education, accenting the practical ways that TV may be employed to improve instruction and learning as well as raise the productivity of skilled teachers.

Neither dry nor academic in approach, **Classroom Television** analyzes TV's poor start in the educational world and brings to the subject of ITV a fresh approach. The book demonstrates that in spite of its record to date, classroom video is one of the most exciting frontiers in tomorrow's educational world.

This book is available through Hastings House, Publishers, Inc., New York, N.Y. 10016

For More Details Circle (60) on Reply Card

Designing & Maintaining The CATV & Small TV Studio, written by Kenneth B. Knecht, is a simplified, yet detailed guide on the installation and maintenance of production facilities for CATV, CCTV, ITV, and small broadcast TV studios. This all-in-one handbook is written specifically to help those who need expert, in-depth guidance on setting up a small to medium size TV studio. The level of presentation can be easily understood, yet provides the technical details needed by those who have a knowledge of electronics. Moreover, the information provided is sufficient to serve the needs of CATV systems and educational or industrial closed-circuit systems, as well as TV broadcast stations.

Everything is included, from pulse distribution and switching systems and camera, film and video tape equipment, to the creation of special effects such as supers, dissolves, wipes, keys, etc. The author fully discusses cameras and lighting, together with color TV equipment, monitoring, and studio and control area signal distribution. Also covered are video distribution amplifiers, video test generators, processing amplifiers, patching networks, etc.

This book is available through Tab Books, Blue Ridge Summit, Pa.

For More Details Circle (61) on Reply Card

NEW PRODUCTS

Video Data Terminal And Encoder

William Moulic, President of **Sono-Mag** and **Systems Marketing Corporation,** has released for production the new SMC video data terminal and encoder for use with automated logging systems. The equipment consists of a CRT screen, an alpha-numeric keyboard unit, and a memory for 512 character storage. When this equipment is connected to an SMC cartridge recorder, messages typed on the screen from the keyboard can be encoded onto the cue track of any cartridge for use in SMC cleartext logging systems.

With this new unit, encoding can be done right in the production room, because it makes no sound at all. The CRT screen may be located any place in the room away from the keyboard. Encoding is done automatically during the final dubbing of the cart. The encoded cart can be "proofed" simply by restarting after recue. Any non-skilled person can operate the unit.

After encoding, the cartridge may be placed in an automation system, or may be used in live operation printing out the English message encoded on a standard page printer.

It then forms the official log of the station (live or automated) when combined with the time of the event. In normal logging a digital clock provides the time which is printed immediately before the encoded material.

For More Details Circle (65) on Reply Card

Metric Conversion

Telex Communications, Inc. have introduced a new Anglo-Metric convertor. The handheld, circular Anglo-Met is a convenient tool for accurate English/Metric conversions. Company spokesman, Jim Dow, director of marketing, instructional products, said "with the conversion of practically all countries in the world to the metric system and increased foreign trade, the need is apparent for a simplified metric convertor."

"Telex has developed such a convertor through their manufacturing experience in precision computers and plotters for aircraft navigation, and military applications. By incorporating the convenient feature of patented Dial-a-Con®, the user is able to simply dial the desired conversion with a pencil point - fast and accurately", Dow said.

For More Details Circle (66) on Reply Card

Random Noise Measuring Set

Tektronix has introduced the 1430, a random noise measuring set for accurate, repeatable measurements in cameras, VTR's STL's transmission system or wherever video-frequency random noise is a problem. Tests can be made without composite sync by using the 1430 generated horizontal sync. Full field measurements can be made with resolution approaching 0.5 dB. CCIR weighting and low-pass filters are built in.

The 1430 is used in a side-by-side comparison test setup. A portion of a line is deleted, then a calibrated noise level is inserted by the 1430. The noise level to be measured and the 1430's level are compared on a waveform monitor or scope.

In-service noise measurements, using a selected line in the vertical interval, can be made with better than 2 dB accuracy.

For More Details Circle (67) on Reply Card

DTL and TTL Circuit Tester

A new instrument, for rapid diagnostic and functional testing of DTL and TTL integrated circuits during operation, has been developed by **Rohde & Schwarz.**

The Logiscope, Type IFP, is a pocket-sized instrument, which simultaneously displays the logic state of all 14 or 16 pins of an IC soldered into a module, irrespective of the state of operation of the whole module, which can be disconnected or clocked through its various states. The signal can be traced through the IC and a defect which in general interrupts the signal path can be recognized directly, especially when a reduced clock frequency (down to approximately 15 Hz) is used. Single pulses down to 1 msec produce a flash which is still clearly visible.

A special feature of the Logicscope is the simultaneous display of the IC reference diagram and the logic level indicators on an expanded 2 3/8" display screen, means that the user does not have to shift his eyes from

the circuits to make readings and thus functional analysis is possible at a glance.

A clip-on connector and a one meter cable connects the Logicscope to the circuit under test so that good readability is insured-even for hard-to-get-at ICs.

The Logicscope requires no power supply of its own. It derives its operating voltage from the test item, locating automatically the positive and the negative poles. Loading of the test items is avoided with aid of buffer stages. The influence of the cable capacitance on short clock pulses is balanced out by decoupling coils. Thus, the functioning of the module under test is not affected.

For More Details Circle (68) on Reply Card

Sound Reverberation

If reverberation is part of your sound game, you might want to take a look at the **Robins/Fairchild** model 659A. It uses six differently-tuned electro-mechanical delay lines to produce a natural echo effect which may be customized at will.

Decay time is selectable over a 3 to 5 second range, with local and remote selection of 3 degrees of reverberation. The unit comes with low frequency equalization, high frequency boost and peak selector, and a high frequency droop control.

While the 659A accepts signals as low as -30 dBm, its maximum output is continuously adjustable to +18 dBm. All signals can be monitored on the units VU edgewise meter.

For More Details Circle (69) on Reply Card

Pre-Sunrise Controller

Multronics, Inc. a manufacturer of AM phasing equipment and RF components has announced the availability of the ML-PSA-50 Pre-Sunrise Power Cutback Unit.

This equipment, with a 50 Watt output, has all components including an RF Contactor for switching installed on a 3'x3' panel for Wall or Top of Transmitter mounting and can be provided with fixed or variable components.

For More Details Circle (70) on Reply Card

2-Meter Amplifier

If you've been looking for a way to up your 2-Meter transmitting power, the **Heath** HA-202 could be the answer to your problems. It takes about four hours to wire up this amplifier that will deliver from 20 to 50 Watts, depending upon the input drive.

Internal antenna change over relay and sensing circuitry provide automatic transmit-receive switching. The amplifier includes emitter-ballasted transistors and stout heat sinks that can withstand high VSWR loads without the need for sensing circuits.

Tuned input-output circuits provide low spurious output and allow coverage of any 1.5 MHz segment of the band without returning. Power output 20W at 5W in; 30W at 7.5W in; 40W at 10W in; and 50W at 15W in.

For More Details Circle (71) on Reply Card

Digital Video Signal Corrector

Consolidated Video Systems has introduced the CVS 504 — a single digital video signal corrector which will process and correct almost any helical video signal up to broadcastable color standards. The CVS 504 processes signals from all 1/4", 1/2", 3/4", 1" and 2" non-segmented helical VTRs.

This new product follows the successful introduction of the company's

(More...)

line of digital video signal correctors at the 1973 NAB in Washington, D.C..

Interfacing the CVS 504 to any of the various helical formats to produce broadcastable color is accomplished with a combination of three simple function buttons. Add to this capability a full compliment of video output controls and you have a truly "universal" digitized helical video signal perfector.

For example, operators can now take the video output from a Sony U-matic and dub up to a quad. This extraordinary process is made possible by an exclusive CVS "color interlacer" switch. The result is phased interlaced color when played back on a quadraplex recorder. Or, the operator can take an EIJA 1/2" recorder and use it as a camera source locked to house sync. If the recorder does not have a capstan servo, he can still drive a camera from the internal sync generator in the CVS 504 and do special effects between the recorder and the camera.

The CVS 504 is not only a digital video signal corrector but also features a built-in processing amplifier, an EIA sync generator and velocity compensation. The user has the further option of adding a true genlock sync generator which is available in a field installable plug-in board.

For More Details Circle (72) on Reply Card

Stereo/Mono Limiter

Wilkinson Electronics is offering a stereo or mono limiter with instantaneous attack with a distortion figure below 1 percent.

Called the LA2-C/S, this limiter at 1 percent or less to 20 dB of limiting. Attack time: 5/4 Radians for gain control before clipping. The overlimit attack time is instantaneous. Compression ratio is more than 35:1. Frequency response +1dB at 50Hz to 35 kHz with full limiting.

For More Details Circle (73) on Reply Card

Video Switcher

Vital Industries has introduced a quality production switcher to meet the need for switchers where a medium number of inputs are required while providing versatile production capability.

Called the VIX-1, this switcher features independent 13-input program bus, 9 sources on mix-effects buses with tally functions, 8 effects patterns with variable border, 4 independent key sources, preset effects pattern limits, effects entry into mix, built-in black burst and color background generator, and DC control cables to panel available in 25-foot increments.

Options include the VCK-1 chroma key, audio-follow on program bus, and video processor.

For More Details Circle (74) on Reply Card

SS Replacement For Rectifier Tube

Electronic Devices Inc. has added a new model to their Solid-Tube line of silicon, solid state, plug-in rectifier tube replacements.

The new model, Solid-Tube R-3DS3 replaces vacuum tube rectifiers types 3DR3 and 3DS3.

This new model joins the other Solid-Tubes in the EDI line in providing a number of advantages over the vacuum and gaseous tubes that they replace. The Solid-Tubes emit no X-

radiation, create no heat, provide greater reliability, and since they have no filament they make ideal substitutes in cases where the filament or flyback transformer is faulty.

For More Details Circle (75) on Reply Card

Dynamic Noise Filter

Burwen Laboratories has designed a new noise filter for use in the TV broadcast chain to remove cumulative noise from all sources preceding it 10 to 11 dB with no apparent effect on music or speech.

The unit uses 40 operational amplifiers which help provide a 100 dB dynamic range. Burwen claims high accuracy and flat response across the entire range.

For More Details Circle (76) on Reply Card

Modular Automation Controller

A totally new concept in audio automation, the CD28 Series of modular automation controllers, has been announced for immediate delivery by **Control Design Corporation.** These units permit updating of presently installed systems as well as the construction of totally new ones without scrapping operating station audio sources.

CD28 units are also compact with the basic system — audio controller, programmer and power supply - occupying only 15 3/4" heighth in standard 19" racks thus allowing installation into most presently installed systems without extensive rewiring.

The basic CD28 System handles up to 2,000 events and 12 audio sources with full random access. Accessory extended memory modules expand the system to 8,000 events of preprogrammed broadcasting.

Programming is simple and can be mastered by inexperienced personnel. A standard input keyboard is utilized for data entry into the MOS Memory thus eliminating thumbwheels or similar devices. Easily readable LED Displays show the event number, function and program source.

For More Details Circle (77) on Reply Card

Digital Multimeter

A new option for the **Fluke** 800A 3½ digit multimeter provides an extended current measuring capability according to an announcement from the Seattle, Washington manufacturer of electronic instruments and systems.

The option, which can be installed at the time of order or retrofitted at a Fluke Technical Center, provides

(*More...*)

NEW PRODUCTS

separate AC and DC high current inputs. Equipped with the option, the Model 8000A will measure up to 10 amperes continuously or up to 20 amperes for one minute or less.

The new option is available for both battery and line operated instruments at an additional cost of $25 if ordered on new instruments. Retrofitted in the field at a Fluke Technical Center, the cost is $35 including parts and labor. Typical turnaround time is 10 days.

Other specifications of the Model 8000A include five ranges of AC and DC voltages, five ranges of AC and DC current on the 2 ampere input terminals and six ranges of resistance.

For More Details Circle (78) on Reply Card

Reel-To-Reel Decks

TEAC Corporation of America is offering a completely new generation of stereo reel-to-reel tape transports with direct-drive servo-controlled DC motor/capstan, which eliminates gears, idlers and belts.

Models 5300 and 5500, the latter with dual-process Dolby* noise reduction system are DC motor forerunners of a new series of slim styled decks.

Both operate with a direct drive servo-controlled capstan which substantially reduces heat, vibration and improves wow and flutter characteristics.

Four separate circuit cards in the 5500 permit simultaneous Dolbyized recording with decoded tape monitoring, a distinct feature not possible with some separate Dolby units.

Other features associated with the Dolby system in the 5500 include: Dolby FM/Copy function to provide decoded listening when transcribing Dolbyized tapes or Dolby FM broadcasts; MPX filter switch disengages the filter and removes the multiplex carrier frequency (19kHz) from FM signals to eliminate phase shift distortion and improve frequency response; Dolby calibration oscillator and a Source/Tape Monitor Switch for comparing the input signal before Dolby encoding with the decoded tape monitor.

For More Details Circle (79) on Reply Card

Audio Cassette Tape Transport

The **Conrac** Model CAS-4 audio cassette tape transport is a U.S. made, three motor, unidirectional, capstan driven, slot loaded unit with a professional 2 channel, 2 track record/play head.

It features positive key slot loading that makes it impossible to insert the cassette incorrectly. The cassette mechanism is entirely interlocked (tamper proof) to prevent damage from misuse.

By design the CAS-4 is a quality, heavy duty tape transport. All transports are manufactured in the U.S. and the component parts are mounted on a heavy metal chassis. All functions, including the solenoid operated heads, are electrically controlled. No mechanical clutches or brake bands are required.

For More Details Circle (80) on Reply Card

Expandable Patch Cable Eliminator

Patch cables always have been a messy station problem. **Dynair Electronics** thinks they have the answer to keeping things straight and on the line in their new Series X Switcher.

The Series X provides pushbutton distribution of from six to 36 inputs to as many as 120 outputs. High input-to-output isolation allows any input to be switched to any or all outputs without loading the source.

Series X is totally modular, allowing assembly into almost any input-output configuration, including video-only or audio-follow-video.

For More Details Circle (81) on Reply Card

Audio Distribution Amplifier

Bethany International (formerly Taft Communications Systems) is going strong with their Taft Model 5002 distribution amplifier.

This unit has 18 isolated 600 Ohm inputs, equalization and roll-off feature provided for signal conditioning before distribution, balanced inputs and outputs, and 20 dB gain which can be increased to 40 dB.

For More Details Circle (82) on Reply Card

Reel-To-Reel Tape Recorder

International Tapetronics has expanded their recorder line to include an all-new reel-to-reel tape machine.

The 850 includes many impressive features, including motion sensing, a multi-function edit mode, air damped selinoids for quiet operation, and automatic tape lifters.

Other ITC 850 features are: TTL circuitry, selective play/record synchronization, 10½ or 14-inch reels, and it plays at 3 ¾ to 7½ IPS or 7½ to 15 IPS.

For More Details Circle (83) on Reply Card

TECHNICAL DATA

100. AMPEREX ELECT. CORP.—A new four-page catalog offered presents useful technical and applications data on an expanding line of 18 high-performance RF transistors for CATV/MATV, communications and instrumentation service. Included in the catalog are charts of low-distortion characteristics and intermodulation specifications for six wide band amplifier types for CATV/MATV service. Also included are curves of gain-bandwidth product vs. IC for eight types that offer fT from 1 GHz to 5 GHz at IC from 0.1 mA to 150 mA.

101. CAMBRIDGE THERMIONIC CORP.—This new Integrated Socket Packaging Brochure provides the basis for a whole new concept of electronic packaging. Cambion's (R) Integrated Socket is a key modular component in the fabrication of a precise, economical, flexible and durable array of wraposts that eliminates the need for printed circuit boards. Designing and building equipment using the Integrated Socket can reportedly result in significant cost savings as reflected by the smaller amount of capitol equipment required to do the job, reduced engineering effort, fewer hardware costs and shorter elapsed time between the basic idea and a working system or production systems.

102. CENTRAL DYNAMICS CORP.—Central Dynamics' new VSP-1200 Series Switcher and new Mix & Effects Amplifier is illustrated in a 10-page full color brochure. Eleven unaltered color monitor pictures are included showing Soft RGB and Encoded Chroma Keys, Vignettes, Soft Edge Wipes, Spotlight, Cameo and borderline effects. Detailed specification brochures are also available.

103. CORNELL DUBILIER ELECTRIC—An eight-page SCR-Capacitor brochure describing the company's paper, paper/film, and film dielectric capacitors is now available. These units have been designed for applications such as SCR commuting, motor speed controls, frequency changers, induction heating, electric vehicles, static power supplies, snubbers, resonant filters, choppers and static switches. Their high quality and reliability plus flexibility in specifications make these capacitors most ideal for all the applications noted.

104. ELECT. ENG. CO. OF CALIF.—Exact, automatic location of cue points and full control over precise synchronization of any two quad or slant-track video and multichannel audio tapes with EECO's new BE460 "Dual Cue" Controller is detailed in a four-page brochure. BE460 operates with EECO's BE450 Wide Range Synchronizer, using SMPTE binary Edit

(More...)

Code. Some Dual Cue/Synchronizing applications illustrated in Text and block diagrams are: combining outputs of multichannel ATR's, video/audio double-system editing, sweetening of audio tapes, video and FM stereo simulcasting and reel-to-reel changeover during video broadcasts.

105. IEEE—The new 32-page IEEE Standards 1974 Catalog is now in print. The new catalog lists more than 350 standards publications by subject as well as in numerical sequence. Included in this new set of listings are the many American National Standards published by IEEE. Standards developed within the Institute of Electrical and Electronics Engineers cover test methods, practices for electrical installations, units, definitions, graphic symbols, letter symbols, and applications methods.

106. MOTOROLA COMM. AND ELECT., INC.—A new full-line closed circuit television and CCTV accessory brochure is now available. The brochure entitled "Visual Communications" describes the many state-of-art features that make CCTV equipment ideal for a variety of important applications.

advertisers' index

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Classified columns are not open to advertising of any products regularly produced by manufacturers unless used and no longer owned by the manufacturer or a distributor.

WANTED

WANTED: All surplus broadcast equipment especially clean A.M. & F.M. transmitters, contractors, capacitors. Surpluss Equipment Sales, 2 Thorncliffe Pk. Dr. Unit 28 Toronto 17, Ont; Canada. 1-73-tf

TUBES WANTED—All types-CeCo 2115 Avenue X, Brooklyn, N.Y. 11235, 212-646-6300-Anytime. 7-73-12X

REQUIRE June, August, September, and December issues of Broadcast Engineering for the year 1969. Contact: Okanagan Broadcasters, Box 100, Kelowna B.C., Canada 2-74-1t

WANTED (Cont.)

WANTED TO BUY: USED COLOR QUAD HI BAND VTR AND NORELCO 70 CAMERA. Call collect (212) 586-3693, or write Mr. A. Neil, 424 West 49th St., NYC 10019. 1-74-3t

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NEW Paps hysteresis synchronous motor HSZ 20.50-4-470D as used in series 400 and 500 machines. Price $39.00 each prepaid, while they last. 90 day warranty. Terms check with order only, no COD's. Not recommended for Tapecaster series 600 or 700.
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NATIONAL TAPE CARTRIDGE SERVICE CARTRIDGES RECONDITIONED - NEW TAPE 12 Years Experienced Personnel. Write for new and reconditioned price sheet. Mastertone Co., 1105 Maple, Dept. B-E 1, West Des Moines, Iowa 515-274-2551 8-73-tf

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CARTRIDGE TAPE EQUIPMENT—Rebuilt. New paint, heads, flywheel, pressure roller, belts, etc. Spotlessly clean and thoroughly tested. 30 day money-back guarantee, 90 day warranty. Also contact us for discounts on new equipment and accessories. AUTODYNE, Box 1004. Rockville, Maryland 20850. (301/762-7626). 7-72-tf

TELEMATION WEATHERSCAN Model TMW-97, fully equipped, less than 2 years old, extra camera. Contact John Dennis, General Manager Sunflower Cablevision, 7th & New Hampshire, Lawrence, Kansas 66044, (913) 841-2100. 1-74-2t

2 RCA TT10AL Transmitters with Sideband filters and Input equipment. Excellent working condition, $15,000 each; $25,000 for both, plus some spares. WHDH-Boston, 617-288-5000. 2-74-1t

EQUIPMENT FOR SALE CONT.

BUILD YOUR OWN TV AND RADIO PRODUCTION EQUIPMENT. Easy, inexpensive, (mostly IC). Plans or kits: Special Effects Generator, Automatic Logger, Vertical Interval Video Switcher, Solid State Lighting Board, Preset Audio-Video Board, Preset Lighting Board, Crystal Controlled Wireless Mikes with matching receivers, Subsonic Tone Control for audio tapes, 8MM SOF Cameras and Projectors, Distribution Amplifiers (Sync, Video, Audio), Audio Control Boards (Studio & Remote) Proc-Amp with compensation and regeneration for adapting Helical Scan VTR's to broadcast standards. PLUS specialized correspondence courses in Telephone Engineering ($39.50), and Integrated Circuit Engineering ($49.50). Plans from $5.95 to $15. SUPER CATALOG plus years updateing of new devices Air Mailed $1.00. Don Britton Enterprises, PO Drawer G, Waikiki, Ha. 96815. 4-73-12t

MOTOROLA MICROWAVE Freq. 7.1-8.4 GHz. Broadband for color TV Xmission. Xmitter freq. deviation ±3 MHz at 60 Hz-5 MHz. Rcvr video response ±0.5db from 50 Hz to 5 MHz. Xmtr Bay $750 ea., Rcvr Bay $750 ea. Radio Research Instrument Co., Inc. 3 Quincy St., Norwalk, Conn. 06850. Tel. 203-853-2600. 1-74-tf

RCA MI-40790-AZ **AIRBEARING HEADWHEEL** assembly $600. **IVC VIDEO HEADS** for 800, 900 machines $75.00. RCA style **VIDEO JACKS** new $2.50 each. You supply panels & save. Send that P.O. today. Norman Gillaspie, Box 2124, Monterey, Calif. 93940. 1-408-375-7424. 1-74-3t

VACUUM CAPACITORS: MMC1500, $150.00; MMC3000, $200.00; MMC5000, $350.00. Lightning arrestors, feedthru, 10 amps, $50.00. Husbands, 6626 Talmadge, Dallas 75230. 2-74-1t

EMPTY REELS: New 1/4". 5" clear plastic with 3" center. $30.00 case of 200. Accurate Sound Corporation, Box 2159, Garland, Texas 75041, Telephone 214-278-0553. 2-74-1t

100 WATT UHF TV TRANSLATOR Emcee model U-HTU-100-D. Slightly used less than 6 months. Channel 24 in., channel 18 out can be retuned. New cost $7,000.00. Available immediately for $2,500.00. Frontier Engineering Corporation, P.O. Box 265, Florham Park, New Jersey 07932, (201) 822-3030. 2-74-1t

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FREQUENCY MEASURING SERVICE — WE'RE #2 — MONITOR REPAIRS — MOBILE UNIT — covers Northern 2/3 Ill., Eastern Iowa, Eastern Minn., Southern 2/3 Wis., Western Mich., and Western Ind., monthly. Radio Aids, 528 Ravine Ave. Lake Bluff, Illinois 60044, (312) 234-0953. 2-74-tf

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HELP WANTED

MOVE UP from your present job in broadcast engineering. We handle all engineering jobs and openings coast to coast. Send full resume confidentially now. The AMPS Agency, 11661 San Vicente Blvd., Los Angeles, Calif. 90049 8-73-tf

IMMEDIATE OPENING for a TV-FM broadcast systems design engineer. Qualifications include a knowledge of communications and broadcast engineering fundamentals, FCC Rules and Procedures, and an ability to write technical reports. Rapid advancement for the right man. Submit resume and starting salary to: W. J. Kessler Associates, 2929 NW 13th Street, Gainesville, Florida 32601. 2-74-1t

WANTED, TV STUDIO ENGINEER with 1st phone to assist in maintenance and run shifts at switcher. Lots of room for advancement with growing midwest station. Write T. Koenig, Box 1072, Columbia, Mo. 65201. 2-74-1t

AEI is looking for highly professional sales representatives for our sales force. Experience in TV engineering with ability to design and develop CCTV and audio systems and/or sales experience in related technical field. Call or send resume to: Paul Dark, V.P., Alexander Electronics, Inc., 1820 Wyandotte, Kansas City, Mo. 64108, 816/474-6656 2-74-2t

CHIEF ENGINEER/TECHNICIAN for 4,000 subscriber 50 mile CATV System in Caribbean. IVC Color studio equipment, Jerrold and Anaconda cable plant. Must be willing to relocate. Knowledge of French language preferred but not mandatory. Send resume and salary requirements to: Frontier Engineering Corporation, P.O. Box 265, Florham Park, New Jersey 07932, (201) 822-3030. 2-74-1t

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HELP WANTED (CONT.)

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Telemation, Inc.

TECHNICAL SPECIALIST: Two excellent openings now exist for Technical Specialists in the area of Educational Television at the State University of New York at Buffalo.

Assistant Television Engineer — Translate campus communication needs into appropriate engineering requirements; design complex campus-wide television systems; research and evaluate equipment specifications; ability to diagnose electronic problems in regard to the repair and maintenance of sophisticated electronic systems and equipment; hardware assembly, installation and performance checkout of campus-wide TV systems; teach faculty and students (ability to articulate and interact) concepts involved in the operation and utilization of television equipment and in the production of instructional materials; schedules productions, playbacks and personnel; supervises full-time and part-time assistants.

Technical Specialist — Research and evaluate equipment specifications; ability to diagnose electronic problems in regard to the repair and maintenance of sophisticated electronic systems and equipment; hardware assembly, installation and performance checkout of campuswide television systems; teach faculty and students (ability to articulate and interact) concepts involved in the operation and utilization of television equipment and in the production of instructional materials.

Both the above positions require a Degree and/or demonstrated work experience ranging from 1-3 years for the Technical Specialist to a minimum of 3-5 years and a First Class Radio Telephone License for the Assistant Chief Television Engineer. Interested individuals should submit a resume complete with salary requirements to: Kenneth Kavanagh, Jr., Chief Engineer, Rm. 22 - Foster Annex, SUNY at Buffalo, Buffalo, New York 14214 2-74-2t

TRAINING

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TRAINING CONT.

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Swiss Performance

Our new Electro Sound ES-505 Professional Recorder/Reproducer has what it took the Swiss centuries to develop. A heritage of classic design and precision performance. The ES-505's essential mechanical and electronic specifications compare favorably to Studer's A-80. And at ½ the price! ☐ European or American—no other professional machine has more significant "Operator Engineered" features. A disappearing headgate for easy editing or cleaning. A built-in reference audio oscillator that supplies test frequencies 50 through 15K for instant alignment. An optical motion sensing system prevents tape damage during control sequencing. And differential disc brakes for ultra smooth tape stops. ☐ Operator simplification. Our ES-505's "Record" indicator light also continucously monitors bias. There are two calibrate positions: one for record and one for reproduce. Our optional third reel is the ultimate in convenience for those heavier editing jobs. Operating modes are instantly recognized with fully illuminated transport controls or optional remote controls. ☐ Operator satisfaction. Electro Sound's unique viscous damped idler fly wheel lowers flutter up to 25%. The ES-505's non-slip capstan improves playback timing accuracy to ±1.8 seconds in 30 minutes recording. ☐ The ES-505 is available in console, portable, and unmounted configurations in ¼" or ½" versions, with 1, 2 or 4 channels of electronics. ☐ The Electro Sound ES-505 comes with the world's only 1½ year extended parts warranty. The American machine to match Swiss excellence.

Performance	Electro Sound ES-505	Studer A-80
Mechanical		
Timing Accuracy	±0.1%	±0.1%
Wow and Flutter 7½ ips	−0.08 rms	−0.07 rms
Electronic		
Frequency Response 15 ips	30-18K Hz ± 2dB	30-18K Hz ± 2dB
Signal-to-Noise 15 ips— Two Track	63 dB Unweighted	62 dB
Distortion	0.4% 2 HD @ 500 Hz. Peak Record	−1.0% @ 1K Hz. Operating Level
Price	$3,395	$6,670

Electro Sound, Inc.
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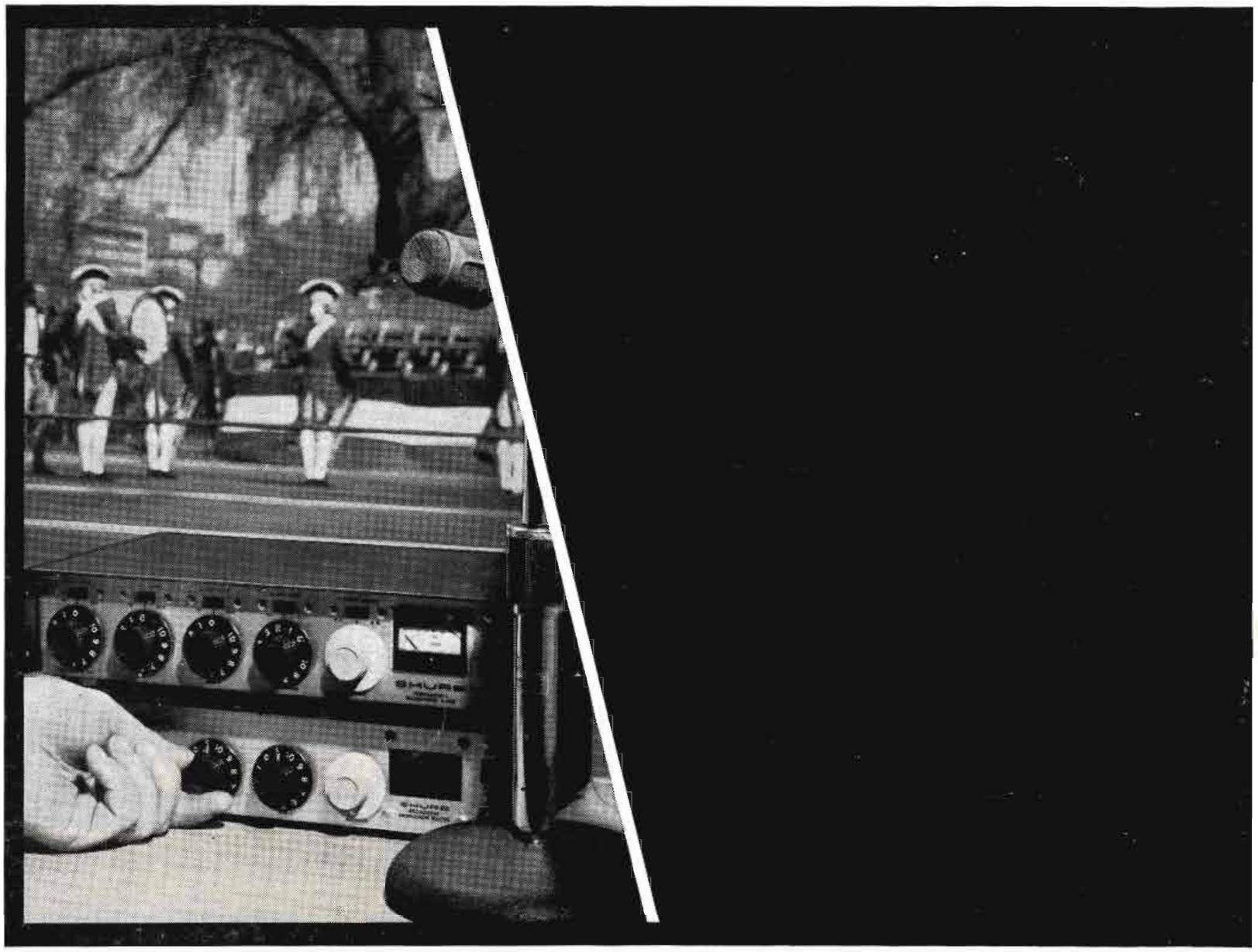
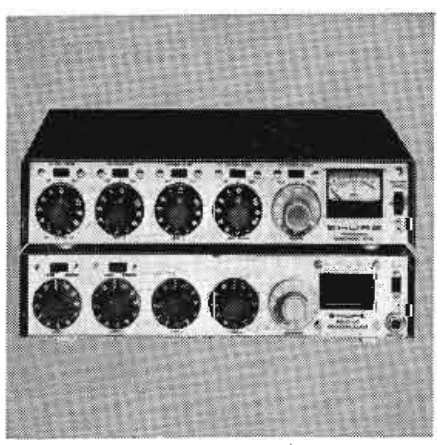


A production console* for $325.80!



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In Canada: A. C. Simmonds & Sons Ltd.

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For More Details Circle (3) on Reply Card