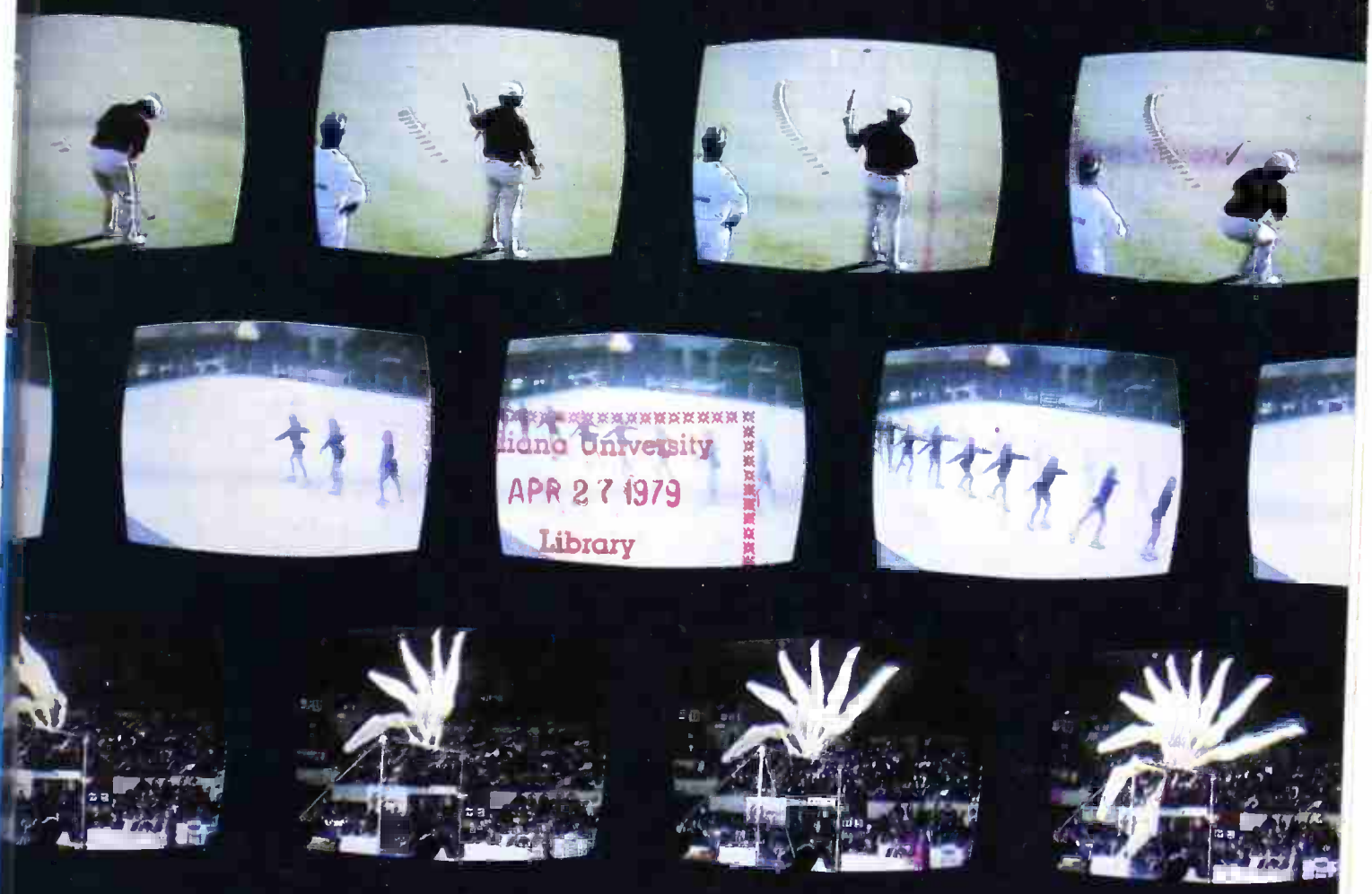
# BROADCAST ENGINEERING®

April, 1979/$2.00





## CBS Actiontrak
## STL equipment

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NEC

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Circle (1) on Reply Card

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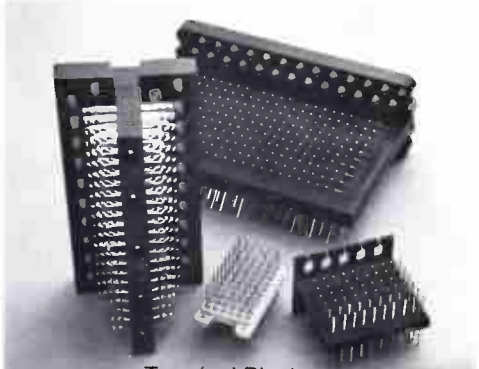
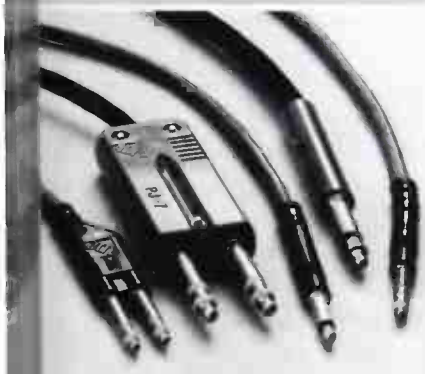
Bantam, Long-frame & Coax Jacks.


Terminal Blocks.


New Printed-Circuit-Board Jacks.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Assembled Panels.

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# BROADCAST engineering

*The journal of the broadcast-communications industry*

***April, 1979 ☐ Volume 21 ☐ No. 4***




## ARTICLES



## STATION-TO-STATION: Contributions by station personnel



## DEPARTMENTS






## THE COVER

When CBS Technology rolled the tape on Actiontrak at the annual SMPTE Television Conference in San Francisco on February 3, the audience viewed some specular motion sequences. Some of these are shown on the cover, and others appear in the article on Actiontrak beginning on page 54.

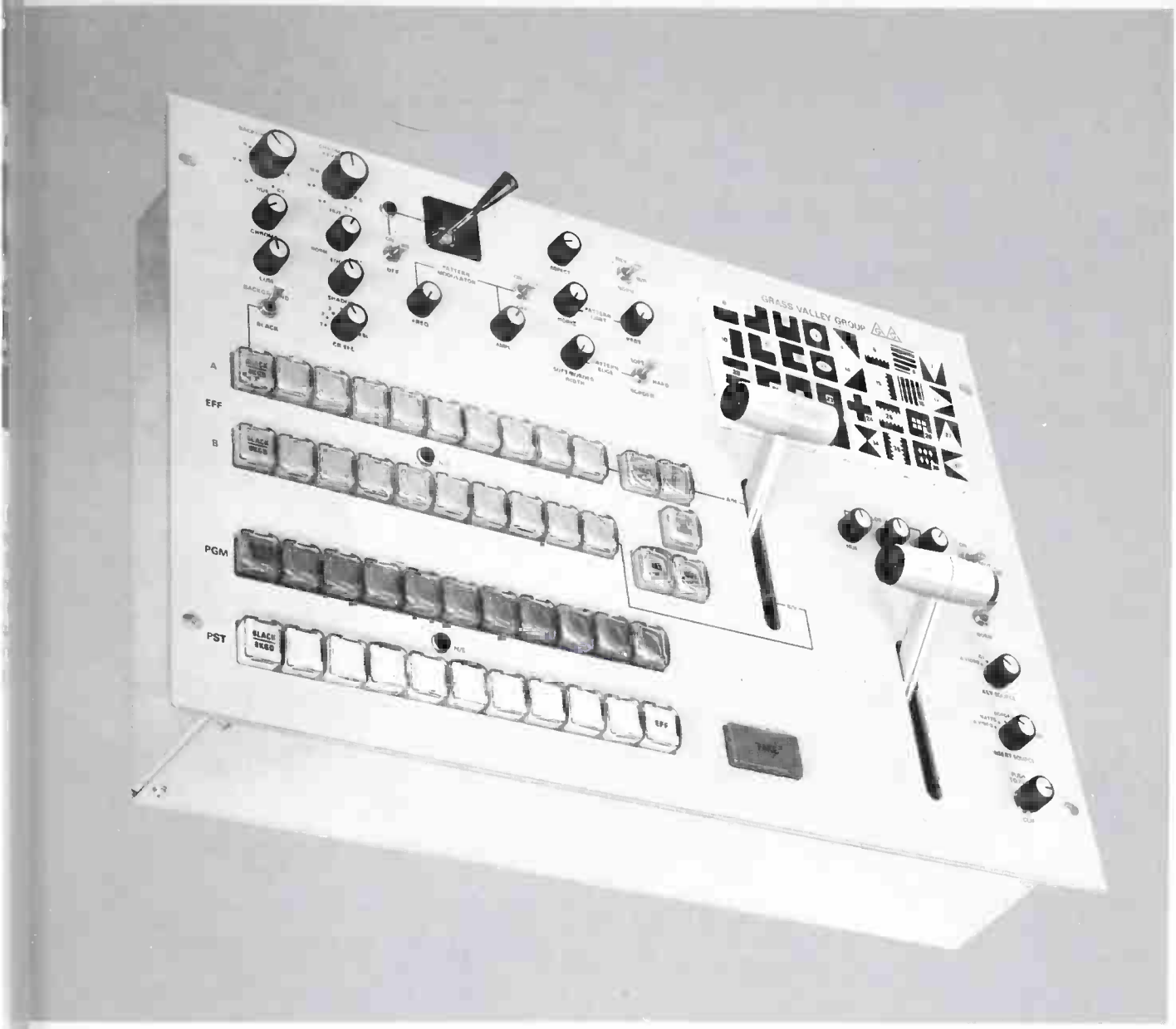
## MAY ISSUE

**Broadcast Engineering's** 20th anniversary issue.

The May issue salutes 20 years of growth and technological developments in broadcasting. It will cover both significant historical events and future developments and trends. Also included will be:

- An overview of NAB/Dallas (a complete replay will be in the June issue)
- New electronic processing devices

# OUR GOOD THING for

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ABP Member, American Business Press

BPA Member, Business Publications Audit of Circulation

**BROADCAST ENGINEERING** (USPS 338-130) is published monthly by Intertec Publishing Corporation, 9221 Quivira Road, P.O. Box 12901, Overland Park, KS 66212.

**BROADCAST ENGINEERING** is edited for corporate management, engineers/technicians and other station management personnel at commercial and educational radio and TV stations, teleproduction studios, recording studios, CATV and CCTV facilities, and government agencies. Qualified persons also include consulting engineers and dealer/distributors of broadcast equipment.

SUBSCRIPTIONS: **BROADCAST ENGINEERING** is mailed free to qualified persons in occupations described above. Non-qualified persons may subscribe at the following rates: U.S., one year, $20; all other countries, one year, $26. Back issue rates, $3, except for the September Buyers' Guide issue, which is $10. Rates include postage. Adjustments necessitated by subscription termination at single copy rate. Allow 6-8 weeks for new subscriptions or for change of address. Controlled circulation postage paid at Kansas City, MO.

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1974 HELICAL FRONT END RECEIVER
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April, 1979/By Howard T. Head

## New Source of TV RFI

The commission's chief engineer has requested six manufacturers of personal computers to send sample equipment to the FCC Laboratories for testing and evaluation. There have been an increasing number of complaints of interference from home computers to television reception and other services.

I have the problem in my own home, and it is a lulu whenever someone in the house wants to watch TV Channel 2 when I am on line with the computer. In my own case, the computer clock frequency is exactly four times the TV color subcarrier frequency, or 14.32 MHz. Multiply that by four and you get 57.27+ MHz, or right smack in the middle of Channel 2 at 54-60 MHz.

The internals of the computer are simply mounted on printed-circuit boards with no shielding, and harmonics and other garbage are free to leak out by radiation, conduction, or otherwise. For the time being, the commission is simply proposing to test to find out what the problem is and how serious. If it's bad, it could lead to a crackdown.

## Don't go too far in automating EBS

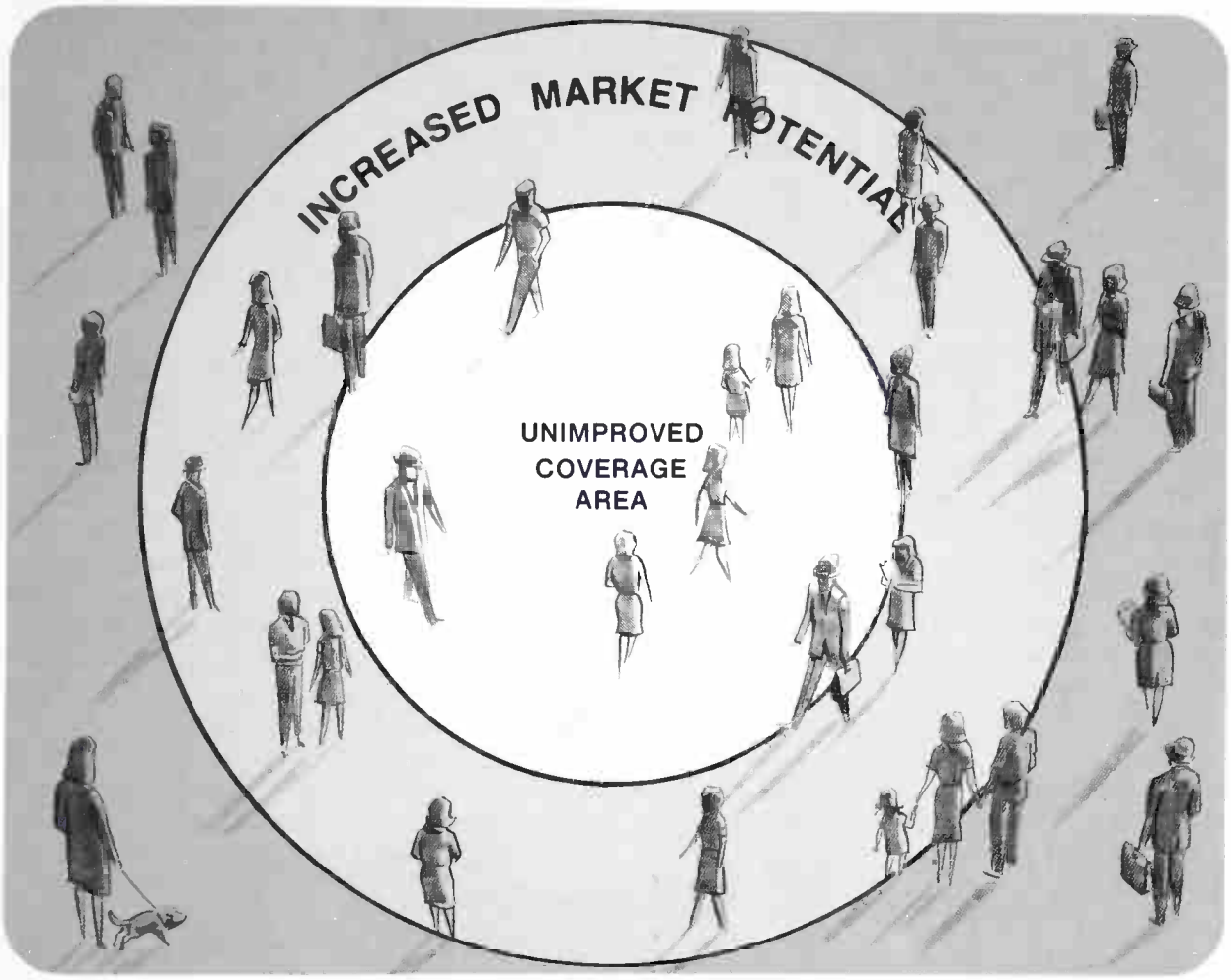
The commission's defense commissioner, on the basis of reports that broadcast stations are either using or planning to use automation for the weekly EBS tests, has reminded all broadcast licensees that the whole purpose of the Emergency Broadcast System is to provide a prompt response to emergencies. This means, among other things, that a live operator must be on duty to take appropriate action whenever EBS is activated. Also, station employees on duty must be fully instructed in the required procedures.

The commission's notice also reminds licensees that tape recordings of the two tones at 853 Hz and 960 Hz will not meet the required ±0.5 Hz frequency tolerance and should not be used for the purpose. The commission's notice also points out that the addition of humming, singing or other music to the EBS message, while not specifically prohibited, is rather tacky and they wish you wouldn't do it.

## Satellite relaying taking off like a rocket

The commission has authorized both AP and UPI to experiment with satel-

# For Increased Market Potential Expand Your Coverage With A Harris AM Transmitter




Harris AM transmitters with PDM* or PSM* will expand your listener coverage area through increased loudness. Actual reports from users are on file to prove this.

The patented Harris PDM and PSM modulation techniques, capable of 125% modulation, deliver the loudest, cleanest signal possible in today's AM transmitters.

Why not let us show you the facts on how you can utilize the latest technology from Harris in reaching the maximum potential audience of your station—whether it is a one, five, ten or fifty kilowatt installation.

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*Harris developed and patented modulation techniques

Circle (7) on Reply Card

lite transmissions, using small dish earth receiving stations, for audio and teletype applications. AP will conduct the tests at 25 receiving locations, and UPI at 30. These experimental plans come hard on the heels of plans by National Public Radio (NPR) for a system of 200 installations, and 550 by Mutual.

CATV use of satellite receiving stations continues its rapid increase, with close to a thousand CATV earth stations now in use. People continue to talk about direct-to-home use of satellites in the 12/14 GHz band, but rainfall attenuation is a problem which has so far been solved only by diversity reception. Voyager I, in relaying pictures to Earth from Jupiter, lost three hours of X-band transmissions while persistent thunderstorms hovered over the receiving station at Melbourne, Australia.

## FCC processing delays getting complaints if not attention

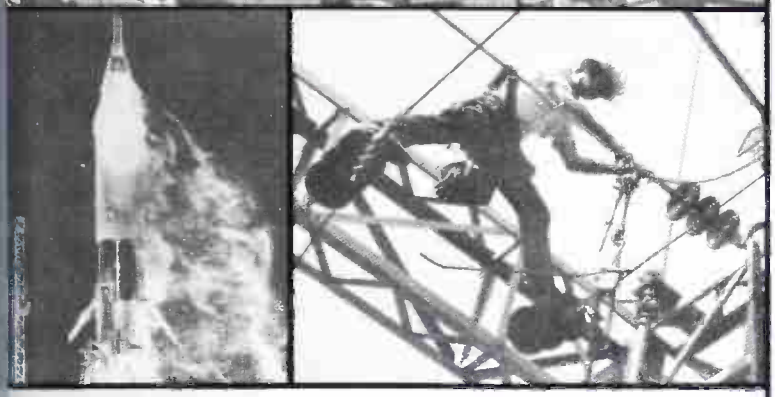
A prominent Washington communications law firm has complained to FCC Chairman Charles Ferris about the continuing delays at the commission in the processing of formal and informal applications. Several other law and engineering firms promptly joined in.

There are a lot of reasons for these delays, although the frequently-offered excuse of "not enough manpower" often means that staff members are assigned to matters unrelated to the essential day-to-day problems which the commission must take care of. Another reason is that in some areas (AM application processing is a good example), the processing procedures often employ archaic concepts and outmoded techniques which are little changed from their adoption 40 or more years ago. Modernization efforts often meet with little success. For example, a recent FCC report attempting to convert the AM ground wave field strength curves to the metric system while adopting computer techniques had difficulty in reconciling various field strength prediction methods to the printed curves in the Technical Standards.

The commission needs to assign adequate and competent manpower to the problem, but it will just bog down again unless some careful thought is given to a fundamental revision and modernization of both methods and concepts.

## Short circuits

The commission's Office of Chief Engineer becomes the Office of Science and Technology, effective May 1, with Stephen J. Lukasik, former Chief Scientist of the Rand Corporation, replacing retiring Ray Spence... a CATV firm in the Washington, DC area is working on a proposal to use the system for traffic signal control . . . the commission has declined to permit a Chicago non-commercial educational FM station to retain an ERP of 100 kW while increasing effective antenna height from 440 ft. to 1290 ft. . . . the Electronic Industries Association (EIA) has filed a court appeal of the commission's order reducing the UHF TV receiver noise figure below 18 dB . . . the commission has authorized a midwestern TV station to transmit news, financial and weather information from 2 AM to 6 AM with background music, on a public service basis . . . What is the commission doing instead of processing applications? It took a 6-page letter to tell a complainant that the "Fairness Doctrine," a quagmire of the commission's own making, did not require equal time to reply to a program which portrayed paranormal phenomona in a favorable light.

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A Hitachi-developed Automatic Beam Optimizer (ABO) circuit cuts out the comet-tailing effect common to lesser cameras when shooting highly reflective objects.

Three 2/3" Saticon tubes combine with a smaller-size high index beam splitting prism to deliver better than 500-line horizontal resolution and better than 51dB signal-to-noise ratio.

And, of course, there are all the additional features that assure sharp, crisp pictures and true colors: built-in 2H contour enhancer with comb filter...standard I & Q encoder...switchable color bar generator...automatic white balance...automatic iris...and a built-in Genlock circuit using black burst to lock your SK-90 to other cameras.

Options include a built-in linear matrix masking amplifier for high fidelity color rendition and a complete remote operating unit which lets the camera range up to 1000 feet away on standard camera cable. For an even greater working range of over 3000 feet, a Digital Command Unit/Triaxial Cable System is also available.

Remarkably, the Hitachi SK-90 may be the first affordable, self-contained portable that doesn't compromise. Contact your Hitachi dealer for more details.

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# industry news

## Subcommittees to study multichannel sound and teletext

The broadcast television systems committee of the Electronic Industries Association has formed two subcommittees to develop recommended broadcast standards for both multichannel television sound and teletext. The move is in line with the interest of the FCC and the industry and commitments by other nations to begin these services.

Multichannel sound involves stereo or second language broadcasting plus other non-broadcast services placed on the television aural carrier. Teletext is the generic term for the transmission of data and graphics on lines in the vertical blanking interval of the television video signal.

For information regarding serving on a task force of one of the subcommittees or general information, contact; Eb Tingley, Electronic Industries Association, Dept. BE, 2001 Eve Street, N.W., Washington, DC 20006.

## Carnegie Commission recommends revisions of public broadcasting

After 18 months of review, the Carnegie Commission on the Future of Public Broadcasting has released a 400-page report which calls for major revisions of public broadcasting's national structure and system of financing.

The recommended changes include:

- The creation of a private, nonprofit Public Telecommunications Trust, to serve as the principal fiduciary agent for the entire system.
- An independent, highly-insulated Program Service Endowment, housed within the Public Telecommunications Trust, with responsibility of "supporting creative excellence" through the funding of television and radio programs and services.
- Substantially increased funding for public television and radio, to reach $1.2 billion by 1985, a cost of $5 per capita.
- Increased spending by public television stations for programs of regional and national use.
- The addition of 250 to 300 new public radio stations within the next six years, to fully serve the nation and provide greater diversity among radio licensees.

The report, entitled *A Public Trust*, is available from Bantam Press, 66 Fifth Avenue, Dept. BE, New York, NY 10019.

## RASCAL system fills the bill for ABC radio networks

Use of computers in the broadcast industry has increased greatly in recent years with such station applications as traffic, administration, production, sales comparison reports and projections. The ABC Radio Network employs a computer system known as RASCAL (Research And Sales Computer AnaLysis) to provide its buyers with an effective planning system.

The system, designed for ABC by Interactive Market Systems (IMS), is an on-line station affiliate file of ABC network affiliates and has the ability to be merged with other data bases such as Arbitron or TGI/SMRB. The RASCAL system allows the research department to provide the sales, affiliate affairs and network management departments with up-to-date data and analyses for both day-to-day and long range functioning of the network.

Because the affiliate file is dynamic, Arbitron's nationwide audience estimates can be updated on a daily basis. Another function the system provides is the ability to rank affiliated stations and non-affiliated stations in a single column, allowing the network radio buyer to single out additional stations for extra media weight when needed. RASCAL also can identify all Arbitron markets in which a station is listed and provide the station's audience rank in each market and for combined markets.

The RASCAL system employs two 300 baud terminals and one 1200 baud terminal and is connected on-line with IMS' DEC-2040 computer for instant access. Although the system has the same capabilities found in other spot radio computer systems, the specially designed software of the system makes it highly suited to the specific needs of buyers and planners of network radio.

**Bill McClenaghan,** research director, ABC Radio Networks, and Sandy Kennedy, research manager, inspect the high speed printer connected to the IMS' DEC-20 Computer.

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- Unique HETROCOLOR™ Processing for optimum performance for color under signals

The 2525 will correct VTR signals from no-lock or V/H lock, synchronous or non referenced, direct or heterodyne, ½" helical through 2" quad. It passes VITS with the same processing as active video, can be remotely controlled, and is transparent to input signals from any source—and all with MICROTIME's proven reliability and ease of operation.

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## VPA 10 years old

The Videotape Production Assoc ation, which was founded in 1969 promote the use of videotape as medium of communication and ser as a forum for the exchange of ne ideas and developments, is cel brating its 10th anniversary th year. In honor of this, VPA offering the first annual "Monito awards winners reel on videoca sette.

For information about obtaini the cassette, contact; Joseph DiB ono, Unitel Production Services, 5 W. 57 St., Dept. BE, New York, N 10019.

## AM stereo test

Belar Electronics Laboratory AM stereo system was tested ov the air by WJR, Detroit, for 3-week period in early March. W was allowed to announce the testi but could not use it for promotion purposes. The station submitted te results to the FCC for inclusion the record of Docket 21314.

## Earth station

The Christian Broadcasting Ne work and KTLA-TV, Hollywood, C have reached an agreement for t installation of a satellite ear station. The terms call for joi construction of a 10-meter satell earth dish and a 10-year agreeme for operation of the station. T CBN hopes to install earth dishes the top 50 metropolitan areas of t country and already has dishes Atlanta, Boston, Dallas and Por mouth.

## Maritime satellites

Intelsat recently announced pl to install equipment designed provide maritime communicati services on board three of its se of Intelsat V international commu cations satellites presently on ord Options for maritime subsystems board additional satellites orde in the future are under the pres contract. The first unit to offer maritime package will be placed orbit sometime during 1981 or 19

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## US/Africa Telecommunications Conference

The first US/Africa Telecommunications Conference and Exhibit was held at the Kenyatta Conference Centre in Nairobi, Kenya in January and was attended by more than 450 telecommunications officials, businessmen and guests from approximately 20 African and Middle East countries.

The program consisted of technical seminars on such telecommunications subjects as mobile radio, TV transmission, satellite communications and telephony.

John Sodolski, EIA vice president and conference chairman, stated, "The Nairobi program was the first attempt to show on a consolidated basis in Africa the broad array of US telecommunications equipment, technology and applications."

## Ohio State Awards presented

Sixty-four awards for meritorious achievement in educational, informational and public affairs broadcasting from a field of 767 entries were presented at the Ohio State Awards in Washington, DC, on March 7.

The competition was established in 1936 by the Institute for Education by Radio-Television of the Telecommunications Center of Ohio State University. Dr. Elizabeth L. Young, director of the Institute and Dr. Harold Enarson, president of the university served as hosts.

The keynote speaker was Henry Geller, assistant secretary of commerce for communications and information. Presenters included Jerome Lawrence, playwright and stage director; Janet Mrrow, member of the National Public Radio board and wife of the late Edward R. Murrow; and John Glenn, senator from Ohio.

## Video conferencing

The FCC recently approved an application filed by the American Telephone and Telegraph Company and GTE Satellite Corporation for providing a video conferencing service via the Comstar domestic satellite system. The authority allows the firms to use the system on a developmental basis to conduct a commercial market trial of their present see-while-you talk service for a 12 month period.

## Evening of nostalgia

"An Evening of Nostalgia," a champagne reception sponsored by the Golden Gate Chapter of American Women in Radio and Television, was held January 18 at Heritage Place in San Francisco. The reception recognized outstanding contributions to local TV programming and included such people as Lucille Bliss, Guy Cherney, Al Constant and Edna Fischer.

## Deaths

Clarence C. Moore, founder and president of Crown International, died on January 24 at the age of 74. Moore was instrumental in the development of the first tape recorder which included a power amplifier, the invention of the cubical quad antenna system, the creation of the first ¼-inch, 4-channel recorder and the introduction of the first solid state power amplifier.

Willard H. Hauser, broadcasting engineer and consultant, died January 24 at the age of 73. Hauser was instrumental in the establishment of New England's first television station, WBZ TV, Westinghouse Broadcasting, which went on the air June 9, 1948. Hauser retired from Westinghouse in 1971 after 42 years and served as a consultant to broadcasting companies until his death. □

WWDL-FM and WICK-AM

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ug Lane operates two fine radio stations in Scranton h just *one* fine broadcast staff, *two* Cetec System 00 automation systems, and a minicomputer-based tion business system. And a lot of creative nagement.

"Our System 7000s let us do the things we want to do roadcasting in a cost-effective way," Doug Lane s. That means almost unlimited program flexibility, , remote sports and news coverage, seven days of gramming "memorized" in advance, consistently erior audio quality. Network "joins" and "cutaways" t are clean and precise. Voice tracks recorded within utes of on-air time. Automatic logging/printing of ery broadcast event.

And with an SBS system handling most of the siness paperwork, Lane Broadcasting is an out- nding example of digital electronics as a partner in od broadcast management.

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Fifteen people operate two radio stations with top-quality style and versatility. Thirteen of them operate the System 7000 keyboards. Small wonder that WWDL-FM and WICK-AM are getting so much attention from listeners. And advertisers. And radio broadcasters from across the nation.

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# association news

## National Association of Broadcasters

1771 N Street, NW
Washington, DC 20036

## NAB proposal

The NAB recently requested that the FCC form a government/industry advisory committee to study proposals "to ensure that all present and future radio stations be authorized to provide fulltime service without significantly diminishing service by other classes of stations."

Under their proposal, the committee would consist of representatives from interested trade organizations and professional groups with a deadline date for the completion of the study established at the outset. The committee would compile the necessary technical and economic data to define the problem and find solutions.

## Wasilewski urges protection of rights

Vincent Wasilewski, president of the NAB, warned that broadcasters must always fight for their first amendment protection or run the risk of government interference.

Speaking at the inaugeral symposium of the University of Houston's School of Communications, November 15, Wasilewski said that if the courts and Congress do not fully recognize the public's right to broadcasting freedom, then "all first amendment rights are going down the drain."

## FCC support

The association recently announced its support for an FCC proposal which would make it easier for radio broadcasters to construct or to improve their facilities without interfering with fixed monitoring stations. Presently, applications are reviewed after filing, but the proposal would require that broadcasters meet certain technical requirements for protection of the stations before an application is filed.

Of course, the NAB assumes that the station's equipment and operating techniques are of the highest technology and that the public is not deprived of a proposed improvement in service. However, at the same time, there may be cases where a station location has become obsolete and should be moved.

## Arbitron commended

In an announcement by Daniel W. Kops, chairman of the radio research committee, Arbitron was commended for its procedures against some stations' policies of exhorting public cooperation with radio ratings surveys in process. A letter sent to Rick Aurichio, vice president and general manager of Arbitron, the committee considers that the practice "may tend to distort radio audience measurements," and "opposed any activities that distort the results of diary or other survey techniques."

## Brief filed

The NAB and several media organizations have filed a friend of the court brief with the US Supreme Court to uphold a ruling that would permit newspapers to publish the names of juvenile delinquents without prior court approval. The ruling was made by the West Virginia Supreme Court of Appeals in the Smith vs. Daily Mail Publishing Company in which two Charleston newspapers and three radio stations identified the name of a juvenile charged in a fatal shooting. The court ruled that the law "creates an impermissible prior restraint on the

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Before you invest in a top of the line character generator, you should know more than just what it can do. That's why the versatile new 3M D-8800 character generator could be just the one for you. You see, all instructions are in English, not in code. And we've put them on a convenient L.E.D. panel above the keyboard for less wasted eye motion. So even a beginner can soon be composing in all kinds of fonts and colors. See your 3M representative right away for the character generator any of your people can run, or call 612-736-1032 for more information. Unless of course, you'd rather exawkm.

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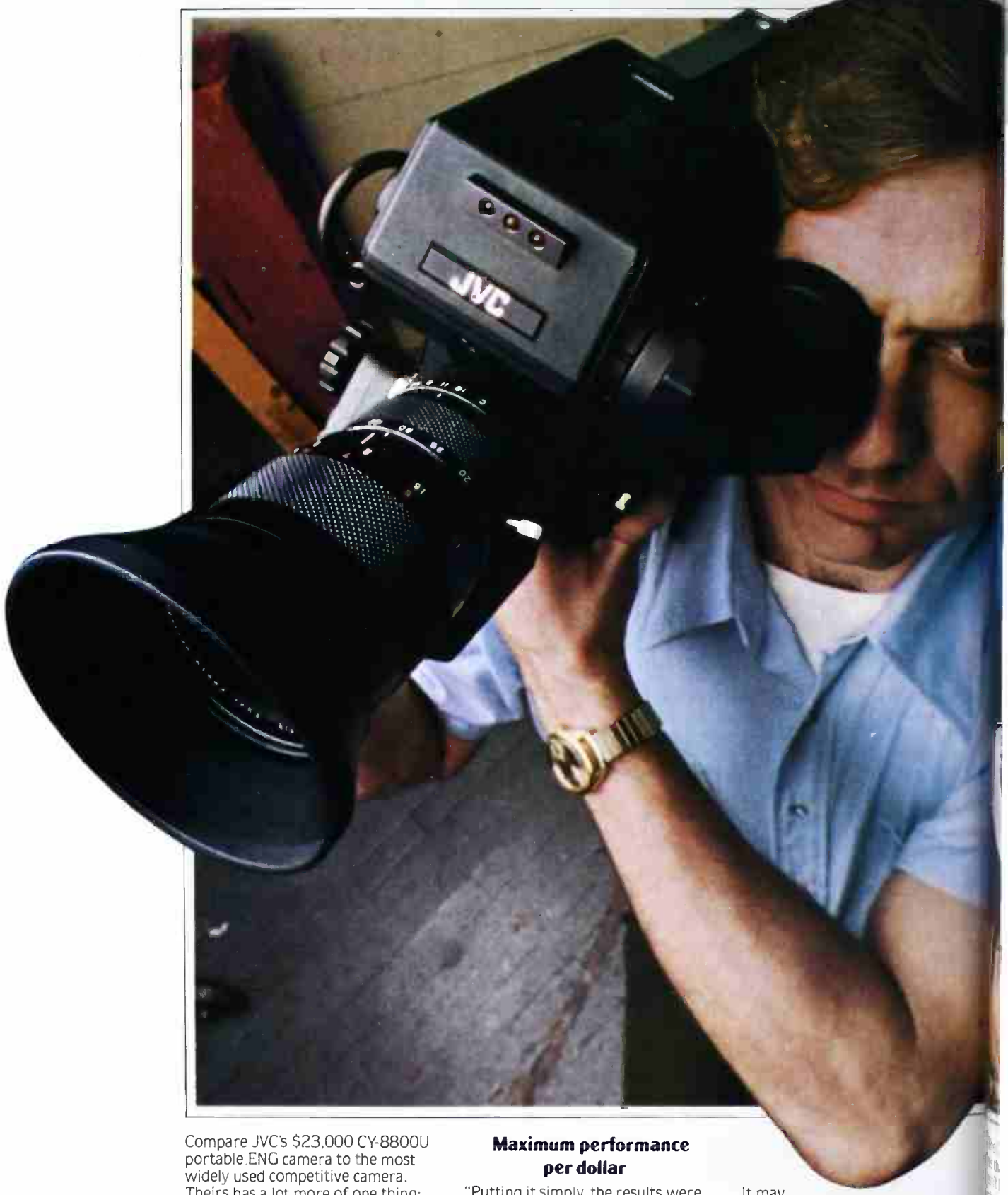


Compare JVC's $23,000 CY-8800U portable ENG camera to the most widely used competitive camera. Theirs has a lot more of one thing: cost. About double, in fact.

But there, for all intents and purposes, the differences end.

Because, in any ENG/EFP assignment where you find normal lighting conditions, you'd be hard pressed to see any difference in results.

## Maximum performance per dollar

"Putting it simply, the results were excellent," says well-known Producer-Director/Cameraman Lon McQuillin in his review of the CY-8800U. "Color quality is marvelous...There are few ENG cameras at any price that can top the JVC's performance, and then only when pushed into very poor lighting conditions...

It may well set the standard for the rest of the cameras in the category."

Behind that performance are high sensitivity and S/N ratio (50 dB). 500-line resolution. Sensitivity doubling (6 or 12dB). Auto white balance. And horizontal and vertical contour correction.

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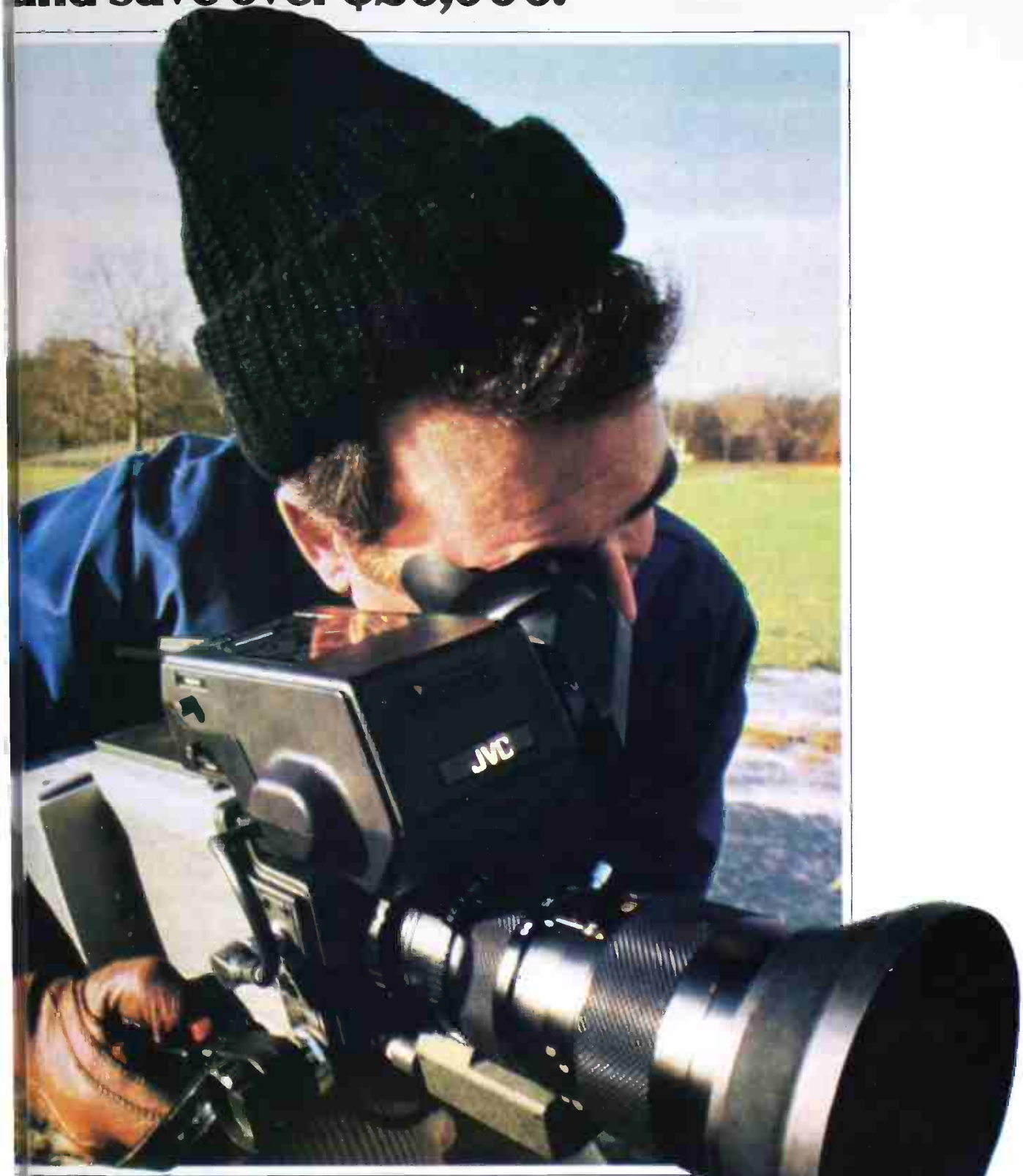


The CY-8800U even has some fea- es that the high-priced camera esn't have. Such as level control mpensation for hot spots. Internal e lapse meter which indicates e life. Plus a moistureproof, rug- J, sleek case that you can rest on r knee or the ground.

**hat do you really need?**

nk about it. If you can get excel- results from JVC, do you really encounter enough critical poor-light assignments to warrant paying twice the price?

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freedom of the press."

The brief supports the decision because it "has removed a legislatively imposed barrier on the ability of the press to freely report to the public information on one aspect of the state's system for administering justice," and "that to sanction this limitation would threaten the ability of the press to inform the public about a vital aspect of this system and ultimately its ability to inform the public on all matters needed for the people to make informed judgments on their system of government."

## Radio report

A study funded by the NAB and conducted by the Committee on Local Television and Radio Audience Measurement (COLTRAM) and Arbitron, a radio rating service, provided new information about the extent of sampling error in radio ratings reports.

The study concluded that when two stations are ranked only one unit apart in the ratings, the difference in ranking may be due to sampling error. However, when the ranking is further apart, the precision of the estimate tends to be relatively high.

Copies of the study are available from the NAB Research Department. Contact: Candy Greene, National Association of Broadcasters, 1771 N. Street, NW, Washington, DC 20036.

## Election results

The NAB has released the results of a recent mail ballot in which 13 broadcasters were elected to the radio board and six to the television board.

Those elected to the radio board include Arnold Lerner, WLLS/WSSH, Lowell, MA; Jerry Lee, WDVR-FM, Philadelphia, PA; William Stakelin, WHOO AM-FM, Orlando, FL; Robert Pricer, WCLT AM-FM, Newark, OH; Charles Wright, WBTS AM-FM, Canton, IL; John Lemme, KLTF, Little Falls, MN; Stanley McKenzie, KWED AM-FM, Seguin, TX; Harry Barker, KQMS, Redding, CA; Ted Smith, KUMA AM-FM, Pendleton, OR; Len Hensel, WSM AM-FM, Nashville, TN; Bruce Johnson, Starr Broadcasting, KXLR, Little Rock, AR; Dick Painter, KYSM AM-FM, Mankato, MN; Edward Fritts, WNLA AM-FM, Indianola, MS.

Elected to the television board were Leslie Arries, WIVB-TV, Buffalo, NY; Eugene Bohi, WGHP-TV, High Point, NC; William Brazzil, Wometco Enterprises, Miami, FL; Kathryn Broman, Springfield Television Broadcasting Corporation, Springfield, MA; Don Curran, Field Communications, San Francisco, CA; Gert Schmidt, Harte-Hanks TV Group, Jacksonville, FL. □

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Learn more about how ADM can increase your audio capabilities. Contact Audio Designs and Manufacturing, Inc., 16005 Sturgeon, Roseville, Michigan 48066. Phone: (313) 778-8400. TLX-23-1114. Southeastern Office: Phone (904) 694-4032. AMPEX Distributed outside U.S.A. by Ampex International Operations, Inc.

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NRBA

**National Radio Broadcasters' Association**

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Washington, DC 20036

## Committee to study 9 kHz spacing

At a meeting late in January, the board of directors voted to establish a committee to study the technical effects of 9 kHz spacing. According to Abe Voron, executive vice president government relations, the "NRBA favors the marketplace determining technical advances and therefore does not oppose or support 9 kHz spacing, however, the board feels that further study is needed to determine if 9 kHz spacing would lead to a general deteriorization of service to the American public."

The board does favor the FCC allocating as many new stations as possible, resulting from technical reallocations, to day-timers as well as minorities.

The board also stated that an all-industry committee will be formed to determine both the benefits and detriments of reduced AM spacing and will consist of proponents, opponents and interested neutral parties as well as technical consultants.

## Trivers internship

A Julian J. Trivers NRBA internship program has been established in memory of the late Trivers. Trivers was involved with media for many years and was instrumental in the early founding days of the NRBA as the National Association of FM Broadcasters. Bob Herpe, NRBA board chairman stated, "He was a true friend of radio and the NRBA board of directors sees no more fitting tribute than the training of young people in the communications field." The program will be funded by the NRBA on a continuing basis.

## Proposal opposed

The NRBA, in opposition to a request by a number of non-profit organizations for creation of a new community service programming category, has asked the FCC to reject the proposals stating that they would "not only add to the

# buying a studio lens

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Circle (19) on Reply Card

overall amount of regulation, but also to the *nature* of the regulation, for it would create ... a right of access to broadcast facilities which has consistently been found, by the commission and the courts, not to exist."

The NRBA sees the proposal as an attempt to create a right of access for a preferred and limited group.

## Comments on FCC fee system proposal

The NRBA, in recent comments filed with the FCC, urged the commission to "abandon its efforts at establishing a fee system until the Congress has provided ... some guidance as to the proper course to take."

The proceeding is still in the Notice of Inquiry stage and the FCC fee schedule was deemed illegal in 1976. Congress currently is studying the matter of fees as part of the rewrite and any fee schedule adopted would be superceded by the rewrite.

The NRBA concluded that, "It seems the height of folly for the commission to undertake a proceeding which (may) run parallel to a Congressional effort."



## Committee formed

The newly-formed Broadcast Ratings Council's Industry Relations Committee has appointed NRBA director Ted Dorf as a co-chairman. The committee will work to establish a closer relationship with companies within the industry and bring a higher profile to the BRC. Dorf, who is general manager of WGAY (Silver Spring, MD), will co-chair the committee with Roger Rice of TVB.

## Minority ownership

In a recent speech before the Wisconsin Broadcasters Association, NRBA president Jim Gabbert stated that license security is the key to growth of minority owners in the broadcast industry.

Because of the present law which states that a license is only a temporary privilege and therefore not secure, a license cannot be used as collateral which would significantly increase the number of minority owners.

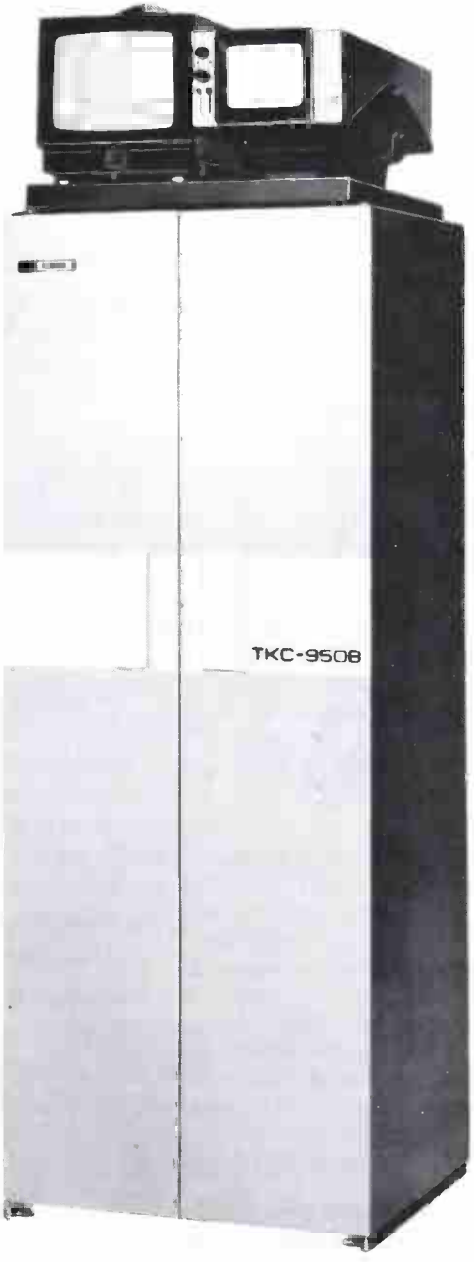
Gabbert concluded that, "Everyone working towards increased minority ownership should also be working for legislation that would provide for license security."

## Contract changes

Two changes based on suggestions from client stations and the Arbitron Advisory Council have been made in Arbitron's radio contract form. Stations will now receive written notice within seven days of Arbitron's decision to delist or delete them from market reports due to alleged rating distortion activities.

Also, a proportionate refund will be awarded by Arbitron if they publish an abbreviated report, deleting seven or more survey days than scheduled or covering a decreased geographic area. □

# No more dirty movies.




The reason: the Ikegami TKC-950B film chain camera's unique optical system removes the correcting field lens from the focal plane where the aerial image is located. Thus, any dust that collects on the field lens is out-of-focus. When you run movies on the large-image field lens of the TKC-950B, the viewer receives a clean, sharp, dust-free picture on his home TV screen.

The TKC-950B system is dedicated to produce the highest color quality and picture stability. For example, a prism beam-splitter separates the images to its three one-inch vidicons.

The TKC-950B takes into consideration the tight quarters in which most film chains must be installed and operated. Remarkably small, it can accept an external multiplexer on either the left or right side of the unit for additional installation flexibility. Compatible with your existing equipment, it is easy to replace obsolete cameras.

Because film chain cameras must run with minimum supervision, we've built a lot of self-control into the Ikegami TKC-950B. A servo-controlled neutral-density filter disc, built into the optical system — along with fast-acting video gain control — respond so quickly, there is no need for individual light compensators with your projectors. A very stable color encoder provides precise color reproduction. Three types of test pulses with six functions, built into the unit, are provided to facilitate set-ups, daily checks and calibration of the gamma-correction circuit.

The TKC-950B is highly stable and any variations in the source material can be compensated for manually or with an optional new automatic color balance accessory which balances white, black and gamma automatically. And each function is available for local or remote control.

For a complete picture of the Ikegami TKC-950B or a demonstration, contact: Ikegami Electronics (USA) Inc., 37 Brook Avenue, Maywood, N.J. 07607; phone: (201) 368-9171.

**Ikegami**

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# association news

## State broadcasting organizations and miscellaneous associations

## State associations

**Arkansas Broadcasters Association**
The ABA business meeting and legislative reception previously scheduled for February 7 was held March 7 at the Coachman's Inn in Little Rock.

Governor Bill Clinton was the keynote speaker. State legislatures were invited to the luncheon and special reception held after the meeting.

**Colorado Broadcasters Association**
Four persons have been nominated by Colorado broadcasters to serve as president of the Colorado Associated Press Broadcasters Association for 1979. Election ballots were due February 1, 1979. Those nominated: Linda Skinner, news director at KQIL, Grand Junction; Bob Bernd, news director at KYOU, Greeley; Bill Pierson, news director at KOSI, Aurora; and Dave Tanin, news director at KRLN, Canon City.

**Florida Association of Broadcasters**
The Midwinter Conference held February 3, 1979, marked the largest attendance for this all-day event in FAB's history. With 175 present Doug Duperrault, general chairman, called the conference on promotion a success.

**Georgia Association of Broadcasters**
The GAB is looking for new members. Anyone interested, contact: GAB, Dept. BE, 6065 Roswell Road, Suite 604, Atlanta, GA 30328.

**Kansas Association of Broadcasters**
Television awards for outstanding achievement in broadcasting will highlight the KAB annual convention in Wichita, June 7-9. The winning categories will be presented at the convention.

For more information on the conference and contest rules, contact: Kansas Association of Broadcasters, Dept. BE, 1052 N. Waco, Wichita, KS 67203.

**Kentucky Broadcasters Association**
The KBA has announced the killing of the Closed Newsroom bill in the Kentucky State Legislature. The bill virtually eliminated the possibility of state police searches of newsrooms.

**Missouri Broadcasters Association**
The board of directors of the MBA have taken a stand against the FCC on spectrum fees. In a resolution dated January 25, 1979, the board of directors resolved that frequency spectrums are physical facts and do not require government maintenance. Therefore spectrum fees would be a violation of the free enterprise system.

**New Hampshire Association of Broadcasters**
The lobbying by the NHAB to keep the Concord Weather Service Station open and operating appears to have been successful. According to the congressional delegation from New Hampshire, Concord will not be one of the 62 national weather station offices in the US to be shut down in 1980.

**Oregon Association of Broadcasters**
Representative Dave Frohnmayer of Eugene, OR, has introduced a bill into the Oregon Legislature that would limit police searches of Oregon news media headquarters. A subpoena would be required in most cases of police searches giving the media an opportunity to contest the necessity of a search.

**South Carolina Broadcasters Association**
The 31st Annual Winter Convention was held on January 23-25 in Columbia, SC. There were 134 registrants present. Governor Riley addressed the convention. At the business meeting six new members were elected to the board of directors. Other items discussed at the board meeting included the 1979 Congressional Luncheon objectives and plans; and establishment of a committee to study the problem of advertising by attorneys.

**Tennessee Association of Broadcasters**
Bill Potts, chairman of the TAB Computer Investigation Committee, announced the first in a series of demonstrations offered to TAB members this year. The program held March 6, consisted of an actual demonstration of equipment of the BIC, Broadcast Information Center, in Nashville, with a question and answer period following the program.

## National/International groups

**Videotape Production Association**
The VPA has established a European chapter. The first meeting was held in the Run Run Shaw Room at BAFTA, London, on February 14. Membership policy was discussed along with the election of the officers and the launching of the

# ENG/EFP in one hand...



# ...studio/field production in the other

## from VICTOR DUNCAN *VIDEO*

### MNC-71CP

offers the latest state-of-the-art prism optics and the reliability of LSI circuitry. A light, fast, on-the-shoulder video production camera for news and fast moving field production assignments.

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for studio/field production, the MNC-710CP affords all the quality features of the MNC-71CP, plus a camera mounted 5″ viewing monitor, remote production control unit, "paint box" and rack-mounted teleproduction CCU. In this studio/field production format, the MNC-710CP is a high quality color production camera that meets all NTSC broadcast standards.

For all your video production needs—cameras, recorders, lighting, support and accessories—contact the largest film and video equipment house in the Midwest.

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organization. The US VPAs reel of award winning commercial, selected in its first annual Monitor Awards competition, was screened.

**Association of Maximum Service Telecasters**

An opposition to the Moseley Associates' petition to the FCC to permit aural station studio-transmitter links to utilize unused UHF-TV channels on a secondary, non-interference basis has been filed with the FCC. In the opposition MST urged the commission to dismiss Moseley's petition listing six reasons for dismissal. In summary, MST stated that "Moseley neither showed the feasibility of the proposed sharing of UHF-TV channels for aural studio-transmitter links nor demonstrated that other feasible present or proposed alternative cannot or should not be utilized."

MST also submitted comments to the FCC on the vertical blanking interval, including line 20. MST endorses broadcast licensee development of the vertical interval and supports licensee implementation of source identification signal (SID) but does not support the use of line 20. "Its use should be determined by the broadcasters to whom it is licensed in accordance with the statutory public interest standard," said MST.



## Society of Broadcast Engineers

**Chapter 22—Central New York**

Charles F. Mulvey, chairman of Chapter 22, has announced the position taken on the proposed increase of dues and certification fees.

The Central New York chapter does not agree that increasing dues is justified at this time. "An increase in dues will result in a decrease in membership."

Mulvey fears that the recent increase in certification fees may discourage future applicants.

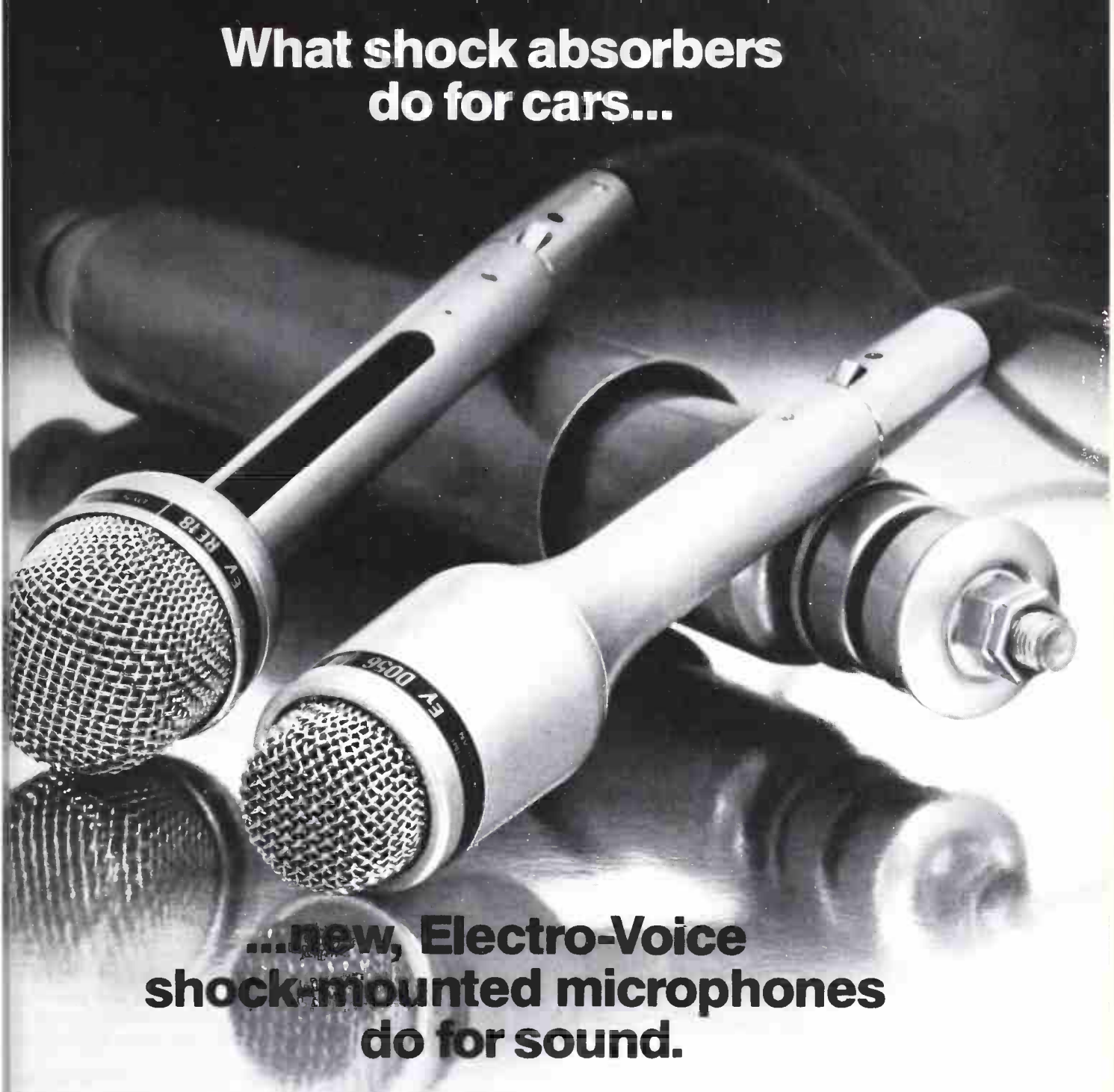
**Chapter 28—Milwaukee**

Bob Paquette, owner of Select Sound in Milwaukee, gave a slide talk on his research into the history of microphones and early transducers at the February meeting. He then gave the chapter members a tour through his Microphone Museum at Select Sound, with mics on display dating from the early years of this century right up to the present.

**Chapter 3—Kansas**

Brad Dick, chapter chairman, met with chairmen from over 15 chapters across the US to discuss problems both on the local and national level. It was discovered that most of the chapters have the same type of problems. One of the more serious is member participation. The national office is concerned that the society increase its visibility. Active membership within the chapters is the primary means of doing so.

# What shock absorbers do for cars...




# ...new, Electro-Voice shock-mounted microphones do for sound.

**056 Omni** – The DO56 shock-unted omnidirectional microphone irtually impervious to mechanical se. Its isolated capsule eliminates possibility of capsule/case collision king the DO56 the ideal microphone enever there is lots of action. The xellent "G-factor" margin makes this microphone less susceptible to bell-like clang typically heard from er shock-mounted microphones en they are accelerated or decelerd rapidly. Plus, a built-in blast filter uces "P-popping" dramatically to p your audio clean.

DO56 also offers attractive styling, king it ideal for broadcast applicas where visual appeal is a necessity. memraflex grille resists denting, ping the DO56 looking like new efinitely.

**RE18 Super Cardioid** – Where ambient noise rejection is mandatory, the companion RE18 super cardioid combines the best performance features of the famous RE15 and RE16 with superb mechanical noise isolation. Acoustic performance is the same as an RE15, while a refined small-profile blast filter resists "P-popping" as much as the larger RE16.

Unlike "multi-port" directional mikes, E-V's exclusive Variable-D® design insures uniform frequency response at *all* angles, for uncolored pickup on and off axis. And Variable-D reduces the bass-boosting proximity effect found in Single-D cardioids, for consistent sound quality at any working distance.

**Electro-Voice Warranty** – Both microphones are covered by Electro-Voice's unique two-year unconditional professional microphone warranty. For two years E-V will replace or repair these microphones, when returned to Electro-Voice for service, at no charge – no matter what caused the damage.

These are microphones to depend on, in the studio or in the field. If they weren't, E-V couldn't offer this warranty. When your application calls for a shock-mounted microphone, test one of these at your E-V professional microphone dealer.

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a gulton company
600 Cecil Street, Buchanan, Michigan 49107

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# business news

## Unex markets headsets

Northern Telecom Canada and Unex Laboratories have signed an agreement under which Unex will market the Venture 1 headset in the US. Northern Telecom has been manufacturing the lightweight telecommunications headsets since 1972.

Under the agreement, Unex will become the source of supply for the headsets and accessories and will establish a service facility for maintenance and repair of the equipment.

## TV, radio sales up

Total US market sales to television receivers, radio and home videotape recorder dealers increased in January over the same month in 1978.

Color television receiver sales amounted to 622,111 units in January, 1979, up 0.5% over 618,963 units sold in the same month last year. Monochrome television receiver sales were 345,605 units, up 10.1%.

Total radio sales were up 15.4%. Sales of home videotape recorders to dealers were 23,330 units, an increase of 72%.

## New stocking facility

The Optima Division of Scientific-Atlanta has established a West Coast stocking facility. The facility will serve customers in California and the 10 western states.

## Editing room available

The CMX facility at Reeves Teletape is now available for 1979 scheduling. *The Room* includes the CMX 340X editing equipment designed for editing control and flexibility.

For more information, contact: Scheduling department, Reeves Teletape, Dept. BE, 708 Third Ave., New York, NY 10017, (212) 661-5010.

## Sales reps added

Signet has appointed new sales representatives. The rep organizations and respective territories are:

- Celco, Kansas City, MO: Iowa, Kansas, Missouri, eastern Nebraska, southern Illinois;
- J. C. Sales, Orlando, FL: Florida;
- Pro Audio Sales, Barrington, IL: northern Illinois, Wisconsin;
- Resource Marketing Associates, Minneapolis, MN: Minnesota, North Dakota, South Dakota, western Wisconsin; and
- Tobias & Company, Houston, TX: Arkansas, Louisiana, Oklahoma, Texas (exclusive of El Paso).

## Companies to merge

Cox Broadcasting and General Electric have agreed to combine Cox with GE's radio-and-television broadcasting and cable television businesses. The transaction is projected to close after September 30, 1979 after obtaining the required government approvals from the FCC.

## Engineering firm forms

The formation of the Jenel Corporation-Consultants and Engineers has been announced. The firm's services include design and engineering of broadcast facilities, satellite earth station facilities and computer controlled systems. Elmer E. Smaling III, consulting engineer, becomes president of the company.

## Kodak to go to Olympics

Eastman Kodak will be photographic consultant for the 1980 Winter Olympics. With the company's assistance, the Lake Placid Olympic Organizing Committee (LPOOC) will offer processing for motion picture and television film in the Olympic Broadcast Center. The company will provide technical advice and counsel to the LPOOC in regard to processing specific types of motion picture film and also establish a still photography processing laboratory at the Olympic Press Center.

## Sony exporting to Japan

Sony has become the first Japanese electronics company to export a finished product back to Japan. Sony Corporation of America is shipping American-made Betamax videocassettes to Japan. The videocassettes are manufactured at Sony's plant in Dothan, AL. The plant has been exporting the Betamax and ¾-inch videocassette to West Germany and England since May 1978.

Morton J. Fink, senior vice president, said that with the addition of Japan to Sony's exports, Sony will be contributing $20 million to the US international trade balance.

The videocassettes manufactured at Dothan are for use with Betamax recorders in the home video entertainment field or for use in conjunction with the Sony portable color camera and portable Betamax for instant-replay home entertainment.

## CBS Vice President dies

J. Kenneth Moore, vice president and general manager of CBS Technology Center, advanced research laboratories for CBS, died February 21, 1979, while working in his office at the center. Moore joined CBS in 1957 and served as director of Advanced Television Technology at the center prior to his appointment to his present position in 1978.

Moore was born in Lufkin, TX, in 1931. He was a graduate of Williams College where he earned a BA and MA in physics. As a physicist he was well known for work in television broadcasting technology, laser image scanning and recording, electronic character generation for display and electronic photocomposition.

Among Moore's technical achievements is the Digital Noise Reducer for Color Television, of which he was co-inventor, earned an Emmy Award in 1978.

Moore is survived by his wife, Antoinette; three daughters, Monique, Cynthia, and Pamela; and three sons, Douglas, Stephen, and Gregory.

# SALES/CONTRACTS

## RCA

RCA has announced recent sales. Westdeutscher Rundfunk (WDR) has expanded its TV program produc-

# UN-CAN IT.

The tape cartridge is a handy little device. Unfortunately the sound quality of programming varies noticeably between "live" and "canned."

dbx has overcome this problem by developing a tape noise reduction system especially for broadcast use. It provides 30 dB noise reduction and 10 dB headroom improvement. This dbx system offers the same benefits as the dbx tape noise reduction system used by recording studios.

The new dbx 148 provides 8 channels of playback (decode) noise reduction in a plug-in modular chassis (space is provided for a spare module). There are two modules available—the 408, for tape playback, and the 409, for playback of noise-free dbx-encoded discs. Typically, the 148 is used in the control room to play back tapes recorded in the production studio with the dbx 142, a 2-channel, switchable (encode-decode) tape noise reduction unit.

Besides "un-canning" carts, the dbx system extends the useful life of old reel-to-reel machines, quiets audio tracks on VTR's, and even cleans up full-frequency telephone lines and microwave links. Because it prevents noise from coming between you and your listeners—and you and your advertisers—it just may be the most important investment you will ever make.

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tion and editing facilities with RCA videotape recording equipment valued at $600,000. The order includes five TR-600 quadruplex videotape recorders, four of which are equipped with RCA's AE-600 built-in editing system.

Radiotelevisione Italiana (RAI) has added 36 RCA TK-76 portable color cameras to its broadcast equipment. The purchase is valued at $2.5 million.

Videosistemas has installed two RCA TR-600 quadruplex videotape recorders equipped with AE-600 editing systems. Videosistemas also has ordered a RCA TK-760 studio/field color TV production camera with an accompanying modification kit.

ABC radio has ordered transmission via the RCA Americom satellite. ABC radio has ordered two full-duplex 8 kHz program audio satellite circuits.

RCA has been awarded a $7 million contract to supply UA-Columbia Cablevision equipment and installation services. RCA will furnish line amplifiers and will provide overall project management services.

Crossroads Christian Communications has increased its production capacity by ordering two TR-600 recorders. These two videotape recorders will join two units already in use.

## Vital Industries

An order amounting to over $250,000 has been placed with Vital Industries for the SqueeZoom and Production Switching Automation System (PSAS). The order was made by Onkio Haus, a Japanese production house in Tokyo.

## Marconi

Marconi Communication Systems has announced recent sales of the Mini-Mobile MK II. Granada Television ordered the compact general purpose television outside broadcast vehicle.

Anglia Television has ordered three-camera outside broadcast vehicles. This mini-mobile is based on a Fiat chassis.

## Tele-Cine

Tele-Cine has announced the sale of 40 30X continuous zoom Schneider lenses to NBC Sports for use on their mobile vans. Tele-Cine is the sole distributor of Schneider Broadcast Television lenses in the US and Canada.

## Sony

Sony Video Products Company, broadcast division has announced the shipping of the BVH-500 portable Type C videotape recorder to Compact Video, Hollywood, Opryland, Nashville; and One Pass Productions in San Francisco.



## FINANCIAL

## COMSAT

Communications Satellite (COMSAT) reported consolidated net income of $34,238,000 for the year ended December 31, 1978, an increase of 5.4% from the previous year.

Operating revenues for 1978 totaled $184,570,000, an increase of $16,383,000 from 1977. Operating

# When does a portable color camera become an affordable studio camera?



Optional studio configuration.

## When it's a Panasonic ENG/EFP camera.

ow you can stop admiring ENG/EFP color cameras, nd start owning one! The surprisingly affordable anasonic AK-750. Thanks to its impressive list of ptions, our three-tube Plumbicon® portable camera ubles as a studio camera.

In the field it's a fully self-contained portable camera at weighs only 20 lbs. (with our optional 12:1 zoom ns shown), so it's easy to handle. It's just as easy on the ower, using only 23 watts. You can interface the AK-750 ith any EFP system, because it can be externally nchronized with a single cable. Timing and phase ljustments are built right into the camera head. r connect it to any studio system, simply by adding the ptional Remote Control Unit and studio viewfinder.

Indoors or out, you can look forward to impressive erformance: With an S/N ratio of 49 dB, and horizontal solution of 500 lines center at the recommended umination of 200 footcandles at f/4. There's even a 6 dB gain for a minimum illumination of just 15 otcandles at f/1.8.

Some impressive circuitry was built into the camera: ke a Y I/Q encoder, an RS-170A sync generator with nlock for studio or EFP use, and a color bar generator. It also features an optical black, and automatic white balance. And there's electronic color conversion, as well as a filter wheel behind the lens.

Horizontal and vertical blanking are both adjustable to meet a variety of recording or playback requirements. And your picture is always crisp and clear thanks to horizontal aperture correction and 1-line vertical aperture correction built right into the camera head.

Not only do you get a long list of standard features with the AK-750, there's also a long list of camera options available. Such as 2-line vertical aperture correction, a chroma key unit, and more.

So if you're pricing both studio cameras and portable cameras, price one camera that can do both. The Panasonic AK-750.

*Plumbicon* is a registered trademark of N.V. Philips of Holland for TV camera tubes.

For more information, write: Panasonic Company, Video Systems Division, One Panasonic Way, Secaucus, N.J. 07094. In Canada, Panasonic Video Systems Department, Mississauga, Ontario.

**Panasonic.**
just slightly ahead of our time.

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expenses for 1978 totaled $155,389,000, an increase of $14,800,000 from 1977.

Net operating income for 1978 amounted to $29,181,000, an increase of $1,583,000 from the previous year.

## Orrox

Orrox (CMX Systems, Videomax) ended its year on December 31, 1978 with revenues of $5,387,926 and profits after tax benefits of $734,178. In the prior year the company reported a loss of $346,731 on revenues of $4,913,090.

The 30% increase in revenues from 1977-78 resulted from increased demand for the company's videotape editing systems. Backlog for the computer-assisted editing systems was approximately $2,200,000 at the end of 1978 compared to approximately $1,300,000 a year earlier.

All of the company's divisions recorded an operating profit.

## General Cable

General Cable has announced record sales for the year ended December 31, 1978, up 37% from 1977. Net earnings increased 25% to $25.3 million, compared to $20.3 million in 1977.

## Cohu

Cohu has declared a quarterly cash dividend of 4 cents per share of common stock, payable April 26, 1979 to shareholders of record on March 20, 1979.

## Reeves

Reeves Teletape reports sales for the first half of its 1979 fiscal year ended December 31, 1978, up 41% from $8,699,000 in 1977. Net income for the first half improved to a record $856,000 compared with $217,000 in the comparable period last year. Earnings per share were a record 38 cents, up 280% from 10 cents last year.

## Ampex

Ampex announced the highest revenue and earnings for the third quarter as well as for the first nine-month period. Earnings increased 44% on a 12% gain in total revenue for the three months ended January 27, 1979.

These earnings were $4.8 million, or 42 cents a share, up from $3.3 million or 30 cents per share, earned in the earlier year. Net sales and other revenues totaled $92.9 million, up from the $82.9 million reported last year.

## Audiotronics

Audiotronics has reported second quarter sales up 20% from the year earlier and net income of $237,000, an increase of 25% compared to the second quarter of last year.

Sales for the six-month period, ending December 31, 1978, were up 14.5% from last year. Net income for the period was $392,000 down from $453,000. □

# Finally.
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Performance of Townsend, Harris, and RCA Transmitters are essentially the same. Primarily it's because they all use the same klystrons and employ I.E. modulated, solid state exciters. It is the high redundancy and ease of maintenance of Townsend Transmitters that makes the difference. Judge for yourself.

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| FEATURE | TOWNSEND | HARRIS | RCA |
|---|---|---|---|
| INSTALLATION CONFIGURATION | Back-to-wall mounting. All servicing from front of transmitter. | Middle-of-floor mounting. Servicing front & rear. | Large, rambling cabinetry. Servicing front & rear. |
| SPACE REQUIRED FOR KLYSTRON CHANGE | 4 ft. in front of cabinetry. | 8 ft. in rear of cabinetry. | 8 ft. in front of cabinetry. |
| KLYSTRON TUNING | From front control panel. | From rear of transmitter. | From front of transmitter. |
| CONTROL CIRCUITRY | Plug-in octal relays mounted on front panel. Spares avail. from several mfgrs. | Solid state. Spares avail. only from original mfgr. | Hard wired relays of many types buried in transmitter. Spares only from ong. mfgr. |
| METERING | Complete metering of all important circuits. No meter switches. | Lacks several meters used by Townsend. | Lacks several meters used by Townsend. |
| HIGH VOLTAGE CONTACTOR | Vacuum type. | Vacuum type. | Air type. |
| HEAT EXCHANGE REDUNDANCY | One for each amplifier. | One for entire transmitter. | One for entire transmitter. |
| BEAM POWER SUPPLY REDUNDANCY | One for each amplifier. | One for entire transmitter. | One for entire transmitter. |
| AMPLIFIER REDUNDANCY | Designed for emergency multiplex. | Not designed for emergency multiplex. | Not designed for emergency multiplex. |

# meetings, events&seminars

**April 21**—The Society of Motion Picture and Television Engineers' *4th Annual Chicago Section All Day Meeting* will be held at the Ramada O'Hare. The purpose of the session is to make available to the industry information and papers of practical application.

Topics to be covered include *Imagery—Today and Tomorrow, Esthetics of Production, Projection Films for Television and Computers in Color TV—Orginating Digital Signals.*

For more information, contact: George Halonen, George W. Colburn Lab, 164 N. Wacker Drive, Dept. BE, Chicago, IL 60606.

**April 23-26**—*The Microprocessor Hands-On Workshop* held in Anaheim will include information and demonstrations on hardware and software, development support systems, applications, selection methodology and project planning and organization.

Other sessions have been scheduled for St. Louis; New York; Seattle; Toronto; Washington, DC; Boston; San Francisco; Honolulu; San Diego; Minneapolis; and Ottawa.

For more information, contact: Kim D. Sanson, Integrated Computer Systems, 3304 Pico Blvd., Dept. BE, P.O. Box 5339, Santa Monica, CA 90405.

**April 23-27**—A five day course entitled *Troubleshooting Microprocessor-Based Systems* has been scheduled by Integrated Computer Systems for Boston.

The course provides information on microprocessor software and hardware, how to apply the most powerful microprocessor debugging techniques and how to use microprocessor troubleshooting equipment.

Other dates have been set for Philadelphia, New York, Toronto, San Francisco, San Diego and Minneapolis.

For more information, contact: Kim D. Sanson, Integrated Computer Systems, 3304 Pico Blvd., Dept. BE, P.O. Box 5339, Santa Monica, CA 90405.

**April 24-27**—*Computer Graphics—State-of-the-Art Techniques and Applications* sponsored by Integrated Computer Systems will take place in Boston. Designed for analysts, programmers, design engineers and program managers, the four day course will include an introduction to graphics, computer graphics hardware, graphics techniques, software for computer graphics, survey and comparison of available graphics software, detailed case studies and future trends.

Other dates have been scheduled for Philadelphia, San Francisco, Seattle, St. Louis, Toronto, San Diego, Washington, DC, Ottawa and Minneapolis.

For more information, contact: Kim D. Sanson, Integrated Computer Systems, 3304 Pico Blvd., Dept. BE, P.O. Box 5339, Santa Monica, CA 90405.

**May 14-17**—*The 1979 Industrial and Commercial Power Systems Conference* of the Institute of Electrical and Electronics Engineers will be held at the Washington Plaza Hotel in Seattle.

Committee meetings and sessions will be held daily and include working group and subcommittee meetings, power systems protection committees, industrial plants power systems committees, power systems

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Telephone: 01-573-3888 Ext. 2114 Telex: 25145

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support committees, electric space heating and air conditioning committees and power systems protection committees.

For more information, contact: Thomas E. Sparling, Dept. BE, 1920 Eastlake Ave. E., Seattle, WA 98102, (206) 325-7770.

**May 17**—*The 11th World Telecommunications Day* will be celebrated by the 154 member countries of the International Telecommunication Union, the United Nations, the specialized agencies, non-governmental organizations and the news media.

*Telecommunications for All* is the theme this year and the ITU has prepared films, posters, photos and articles to be used in conjunction with the commemoration of the day.

For more information, contact: International Telecommunications Union, Place des Nations, Dept. BE, CH-1211, Geneve 20, Switzerland.

**May 27-June 1**—*The 11th International Television Symposium and Exhibition* will be held in Montreux, Switzerland. Technical developments in the area of international television including the effect of digital video techniques, the growth of satellite program distribution and broadcasting, the growth of cable television networks and the emergence of new services using the home television receiver will be covered.

Concurrent morning sessions will run from 9 AM to 12 PM and begin on the second day of the symposium. Following are the days and titles of each session: Monday, May 28, *Video Production Systems* and *Terrestrial Broadcasting Equipment*; Tuesday, May 29, *Video Post-Production Systems* and *Satellite Broadcasting Equipment*; Wednesday, May 30, *Digital Signal Origination, Processing and Transmission* and *Equipment for Modern CATV Systems*; Thursday, May 31, *Digital Recording Technologies* and *CATV Equipment for Reducing RF Interference*; Friday, June 1, *New TV-Services*.

Concurrent sessions also will run each afternoon from 2 to 5 PM and include the following: Monday, May 28, *Terrestrial Broadcasting Systems* and *Video Production Equipment*; Tuesday, May 29, *Satellite Broadcasting Systems* and *Video Post-Production Equipment*; Wednesday, May 30, *CATV Systems and Digital Equipment for Signal Origination, Processing and Transmission*; Thursday, May 31, *Radio Interference with CATV* and *Digital Recording Equipment*.

An equipment exhibit will be held daily from 9 AM to 7 PM except on the last day when it will close at 1 PM. Exhibitors include Ampex, Robert Bosch GmbH, Fuji Photo Film, Hitachi Denshi Europa, Ikegami Tsushinki, 3M, Rohde & Schwarz, Sony, Thomson-CSF, Victor Company of Japan and many others.

For more information, contact: R. Jaussi, International Television Symposium and Technical Exhibition, Dept. BE, P.O. Box 97, CH-1820 Montreux, Switzerland. □

# people in the news

## Radio/Television

**George W. Hager,** former corporate attorney for Mobil Oil, has joined the Christian Broadcasting Network as a legal vice president. Hager will be responsible for dealing with various government agencies, including the FCC, as well as handling equipment purchasing contracts, lease arrangements negotiations and other legal matters.

**Ron Deem** has been named division manager for broadcasting of the broadcasting division of the Kansas State Network. Deem has been with the network since 1976 most recently as manager of operations.

Recent personnel changes at WGOE radio, Richmond, VA, include **Dabney Gill-Cortina** as vice president, **Jay August** as music director, and **Lauren Linas** as promotions director.

The broadcast engineering consultant firm of Jim Cope and Associates has named **Debra Parr** as the new marketing administrator. Parr comes to the firm from Elixir Industries.

In a recent announcement by the Christian Broadcasting Network, **Dave Williams** was named general manager of WANX-TV, Atlanta. Williams joins the station from CBN's spot sales division where he was a general manager.

## Agencies/Associations

The Federal Communications Commission has named **Stephen J. Lukasik** to the position of chief scientist. Lukasik will replace Raymond E. Spence who is retiring this month. The appointment will become effective May 1.

Results of a recent election by the National Cable Television Association board of directors are as follows: **Douglas Dittrick**, chairman; **William Bresnan,** vice chairman, **Gustave M. Hauser,** treasurer; and **Richard W. Loftus,** secretary. The men will take office at NCTA's 1979 convention in Las Vegas May 20-23.

The Cleveland Institute of Electronics recently named **Dr. William L. Bowden** as president. Bowden has headed a special mission on post-secondary and occupational education in the southern states since 1977.

**Barry D. Umansky** has joined the National Association of Broadcasters' legal department. Umansky has served as an attorney with the FCC since 1972.

**Robert W. Thomas,** general manager of KWIT and director of broadcasting for Western Iowa Community College, will assist new public stations in the planning and construction process in his position as radio projects manager for expansion for the Corporation of

ublic Broadcasting. Thomas has been serving as a PB advisor to stations with management or operat-onal problems.

## Manufacturers/Distributors

**n A. Summers** will replace **Nyal D. McMullin** as resident and chief operating officer for Consolidated ideo Systems it was recently announced. Summers as been with CVS since 1976 most recently as eneral manager. McMullin will become chairman of he board and chief executive officer.

**awrence P. Carr** has been named president of lacbeth Sales Corporation, a wholly owned subsidi-ry of OSRAM, GmbH. Carr has been with the firm nce 1974 most recently as vice president and ontroller.

ummers

Carr

King

**avid King** has been appointed general manager of dministration at Omega Video with responsibility for ll administrative and financial activities of the ompany. King comes to Omega from Allen T. Pliska, PA where he was a principal.

**hn Spiker** will be responsible for evaluation of new roducts and lines of distribution for Omega Video in s position as product manager. He will function as a ison between the firm and its suppliers and also be charge of engineering support and service.

he newly created position of national sales manager r Videomedia has been filled by **Hank Wilks,** who ill be responsible for planning and implementing a ational dealer network for the Z-6 computerized icroprocessor-based editing system. **Keith Reynolds,** rmerly with Tri-Tronics, has assumed the position of roadcast sales manager vacated by Wilks.

ecent staff appointments at 3M include **Victoria anson** as manager, marketing communications and erchandising for commercial/educational and broad-ast/recording of the magnetic audio/video products ivision. Hanson will be responsible for advertising, ublic relations and sales promotion literature. **Frank l. Price** has been appointed market development anager for the radio broadcast market of the agnetic audio/video products division and will be esponsible for marketing the CentraCart cartridge ystem to radio stations. □

# STL equipment: design and selection

By Gary A. Breed, consulting engineer

The Studio-Transmitter Link (STL) is more than a sophisticated version of two tin cans and a string stretched between the studio and transmitter. For many radio and television stations it is a lifeline, the only way to get their programs from one point to the other. For others, it is a means of eliminating dependence on the telephone company. For still others, it is the key to maximum quality, operating efficiency, and reliability.

This article and the accompanying summary of available equipment provides guidelines to choosing STL equipment for a variety of requirements and to better utilization of existing STL equipment.

## STL basics

Authorized frequencies for STL operation are:

| | | |
|---|---|---|
| Aural STL: | 947 - | 952 MHz |
| Television STL: | 1990 - | 2110 MHz |
| | 2450 - | 2500 MHz |
| | 6875 - | 7125 MHz |
| | 12700 - | 13250 MHz |

Note that these are all in the *microwave* category, and require special attention to path, power, and losses when designing a system. Later in this article, the design considerations for STL (and other microwave) systems will be considered.

A typical STL system contains a transmitter, receiver, antennas, feedlines and subcarrier generators and demodulators for audio and control functions. It may have redundant equipment for portions of the system, and it may be 2-way, with a return link from transmitter to studio for monitoring and telemetry.

**Transmitter:** An STL transmitter is a low power unit, typically 0.1 to

**Locating** the STL transmitting antenna at the studio can be complicated by city building codes, availability of rooftop space, etc. These photographs show some typical installations. (Photo A) This Scala Paraflector at WNBC in New York is mounted inside the Empire State Building. Note the mirror on the windowsill used for visual checks. (Photo B) Rooftop antenna installation. (Photo C) These STL antennas are attached to the structure at WCFL. (*Photographs courtesy of Marti Electronics*)



2 W, frequency modulated, with ufficient bandwidth for main chanel and subcarriers. The main hannel may be audio or composite tereo in the case of an aural STL, r it may be video in a television TL. Occupied bandwidth is 500 Hz in an aural STL, and 17,000 or 5,000 kHz in a television STL, epending on the band. Most curnt production equipment is 100% olid-state, with few exceptions, and an be expected to have outstanding eliability. Operation is little more an turning the unit on and off and djusting input levels. Modern icrowave equipment design just oesn't require much "tweaking."

**Subcarrier generators:** These are vailable to provide channels for emote control, data links, voice rade communications, on up to 15 Hz full-fidelity audio. Exact freiencies of the subcarriers varies om manufacturer to manufacturer, ut all are chosen for a minimal mount of crosstalk with main hannel and other subcarriers.

**Receiver:** The STL receiver has a ain channel output, plus wideband utputs for driving subcarrier deodulators. Operation is simple, ith few adjustments necessary. ecently, receiver design in the icrowave frequency range has en rapid improvement, with the pectrum crunch pressuring the dustry for better equipment at gher frequencies. All of these velopments will eventually filter eir way into broadcast STL equipent as reliability is proven.

**Subcarrier demodulators:** Of urse, these are the "other end" of e subcarrier channels. They may separate pieces of equipment om the STL receiver, or they may plug-in modules in the receiver ainframe. Regardless of their ysical arrangement, they are an tegral part of the STL receiving stem.

**Antennas:** There will be a minium of two antennas in an STL stem, one each at the transmitting d receiving ends. A directional tenna is required by the FCC les and Regulations, but that is ly common sense in a point-toint system such as an STL. The tenna almost certainly will be a rabolic reflector of some type, ther the *dish* type, or a flat flector curved in one plane (i.e. e Scala Paraflector). For short ks at the higher frequencies, horn tennas or special linear design tennas may find their way into L systems. The gain of an tenna is an important part of the stem design, and is related to the e (and cost) of an antenna. The antennas may be pointed directly at each other, or passive reflectors may be used to reduce feedline losses, or to solve antenna location problems. Polarization may be either horizontal or vertical, depending on the potential for interference from other signals, or from multipath effects. In New York, Los Angeles or Chicago, polarization choice may be critical, but in the plains areas, it is likely to be an arbitrary choice.

**Feed system:** Microwave feed systems are a bit more than coax with a connector at each end, although in a simple system it may be nearly so. Feedlines will vary from small coax for short runs to waveguide for longer runs at higher frequencies. The feedline type and size is determined by the system requirements concerning acceptable losses, as will be shown later. Also in the feed system may be circulators, power dividers, or other switching, isolation and combining circuitry whose added losses also must be accounted for in the system design.

**Options:** The most common option is some type of redundancy to provide protection against failure of the link. One type is the dual STL for stereo operation, which places two aural STL systems within the bandwidth requirements for one channel. This system places a transmitter-receiver pair on each of two frequencies, 125 kHz either side of the channel center frequency, and has two antenna systems of opposite polarity (to minimize interaction). Clearly, if one system fails, there is

**Figure 1** profile chart for plotting STL path and obstructions.

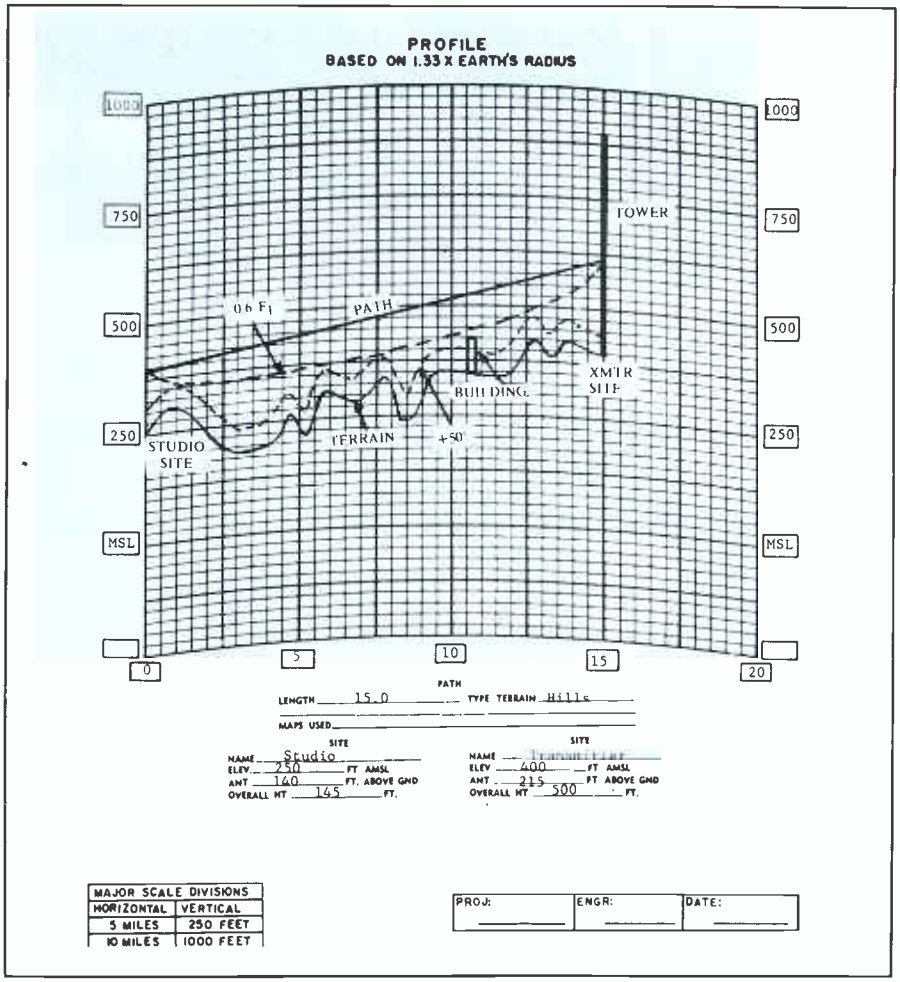
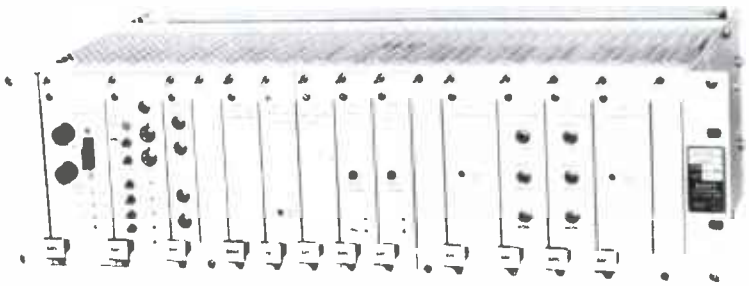



**Figure 2** Typical checklist for microwave path analysis.

MICROWAVE PATH ANALYSIS

| STATION | STUDIO | TRANSMITTER |
|---|---|---|
| FREQUENCIES | 1990 2008 MH | |
| PATH LENGTH (MI) | 15 | |
| FREE SPACE PATH LOSS (DB) | -126 1 | |
| TOWER HEIGHT (FT) | 145 | 500 |
| TRANS LINE TYPE/LENGTH (FT) | 1 5/8"X 175' | 1 5/8"X 240' |
| LINE LOSS (DB) | -1 9 | -. 6 |
| BRANCHING LOSS (DB) | -0 5 | -0 5 |
| FIELD ALLOWANCE (DB) | -0 5 | -0 5 |
| RADOME LOSS (DB) | -- | -- |
| TOTAL FIXED LOSSES (DB) | 6 5 | |
| TOTAL PATH LOSS (DB) | -132 6 | |
| ANTENNA HEIGHT (FT, AGL) | 140 | 215 |
| ANTENNA SIZE (FT) | 4 | 6 |
| ANTENNA GAIN (DB) | 25 5 | 29 0 |
| TOTAL ANTENNA GAIN (DB) | 54 5 | |
| NET PATH LOSS (DB) | -78 2 | |
| TRANSMITTER POWER (DBM) | +3 | |
| RECEIVED CARRIER LEVEL (DBM) | -39 2 | |
| RECEIVER THRESHOLD (DBM) | -80 | |
| FADE MARGIN (DB) | 40 8 | |



**Digital audio** channels, such as on this Bayly unit, provide 15 kHz response and 75 dB S/N or better.

**The Marti** STL-8 transmitter (aural STL equipment) has a companion receiver unit packaged in a similar console.

**The Moseley** aural STL receiver.

**The Moseley** aural STL transmitter.

a monaural channel **still** on line, and if switching of control and SCA audio subcarriers is provided, no loss of air time will be experienced.

Another type of redundant operation is the *hot standby* system which has two complete STL systems in constant operation on the same frequency, one of which operates into a dummy load. At time of a failure of the main system, automatic switching controls place the backup system on line and sound an alarm. Of course, there is an almost double cost involved in this kind of system, but with losses that could occur with a failure during morning drive, or prime time, it could be cheap insurance.

Other options include return links from transmitter to studio in cases where off-air monitoring is not usable, telemetry channels, voice-grade paging or intercom channels (order wire), or computer data links.

An interesting recent development is digital transmission of audio channels which provides signal-to-noise ratios of up to 75 dB and better. These can be multiplexed onto a television STL channel, but are not yet available for operation on the narrower bandwidth aural STL channels.

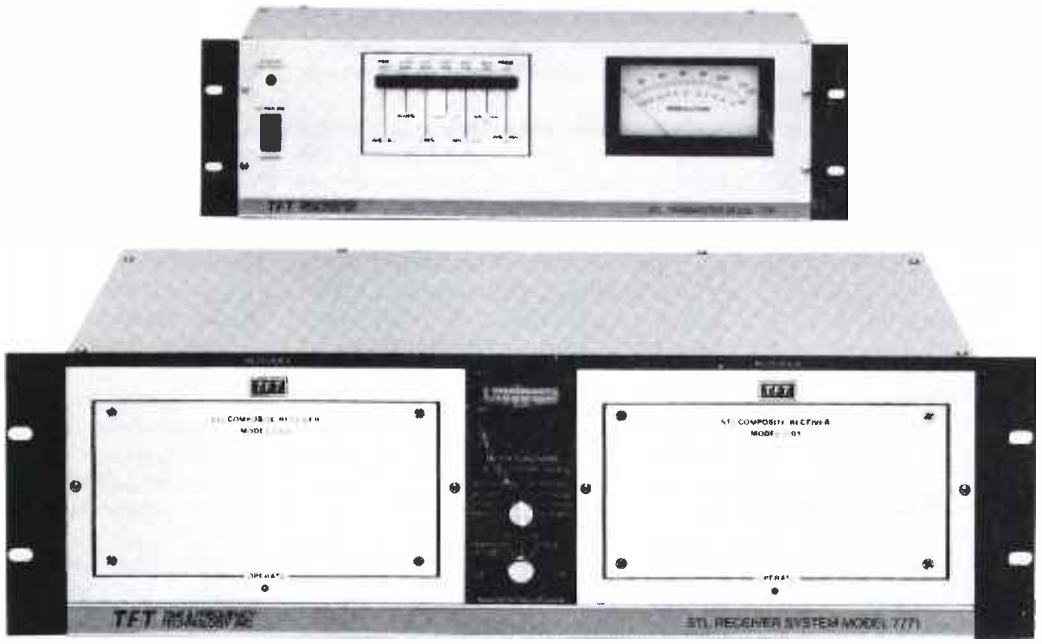
### Making it work...on paper

The signal path in any microwave system consists of the transmitter, receiver, antennas, feed systems, and the medium of transmission: the atmosphere. The only part of the path over which there is no real control is the air between the antennas. This is the place to start when analyzing the signal path: a long hard look at the path between the station and transmitter.

To determine how the terrain and obstructions offset the signal path, a cross-section of the intervening terrain is plotted on graph paper representing 1.33 times the earth's radius; this is the *apparent* curvature seen by the signal traveling through air under normal conditions. Elevation data for the plot is best determined by plotting a line on a US Geological Survey Quadrangle map between the sites and transferring the elevation information to the path plot paper. In addition to the ground elevation, add all known obstructions such as grain elevators, mine shafts, buildings, oil tanks and the like.

For normal residential or rural terrain, draw a line 50 ft above the ground level to allow for trees.

# Introducing the TFT Model 7700 Series STUDIO TRANSMITTER LINK



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The TFT 7700 SERIES STL is a fully secure, powerful, broadcast quality audio channel between the studio and transmitter which is a step beyond anything previously available in STUDIO TRANSMITTER LINKS. And answers the need for:

**MORE POWER** (12 watts minimum, adjustable) provided by a high efficiency transistor-output-stage in the transmitter.

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**HIGHER QUALITY SOUND**—now possible thanks to a 70 dB signal-to-noise ratio with less than 0.2% harmonic and intermodulation distortion, 40 dB stereo separation at 50 Hz to 15 kHz, and 60 dB crosstalk between main and sub-channels.

**GREATER FREQUENCY STABILITY**—the result of a fully frequency-synthesized transmitter.

**EASE OF MAINTENANCE**—through modular construction of the receiver, transmitter and mainframe—it saves you money.

**THE TFT 7700 SERIES STL** is just part of a new era of digital remote control products engineered to be a step ahead of the times. For more facts on remote control and broadcast monitoring equipment call or write:

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houses and other structures. This is important because trees can absorb quite a bit of microwave radiation and it would not be pleasant to discover that the path is acceptable only in winter after the leaves have fallen. The other clearance factor that must be plotted is the Fresnel zone allowance; this represents the *broadness* of the signal—its deviation from a pencil-thin beam. The equation for the first Fresnel zone is:

$$F_1 = 72.1 \sqrt{d_1 x d_2/(fxD)},$$

where $F_1$ is the first Fresnel zone in feet, $d_1$ is the distance from one end of path, D is total path length in miles, $d_2 = (D - d_1)$, and f is frequency in GHz.

The standard allowance for Fresnel zone effects is 0.6 times the first Fresnel zone. Calculate 0.6 $F_1$ for enough distances to make a smooth line showing additional clearance allowance. A sample plot of a 15 mile path over hilly terrain is shown in Figure 1.

Once the path and required clearances are established, the height required for antennas at each end can be determined by placing a straightedge on the path plot and rocking it back and forth until the best combination of tower heights is established at both ends. Now the physical requirements for the system are known.

Refer now to Figure 2 for tabulation and calculation of signal path performance. First, the losses must be tabulated. The free space loss, during the signal's excursion through the atmosphere, is calculated using the following equation:

$$\text{Loss (dB)} = 96.6 + 20 \log F + 20 \log D$$

where F is frequency in GHz and D is path length in miles.

Also needed are feedline losses for both antenna systems. This information is determined from manufacturer's published specifications for the transmission line type and frequency of operation in dB per 100 ft attenuation, times the line length divided by 100.

Having done that, add in losses for other feed system components also determined from manufacturer's published data. An additional *field allowance* of one dB total is added for contingencies. Antenna radomes introduce losses, too, but

**STL antenna** installations at the broadcast transmitter site frequently use the existing tower for support. (Photo D) Here is the STL antennas for WBAP, Fort Worth, TX. In locating an STL antenna on a "hot" series-fed AM tower, the STL transmission line must be isolated from ground. (Photo E) This photograph shows how two STL antenna systems were isolated from a very hot 50 kW tower by using solid reflector antennas to radiate the STL signal from the hot tower a short distance (10 ft) to another pair of "grounded" reflector antennas. The site is shared by WPAP/Fort Worth and WFAA/Dallas, TX. (*Photographs courtesy of Marti Electronics*)


often the manufacturer will publish antenna gain specifications with this loss included. So check, and add radome losses if necessary. The total of all the feed system losses is added to the free space path loss to get a total path loss figure.

Now, do the same for gain of the system, usually just the gain of both antennas summed together. The accumulated losses yield a net path loss figure which represents the net loss from antenna connector of the transmitter to the antenna input of the receiver.

Calculation of system fade margin consists of taking the transmitter power expressed in dBm and subtracting net path loss to get the received carrier level. Subtracted from this level is the receiver threshold level, which results in the target of this whole exercise in gains and losses: the fade margin. The difference between the receiver threshold and the available signal, a buffer zone of sorts, allows the path to fluctuate from normal and still maintain communications. A commonly used design target for fade margin is 40 dB. At a path length of 5 miles or less, this 40 dB margin gives a statistical reliability of 99.99%, which represents less than 9 s/day when the path is such that losses bring the received carrier level below the receiver threshold. This is a statistical figure, and actual performance could vary considerably in any given system. Lower fade margins may provide adequate reliability estimates for intercity relay use, or remote pickup situations; but, the STL *must* be reliable, so don't settle for less. Unless the path is less than 20 miles or so. Fortunately, for shorter paths, using standard equipment and relatively small antennas, the 40 dB figure can be reached, so compromise is rarely necessary.

A note on this path analysis: several trial calculations will be needed for checking all the available choices for feedlines and antennas. The best way to go about it is to work from both ends to the middle; that is, add losses and establish the worst case net path loss. Then, plug in feedline losses and antenna gains until the right combination is reached. Of assistance is the following equation for determining gain of a parabolic dish:

$$\text{Gain(dB)} = 20 \log F + 20 \log D - 52.6$$

where F is the frequency in MHz and D is dish diameter in feet. Standard dish sizes are from two feet and larger in 2-foot increments.

While considerably more detail can be examined in the theoretical analysis of microwave systems, the above information is the standard set of calculations used by manufacturers and engineers involved in microwave system design.

### Making it work...in practice

So it works on paper; will it work when it's all put together? If it's built exactly as designed, and some significant structure was not neglected, it should work. But check the theoretical figures again to make sure nothing is left out.

First, check the path closely, from ground level. Drive the entire path, noting buildings, and other obstructions carefully. Watch for large obstructions that are not in the path, but nearby. They may present problems with reflections if they are too close to the line of the path. If in doubt, research the situation in a good microwave system book, or get an engineering firm experienced in microwave systems to help. Now is the time to solve any potential problem—not later when it doesn't work!

Sight along the path with binoculars, if possible, from a vantage point as close as possible to the antenna location. This can be very enlightening as to potential obstructions, or just to make sure that the path indeed is a clean, straight shot from end to end.

Once all equipment is on site and ready to go, the usual cautions regarding construction are in order: no sharp bends or kinks in feedlines, check for shipping damage, bent antennas, and overtightened clamps. Meter readings on the equipment should agree with final test data. If microwave test gear is available, use it. High VSWR, low power, and off-frequency equipment have spoiled many a day. Once it is all in place, the good ol' smoke test is in order: If it fails the test (doesn't smoke), and a signal appears at the receiver...success!

It takes planning and care to see that an STL or other microwave system is going to perform as desired, with predictable reliability, and with the assurance that it was done right from start to finish. □

### STL equipment: Source index

The following sources provide STL instruments or supporting equipment to the broadcast industry. Some listed do not separately manufacture this equipment, but only represent other manufacturers in providing STL equipment in systems work and turn-key operations. To obtain literature on equipment from these companies, circle the appropriate numbers on the reader service card.

Dealers who also provide such equipment may be found listed under this category in the **BE** Buyers Guide, September, 1978.

| | | | |
|---|---|---|---|
| Bayly Engineering | 200 | Micro Control Associates | 213 |
| CCA Electronics | 201 | Microwave Associates | 214 |
| Cetec Broadcast Group | 202 | Moseley Associates | 215 |
| Coastcom | 203 | Nurad | 216 |
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| McMartin Industries | 211 | | |
| Micro Communications | 212 | | |

# Directional array field strength calculations

By Donald L. Markley, BE facilities editor and consulting engineer


Figure 1

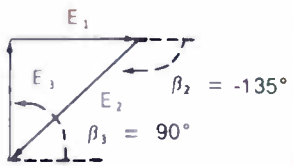


Figure 2

Table 1

$\beta_1 = S_1 \text{ Cos } \Theta \text{ Cos } (\Phi_1 - \Phi) + \Psi_1$

$\beta_1 = 0 \text{ Cos } 0 \text{ Cos } (0 - 90) + 0$

$= 0$

$E_1 = 1 \, f(\Theta) \angle 0 \text{ at } \Theta = 0 \quad f(\Theta) = 1 \therefore E_1 = 1 \angle 0$

$E_2 = 1.414 \angle 90 \text{ Cos } 0 \text{ Cos}(0 - 90) + (-135)$

$= 1.414 \angle 90 \text{ Cos}(-90) - 135 = 1.414 \angle -135$

$E_3 = 1.0 \angle 180 \text{ Cos } 0 \text{ Cos}(0 - 90) + 90°$

$= 1.0 \angle 90$

Many broadcast technicians have a tendency to ignore the mathematics of field strength calculations. All such calculations are considered to be almost as complex as Einstein's special theory of relativity and more mystical than the further reaches of astrology. The biggest problem is really the emotion experienced by many at that terrible word "mathematics."

The field strength values can actually be calculated in the simplest of methods using nothing more complicated than basic trigonometry. The general equation is stated in a number of publications* and only requires the ability to calculate the Cosine function and operate a protractor. The basic equation is:

$$E = \sum_{N=1}^{k} E_k \, f_k(\Theta) \quad \beta_k$$

where $E$ = the total field strength
$k$ = the $k^{th}$ tower
$n$ = the number of towers in the array
$E_k$ = the field strength from each tower
$f_k(\Theta)$ = the vertical form factor of each tower
$\Theta$ = the elevation angle above the horizon.
$\beta_k = S_k \text{ Cos } \Theta \text{Cos}(\Phi_k - \Phi) + \Psi_k$
$S_k$ = spacing of each tower in degrees
$\Phi_k$ = bearing from the reference point to each tower

**Theory and Design of Directional Antennas*, Carl Smith, Smith Electronics, Inc., Cleveland, Ohio, 1969.

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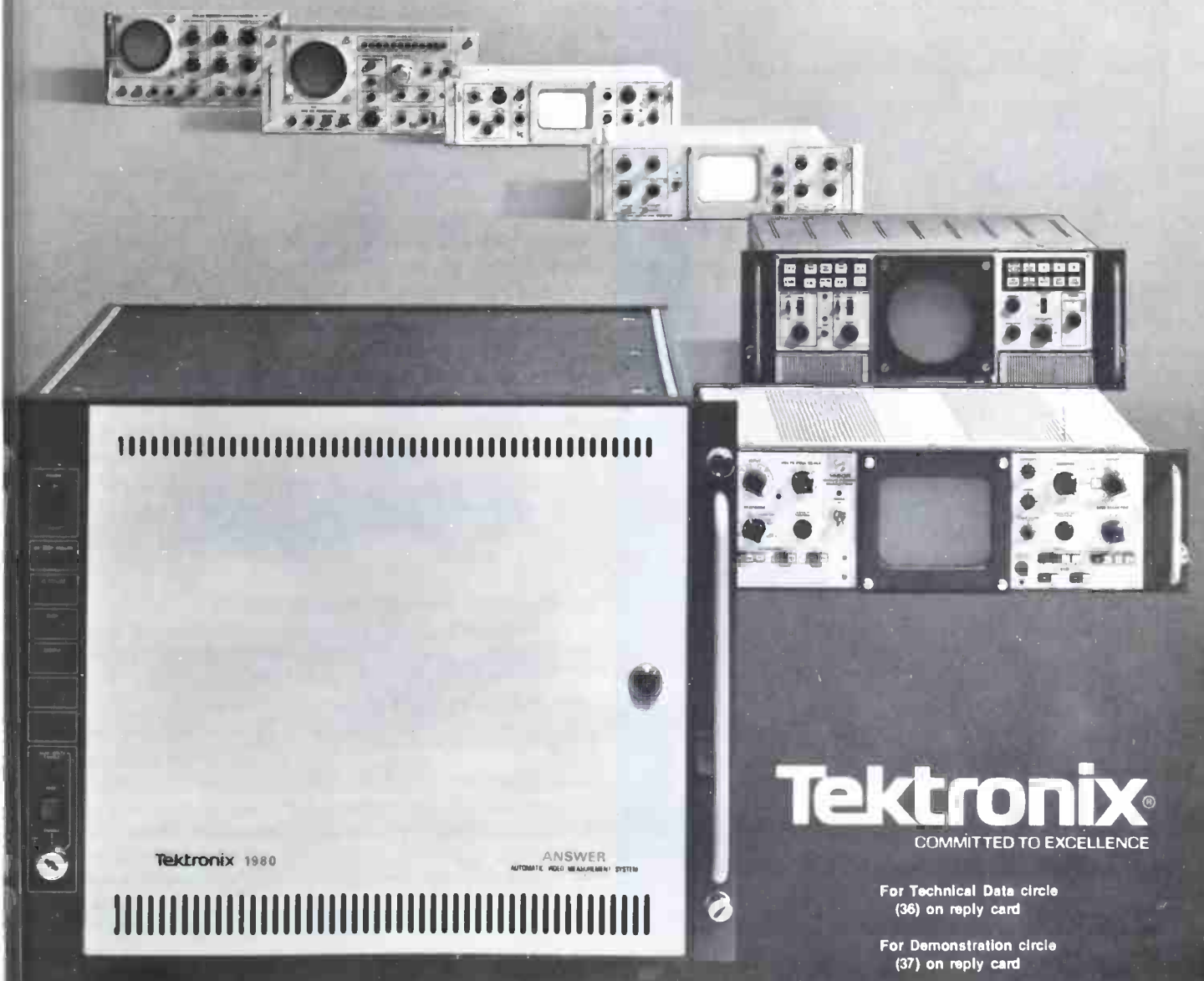


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$\Phi$ = bearing from the reference point to the observation point (desired bearing)
$\Psi_k$ = phase of each element

This equation simply states that the total field strength from the array can be determined by adding together the individual fields from each element in the array. The method of addition must include compensation for the difference in the phase of the signals caused by spacing, the shift in the signals

Figure 3

DIRECTIONAL ANTENNA ANALYSIS PROGRAM

| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 76 | Lbl | 52 | 11 | A | 104 | 01 | 1 | 153 | 39 | COS | 201 | 39 | COS | |
| 1 | 13 | C | 53 | 42 | STO | 105 | 95 | = | 154 | 54 | ) | 202 | 54 | ) | |
| 2 | 29 | CP | 54 | 03 | 03 | 106 | 42 | STO | 155 | 54 | ) | 203 | 54 | ) | |
| 3 | 47 | CMs | 55 | 00 | 0 | 107 | 08 | 08 | 156 | 85 | + | 204 | 54 | ) | |
| 4 | 42 | STO | 56 | 42 | STO | 108 | 75 | - | 157 | 73 | RCL | 205 | 95 | = | |
| 5 | 00 | 00 | 57 | 56 | 56 | 109 | 01 | 1 | | | Ind | 206 | 42 | STO | |
| 6 | 91 | R/S | 58 | 42 | STO | 110 | 95 | = | 158 | 09 | 09 | 207 | 58 | 58 | |
| 7 | 76 | Lbl | 59 | 57 | 57 | 111 | 42 | STO | 159 | 95 | = | 208 | 73 | RCL | |
| 8 | 14 | D | 60 | 71 | SBR | 112 | 07 | 07 | 160 | 42 | STO | | | Ind | |
| 9 | 42 | STO | 61 | 44 | SUM | 113 | 75 | - | 161 | 59 | 59 | 209 | 08 | 08 | |
| 10 | 01 | 01 | 62 | 53 | ( | 114 | 01 | 1 | 162 | 43 | RCL | 210 | 65 | X | |
| 11 | 91 | R/S | 63 | 43 | RCL | 115 | 95 | = | 163 | 05 | 05 | 211 | 43 | RCL | |
| 12 | 76 | Lbl | 64 | 56 | 56 | 116 | 42 | STO | 164 | 77 | x≥t | 212 | 58 | 58 | |
| 13 | 15 | E | 65 | 33 | $x^2$ | 117 | 06 | 06 | 165 | 30 | TAN | 213 | 65 | X | |
| 14 | 07 | 7 | 66 | 85 | + | 118 | 71 | SBR | 166 | 01 | 1 | 214 | 53 | ( | |
| 15 | 02 | 2 | 67 | 43 | RCL | 119 | 39 | COS | 167 | 42 | STO | 215 | 43 | RCL | |
| 16 | 42 | STO | 68 | 57 | 57 | 120 | 97 | Dsz | 168 | 58 | 58 | 216 | 59 | 59 | |
| 17 | 02 | 02 | 69 | 33 | $x^2$ | 121 | 04 | 4 | 169 | 61 | GOTO | 217 | 39 | COS | |
| 18 | 43 | RCL | 70 | 54 | ) | 122 | 00 | 8 | 170 | 02 | 2 | 218 | 54 | ) | |
| 19 | 02 | 02 | 71 | 34 | $\sqrt{x}$ | 123 | 88 | 8 | 171 | 08 | 08 | 219 | 95 | = | |
| 20 | 65 | X | 72 | 65 | X | 124 | 43 | RCL | 172 | 76 | Lbl | 220 | 44 | SUM | |
| 21 | 05 | 5 | 73 | 43 | RCL | 125 | 56 | 56 | 173 | 30 | TAN | 221 | 56 | 56 | |
| 22 | 95 | = | 74 | 54 | 54 | 126 | 33 | $x^2$ | 174 | 53 | ( | 222 | 73 | RCL | |
| 23 | 42 | STO | 75 | 95 | = | 127 | 85 | + | 175 | 53 | ( | | | Ind | |
| 24 | 03 | 03 | 76 | 91 | R/S | 128 | 43 | RCL | 176 | 43 | RCL | 223 | 08 | 08 | |
| 25 | 71 | SBR | 77 | 76 | Lbl | 129 | 57 | 57 | 177 | 05 | 05 | 224 | 65 | X | |
| 26 | 44 | SUM | 78 | 44 | SUM | 130 | 33 | $x^2$ | 178 | 38 | SIN | 225 | 43 | RCL | |
| 27 | 97 | Dsz | 79 | 00 | 0 | 131 | 95 | = | 179 | 65 | X | 226 | 58 | 58 | |
| 28 | 02 | 2 | 80 | 42 | STO | 132 | 44 | SUM | 180 | 73 | RCL | 227 | 65 | X | |
| 29 | 00 | 1 | 81 | 56 | 56 | 133 | 55 | 55 | | | Ind | 228 | 53 | ( | |
| 30 | 18 | 8 | 82 | 42 | STO | 134 | 92 | INV | 181 | 10 | 10 | 229 | 43 | RCL | |
| 31 | 43 | RCL | 83 | 57 | 57 | | | SUB | 182 | 54 | ) | 230 | 59 | 59 | |
| 32 | 55 | 55 | 84 | 43 | RCL | 135 | 76 | Lbl | 183 | 39 | Cos | 231 | 38 | SIN | |
| 33 | 55 | ÷ | 85 | 00 | 0 | 136 | 39 | COS | 184 | 75 | - | 232 | 54 | ) | |
| 34 | 07 | 7 | 86 | 42 | STO | 137 | 53 | ( | 185 | 73 | RCL | 233 | 95 | = | |
| 35 | 02 | 2 | 87 | 04 | 04 | 138 | 53 | ( | | | Ind | 234 | 44 | SUM | |
| 36 | 95 | = | 88 | 43 | RCL | 139 | 43 | RCL | 186 | 10 | 10 | 235 | 57 | 57 | |
| 37 | 34 | $\sqrt{x}$ | 89 | 04 | 04 | 140 | 03 | 03 | 187 | 39 | COS | 236 | 92 | INV | |
| 38 | 35 | 1/x | 90 | 65 | X | 141 | 75 | - | 188 | 54 | ) | | | SUB | |
| 39 | 65 | X | 91 | 05 | 5 | 142 | 73 | RCL | 189 | 55 | ÷ | | | | |
| 40 | 43 | RCL | 92 | 85 | + | | | Ind | 190 | 53 | ( | | | | |
| 41 | 01 | 01 | 93 | 01 | 1 | 143 | 06 | 06 | 191 | 43 | RCL | | | | |
| 42 | 95 | = | 94 | 00 | 0 | 144 | 54 | ) | 192 | 05 | 05 | | | | |
| 43 | 42 | STO | 95 | 95 | = | 145 | 39 | COS | 193 | 39 | COS | | | | |
| 44 | 54 | 54 | 96 | 42 | STO | 146 | 65 | X | 194 | 65 | X | | | | |
| 45 | 91 | R/S | 97 | 10 | 10 | 147 | 73 | RCL | 195 | 53 | ( | | | | |
| 46 | 76 | Lbl | 98 | 75 | - | | | Ind | 196 | 01 | 1 | | | | |
| 47 | 12 | B | 99 | 01 | 1 | 148 | 07 | 07 | 197 | 75 | - | | | | |
| 48 | 42 | STO | 100 | 95 | = | 149 | 65 | X | 198 | 53 | ( | | | | |
| 49 | 05 | 05 | 101 | 42 | STO | 150 | 53 | ( | 199 | 73 | RCL | | | | |
| 50 | 91 | R/S | 102 | 09 | 09 | 151 | 43 | RCL | | | Ind | | | | |
| 51 | 76 | Lbl | 103 | 75 | - | 152 | 05 | 05 | 200 | 10 | 10 | | | | |

being fed to the individual towers and the vertical angle from the array to the observation point.

The simplest method of performing this addition is to combine the signals graphically. This method has the additional advantage of displaying the relationship of the various signals in an easily understood manner.

### 3-tower array

A simple 3-tower might be as shown in Figure 1. This array has quarter wave spacing and will produce nulls at 090°, 180° and 270°. For the purpose of this example the height is not significant. Figure 1 shows the elements to be on a 000° bearing with a spacing of 90° between elements.

The general equation has been evaluated in Table . First, the term $\beta_1$ has been evaluated for tower number 1. As shown, most terms simply drop out as the calculations proceed. All calculations are then shown for a bearing of 090° from the reference line of true north. Figure 2 shows these individual field strength values simply added together in the normal

## )irectional arrays

ıshion for magnitude and angle of vectors. That is, ıch field strength is added to the end of the previous eld strength vector at the angle $\beta$. The result is the istance from the tip of the final vector back to the :ference point. At this bearing, the resultant is 0. A ıeck at 180° and 270° will result in the same total lthough the placement of the individual vectors will ıange.

For other bearings, simply insert the appropriate alue of $\Phi$. For other vertical angles, the vertical form ıctor must either be calculated or determined from ıe tables available in the *NAB Engineering Handbook*. To completely determine the pattern field rength values, this process can be repeated at each ıterval of azimuth and vertical angle.

### Alternate method

Obviously, this method will require a great deal of me and effort. While not difficult, it is laborious. A ıore convenient method would be to utilize one of ıe new programmable calculators to perform the ılculations. A program for the Texas Instruments ıodel 59 is shown in Figure 3. While this method of nalysis does not demonstrate the combining of the ıdividual fields to produce nulls and lobes, it is very ccurate and does provide an easy (labor-wise) ıethod of determining field strength values. This rogram is used in the following manner:

1. Enter the number of towers as "C."
2. Enter the array efficiency as "D" (enter in ıv/m).
3. Enter the parameters for each tower as follows: ll parameters for towers should be entered in groups f five. The order is bearing of the tower, spacing om reference point in degrees, relative field, phasing nd height in electrical degrees. Tower 1 would be tored in spaces 11-15, tower 2 in 16-20, tower 3 in 1-25 and so on up to tower 8 in spaces 46-50.
4. Press "E" to calculate a scale constant which ill adjust the relative field values to the actual attern size. This is the slow part requiring up to 30 ıin for this little machine. If the constant is known, can simply be entered in location 54 and the next tep can be taken.
5. Enter the desired vertical angle in degrees and ress "B."
6. Enter the desired horizontal angle (azimuth) and ress "A" to obtain the field strength at that angle.

It is not necessary to enter the vertical angle each me unless a change from the previous value is esired. The inputs for bearing to each tower should e in degrees from true North, as should be the zimuth value. The spacing of each element and the eight should be in electrical degrees. If these values re not known for existing stations, they are available n the station license as the "theoretical" values. The fficiency can be found in the original station roof-of-performance.

Though this little machine plugs away for a long ime to determine the initial constant, subsequent alculations at each value of $\Phi$ and $\Theta$ are fairly fast. f this method and machine appears to be too slow, ry doing the whole pattern by the graphical method. t will be a good education. □

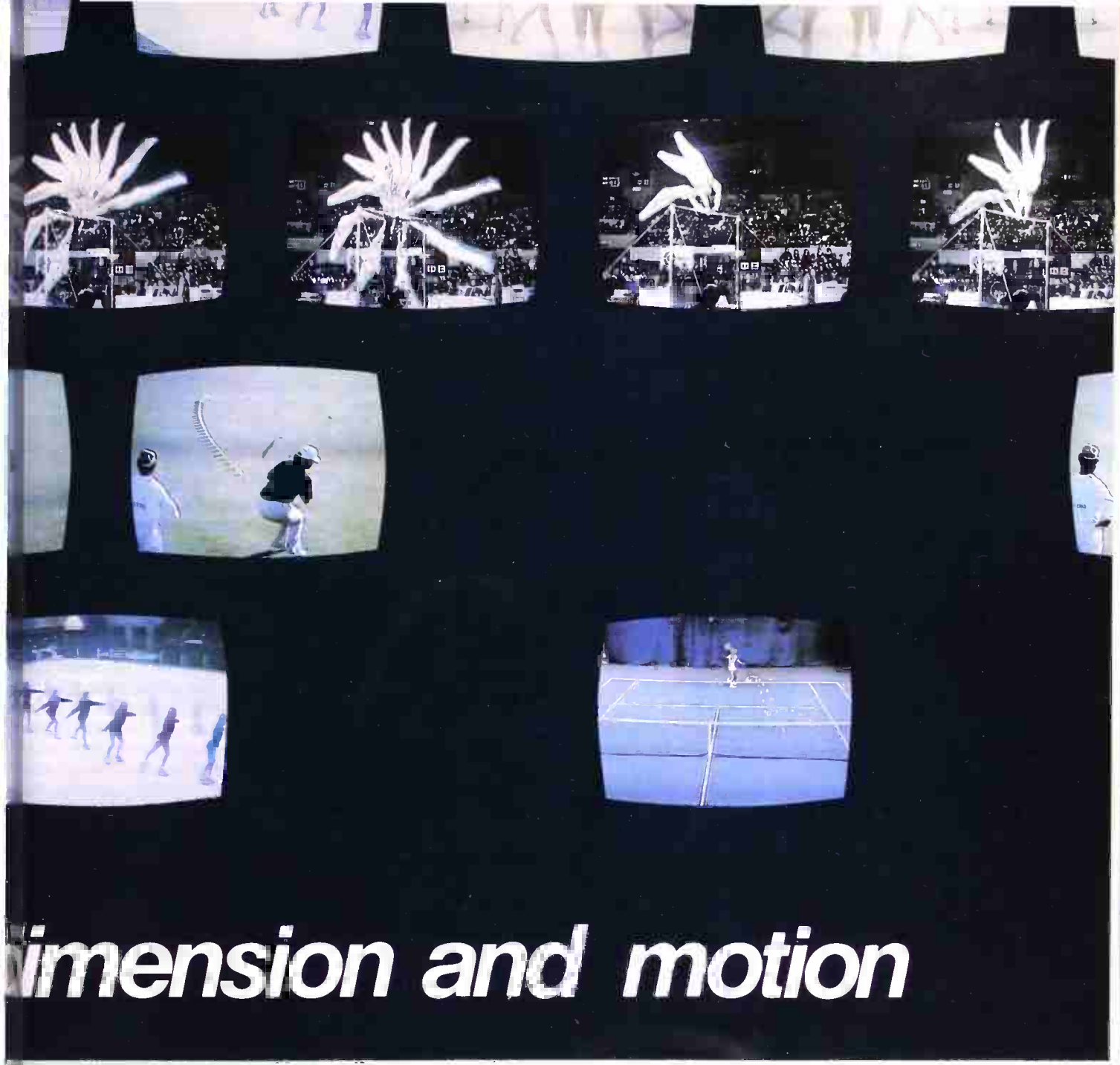
# CBS Actiontrak adds

When CBS Technology Center rolled the tape on its latest version of Actiontrak™ at the annual SMPTE Television Conference in San Francisco on February 3, the visual displays literally froze the audience's attention with spectacular motion sequences. Actiontrak was introduced by CBS early in 1978, covered the Super Bowl and the Masters Golf Tournament, and opened up a new dimension of displaying motion sequences to please rapt viewers.

Television engineers, producers and viewers are accustomed to seeing motion on television displayed in real time, instant replay, slow motion replay, stop action and a progression of still pictures. In other areas, film and stroboscopic techniques are used by scientists to display motion effects as pioneered by the famous Dr. Edgerton in the late 1940s. His techniques have resulted in dramatic displays of the motion of bullets, missiles, wind tunnel experiments and other phenomena where ultra high speeds are involved. Now, Actiontrak adds an extra dimension to video displays whereby any normal color video source is used to generate, in real time, multiple images of a subject in motion.

As described at the SMPTE Convention, CBS's Actiontrak incorporates the advantages of PCM-encoded video signals and digital access memory to produce spectacular motion displays. In terms of block diagram and circuitry functions, Actiontrak stores a reference field of video which represents the scene to be displayed as it begins the selected action sequence, compares elements of this reference

During the preparation of this article, **Broadcast Engineering** learned of the sudden death of J. Kenneth Moore, director of the CBS technology center and a prominent figure in the development of Actiontrak. A note on his passing appears in the Business News section.



# imension and motion

picture with subsequently-arriving video signals, tags and stores those pixels which are distinctly different from those in the reference field, and displays a realtime video of the original plus the stored pixels to create successive images of "moving" subjects in a single display.

Since its introduction, CBS has made significant design advances in the Actiontrak system. In the earlier system, the visual sequences were good, but with successive images being partially obscured by preceding images. At this year's SMPTE convention, CBS demonstrated the latest version of this system which incorporates new software to eliminate the image overlap problem and to provide additional flexibility in imagery display.

Actiontrak now permits a continuum of motion to be displayed without serious interference from previous images. The resultant effect is a display of motion where the path of a ball, a gymnast in action, a figure skater's routine, the stroke of a tennis racket, a golfer's swing, or any other action sequence can be followed from beginning to end as a remarkable visual sequence. In addition, the producer can choose the type of display desired: early images can be displayed with intensity equal to that of subsequent display, or earlier elements of the sequence can fade away. The latest feature lets the producer show motion decaying (fading away as trailing, ghostlike images) at a selectable rate.

The sequences shown here are only a few of the action sequences which have held audiences spellbound. These are in full color, and the viewers of the CBS tape at SMPTE got a firsthand exhibit of the flexibility in imagery now possible with the Actiontrak system.

While the immediate beneficiary of Actiontrak technology is the home viewer of sporting events, a quantum jump in its application to the advancement of professionalism in sports is an obvious future application. □

# Saticon tubes: growing importance in color video cameras

By R. G. Neuhauser,

Image Device Application Engineering, RCA Electro Optics and Devices

The Saticon™ is a vidicon-type camera tube with a Selenium-Arsenic-Tellurium photoconductor. The tube was developed specifically for small high performance color television cameras, but has proven useful for many other television-camera applications. The photoconductor represents an improvement in resolution, stability and reduction of optical flare over the presently used lead oxide photoconductors. The Saticon employs a new gun structure specifically designed to produce improved registration and registration stability in color cameras and to reduce the lag of the tube.

It is capturing an increasing portion of the tube sockets for color television cameras. It has already captured more than half the market for new electronic journalism type color cameras and new telecine color cameras, and a substantial number of additional users are converting existing cameras to Saticons to take advantage of its high performance characteristics and longer life.

There is a normal reluctance on the part of camera manufacturers to swing to a new technology away from a long accepted standard such as the role that lead oxide photoconductor tubes have played in the last decade or more. And there is also a reluctance on the part of users to live through the inevitable growing pains that a new product encounters during its introduction. Fortunately, these growing pains for the Saticon tubes have been minimal and relatively insignificant and very amenable to a swift correction.

The decision by RCA to utilize Saticon tubes in the cameras using 18mm diameter tubes for electronic journalism (EJ) was based on detailed laboratory performance and life tests of the tubes themselves. It was further based upon rigorous side-by-side tests of identical cameras equipped with BC4908 Saticon tubes and with lead oxide tubes, all of the precautions of blind test, color monitor interchange and skilled critical observers being employed. The predicted advantages of Saticon resolution (lack of flare, equivalent or better lag, and signal and background uniformity) were evident. The concern that different characteristics of handling specular highlights, spectral sensitivity and other secondary problems might produce a fatal flaw was also dispelled by these rigorous tests. The tests showed that nothing was lost and significant improvements in picture quality were obtained. This, coupled with the good photoconductor stability and the protected long life (now borne out by field experience), has resulted in the swing towards Saticon tubes in EJ cameras.

In telecine cameras, the use of high contrast film produces lag problems with vidicon tubes. The 25mm BC4909 Saticon tube produces great improvements in lag with cameras that are equipped to provide individually controlled bias light and 0.4 gamma correction or more. In this field, the number of new cameras being sold with Saticon tubes started almost immediately at 40%. Conversion of existing cameras also is accelerating.

### The photoconductor

The Saticon is essentially a conventional type vidicon with a Selenium-Arsenic-Tellurium photoconductor. Hence the Saticon name. Selenium, the oldest known photoconductor, was discovered in 1873 and has been used in a host of light-sensitive devices, including photographic exposure meters and xerographic copying-machine plates.

The first photoconductive vidicons made by RCA employed selenium. The high sensitivity, low dark current, and low lag were distinctly advantageous features. The disadvantages were that the tubes suffered from lack of red sensitivity and short life, and the glassy amorphous selenium layer tended to crystallize, even at room temperature, to produce conductive white spots. Unless some method of cooling the tube was employed, this latter characteristic definitely limited tube life. Later development work showed that adding arsenic greatly reduced the tendency for selenium to crystallize. It also was established that adding tellurium would increase the red sensitivity through the entire visible spectrum, and the concept of developing a selenium photoconductor in a heterojunction configuration was explored.

Subsequently, the research laboratory of NHK, the Japanese Broadcasting Corporation, took up the search for a way of making a satisfactory selenium-based photoconductor. After some intiial success at NHK, the Central Research Laboratory of Hitachi began to collaborate with NHK in the development of a practical photoconductor and associated camera tube, intending to produce a tube specifically for color-television cameras. The result of this collaboration was a tube they called the Saticon.

### Developmental objectives

Any new camera tube must show improved or at least equivalent performance in resolution, lag and sensitivity when compared to tubes in use. Beyond these are a number of other characteristics, uniquely

ecessary for a color camera, that lso must be maintained or improved. These are registration abili-, registration stability, spectral esponse, light dispersion from the hoto-layer, signal uniformity, low ark current, small size and predictable light-transfer characteristics. Several additional factors necssary for practicality and economic ability are long life, freedom from lemishes, resistance to image urns, usefulness over a wide mperature range, and reproducility in manufacture.

**Photoconductor development**

In order to intelligently develop a tisfactory photoconductor using lenium, tellurium and arsenic, it as first necessary to develop an nderstanding of the electronic ructure of the photoconductive aterials. It was determined that hen the p-type selenium is deposed on the typical transparent gnal electrode consisting of tin ide which has n-type conductivity igure 1), a reversed-biased junction prevents excess holes from ing injected into the photoconducr and contributes to the desired w dark current. On the opposite de of the photoconductor, the tural p-type conductivity of the yer traps electrons in all available rface sites during the initial scan the layer and prevents unwanted ectrons from the beam from conibuting to dark current. In effect e two barriers produce effect, two terojuntions, and the photoconuctor operates with low dark rrent. The entire target voltage is pressed reasonably uniformly ross its bulk.

The first task in developing the otoconductor was to introduce the abilizing material into the photoyer without seriously disturbing sirable electrical characteristics. n appropriate arsenic concentran was developed that balances e stability of the selenium at high mperatures without producing unanted electrical characteristics.

The next problem was to introce tellurium into the layer to crease the red sensitivity. The lution, shown in Figure 2, was to corporate the tellurium in the ighborhood of the signal plate to hieve good red sensitivity, but far ough away from it to prevent sruption of the barrier and any crystallization tendencies. The ickness of this layer and the ncentration of tellurium in the llurium-bearing layer determine e increase in the red sensitivity.

The thickness of the remainder of e photolayer is also critical because the storage capacitance of the layer (and thus lag) will be high if the layer is thin, while too thick a layer requires too high a target voltage. With a given hole-carrier lifetime and mobility in the selenium-arsenic layer, the electric field must be high enough to pull the carriers through before they are lost by recombination.

The target voltage was centered on about 50 V, but even at this voltage there could be problems with secondary emission from the surface of the selenium. This secondary emission would introduce instability in the beam or even cause the scanned area to flip over to the "high-velocity" scan mode if the secondary emission becomes greater than unity at this target voltage. A thin, porous layer of antimony trisulphide is deposited on the scanned area to reduce this tendency for secondary emission.

**Photoconductor performance**

The photoconductor that evolved exhibits the following characteristics.

**Sensitivity and spectral response**— In the band of wavelengths approximating the blue channel of a color television camera, the photoconductor has nearly 80% quantum efficiency, which is very close to the sensitivity of a lead-oxide photoconductor (one charge carrier per photon is 100% quantum efficiency). The sensitivity decreases through the visible spectrum, as shown in Figure 3. The color camera green-channel sensitivity of the selenium-

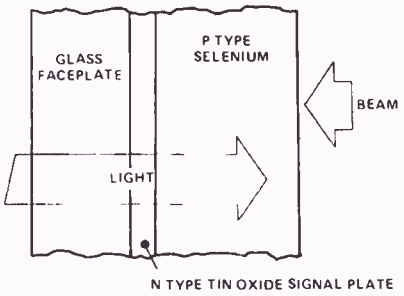



**Figure 1** The cross section schematic of a selenium-type photoconductor shows the electronic configuration of its layers. When a positive voltage is applied to the signal plate, a reversed bias junction is formed between the N & P type materials. The beam scans the right side and charges the target negatively to the cathode voltage.

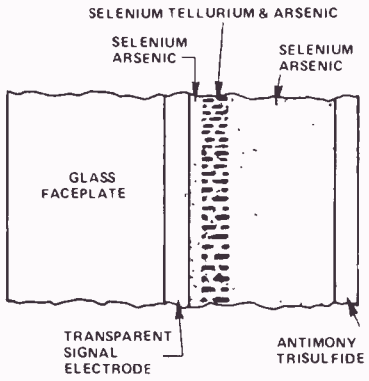



**Figure 2** This cross section of the Saticon tube photoconductor shows where the stabilizing arsenic and red sensitivity enhancing tellurium is introduced into the photoconductor and the location of the secondary emission suppressing antimony trisulphide.

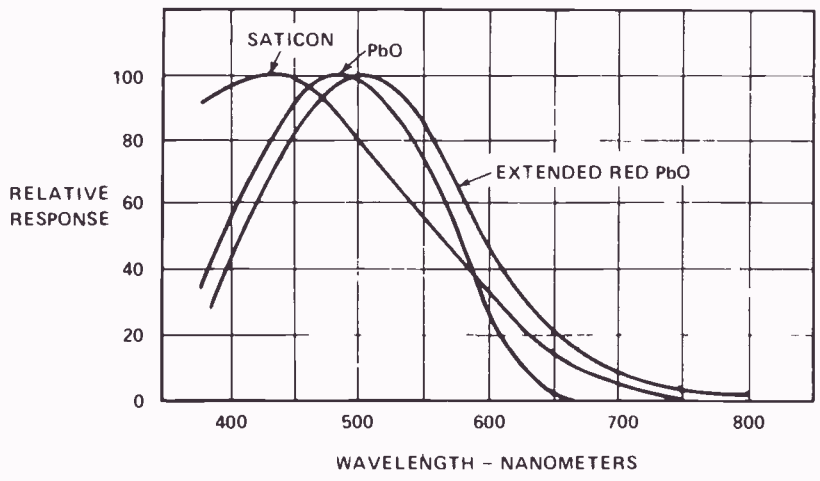



**Figure 3** Spectral sensitivity characteristics differ between the Saticon tube photoconductor and the lead-oxide photoconductor.

arsenic-tellurium photoconductor is 10-15% less than the green-channel sensitivity of a lead-oxide photoconductor.

For live cameras, the tubes are selected for maximum sensitivity in the intended channel, hence R, B and G versions are available as BC4908R, B and G or BC4390R, B and G.

The red sensitivity is higher than a non-doped lead oxide and is in the range of the red sensitivity of highly doped extended red doped lead oxide photoconductors. The sensitivity extends beyond the 700 nm threshold of the visible spectrum to nearly 800 nm. This band of light must be excluded from the optical system by the use of appropriate IR filters in the camera.

The photoconductor, line lead oxide, has a linear light-transfer characteristic (gamma of unity) over the useful range of signal current. In terms of sensitivity, RCA measurements show that Saticon tube sensitivity is greater than that of lead oxide tubes by 18% in the red channel, lower by 11% in the green and a toss-up (within 3%) in the blue channel.

**Dark Current and Reflectivity**—The dark current in the Saticon tube is extremely low, typically 0.5 nA/cm$^2$, testifying to the efficiency of the reverse-biased junctions. Thus the dark current in a 25mm Saticon tube with a useful scanned area of approximately 1 cm$^2$ is 0.5 nA; in an 18mm tube it is 0.25 nA.

The optical absorption and reflectance of the photoconductive layer is of particular importance. Glassy selenium is red in color (i.e., it reflects and transmits red light). The addition of the tellurium reduces this reflectivity and the photoconductor appears nearly black. Measurements of the reflectivity of various typical camera-tube photoconductors as shown in Figure 4.

The consequences of this low reflectivity and high absorption are two-fold. First, very little light is reflected back into the optical system from the photoconductor. With some camera tubes, particularly with red and green light, an appreciable amount of light is reflected back into the optical system where it appears unwanted in portions of the image and deteriorates the contrast and color fidelity of lowlights in the picture.

It is evident that this reflected light can cause a significant deterioration of image quality, especially in view of the fact that more than 1 or 2% reflectivity from the other optical surfaces of a color camera optical system is considered unacceptable. The improvements in this characteristic in Saticon tubes are evident in the signal waveforms produced by a high-contrast image transition, and very little flare compensation is needed in the video

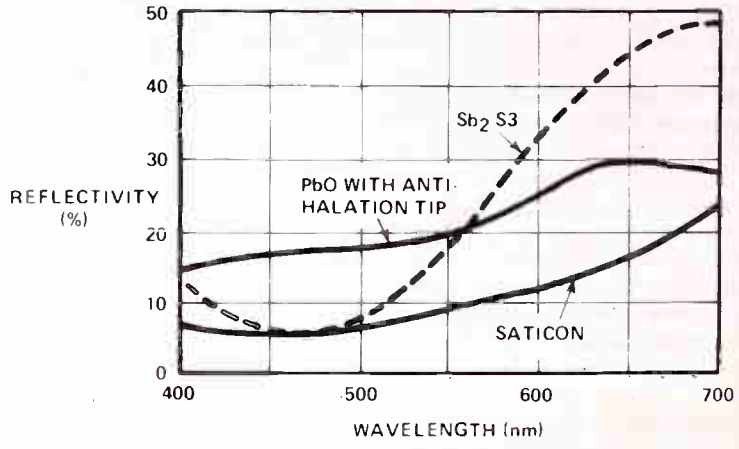



**Figure 4** Relative light reflecting characteristics differ between types of photoconductors as a function of wavelength in the visible spectrum. Low reflectivity means low scattering of light over the image and better color fidelity at low light-levels.

rocessing to compensate for light eflected from the photoconductor id scattered over the remainder of e image.

A second benefit accrues from the ght-absorbing characteristics and om the homogeneneous noncrystal- ne nature of the Saticon photocon- ictor. Very little light is dispersed rough the photoconductor. a qual- that contributes to the good solution characteristics of this notoconductor as compared to ad-oxide tubes where the crystal- he photoconductor disperses red id green light through the photo- nductive layer and causes loss in solution. In Saticon tubes, the solution is independent of the avelength of light.

**g**—In the Saticon tube, trapping fects are negligible, and the notoconductor lag is caused pri- arily by the storage capacitance of e photolayer in series with the fective beam resistance. The stor- e capacitance of the Saticon notoconductor, higher than of lead- ide photoconductive tubes, could ake the Saticon tube noncompeti- e if means did not exist for ducing the resulting lag.

**as-Light**—Means do exist, how- er, and the first and most effec- e of them is the use of bias hting. Bias lighting is the tech- que of putting uniform light on the otoconductor to bring the zero- nal (picture blacks) charge vol- e up to some voltage that is arly as high as the velocity read of the electrons in the anning beam.

This velocity spread, expressed in ctron volts, represents an effec- e beam resistance. It was discov- ed accidentally in 1967 that this thod of operating a tube (and er electrically subtracting this iform signal or black level pedes- from the signal) is an effective d acceptable method of reducing lag of a photoconductor when lag is primarily the result of the rage capacitance of the photo- er. Most television cameras using d-oxide or Saticon camera tubes w employ this technique. Bias hting is particularly effective en used with Saticon tubes cause the photoconductor sensi- ity is uniform. The use of uniform s lighting does not introduce unwanted black-level non-uniformities.

In the newer versions of the Saticon tube, another means is used to further reduce the lag; namely, the low-beam-impedance gun. This gun is discussed in a later section of this article.

**Uniformity and Stability**—The Saticon photoconductor is a glassy impervious layer that can be exposed to air, sealed to a tube by a cold indium pressure-sealing technique, and even pretested for electrical characteristics. Thus, the photoconductor can be made very uniform in thickness since it does not have to be fabricated within the confines of a small bulb, and a large number of faceplates can be processed at one time. Fabricating it with uniform thickness contributes to the Saticon's highly uniform sensitivity over the scanned area. Making many faceplates at a time contributes to similar characteristics from tube to tube and makes possible the selection of only those photoconductors lots that meet the desired performance characteristics.

The glassy layer also produces unusual stability of the electrical characteristics with time. It is impervious to doping by gases generated within the tube, and it is not subject to deterioration or change caused by electrolysis effects when current is drawn through the photoconductor. These effects can and do change the characteristics of the porous photoconductive layers of both lead-oxide and antimony trisulfide tubes as they are used or stored.

The Saticon-tube photolayer is a material that is stable over a wide temperature range. It also maintains, practically constant, all of the important performance characteristics such as lag, resolution, sensitivity, and resistance to image retention over this temperature range. The tube is rated to operate from -30 C (-22 F) to +50 C (122 F) and can operate for short periods of time at temperatures as high as 65 C (149 F). It appears that operation at high temperatures within this range does not shorten the life of the tube, as is the case with lead oxide. To our knowledge, no tubes have been lost because of overheating in cameras.

## Saticons

Another beneficial characteristic of the Saticon photoconductor manufacturing process is the ability to make the tube reasonably defect-free (from spots, etc.). The photoconductor is also relatively resistant to damage that can cause spots after it is manufactured, unlike the relatively fragile antimony trisulfide layer. The occurrence of any defects or spots during operation is indeed rare.

**Resistance to Image Burns**—Camera tubes are often called upon to operate with scene contrasts that are beyond the normal range. When specular highlights (such as the reflections of the sun or spotlight from chrome surfaces) or a direct view of a lightbulb are encountered, the tube should cope with the situation gracefully. It is obvious, however, that the available tubes cannot properly respond to and faithfully reproduce the contrast ratios of more than 10,000 to 1 which typically occur in these situations.

The two effects of specular highlight overloads are a bright comet-tail on a moving specular where the beam cannot handle the signal level for a number of frames and the persistence of an image after normal operation is restored. Saticons are operated at beam currents set to handle 4 times the normal highlight signal current in EJ and studio cameras. This removes most of the comet-tailing and also minimizes the persistent image. The persistent image is higher contrast than it is with a lead oxide tube but it decays more rapidly. It is white instead of the characteristic lead-oxide "red-trail" and is generally accepted as less objectional than the characteristic of the lead-oxide tubes.

Newer cameras are being provided with circuitry that turns the beam on more fully when specular highlights are encountered. This circuitry reduces comet-tail, amplitude and duration of the persistent image caused by specular highlights.

In film pickup where improved signal to noise ratio is desired to offset the film grain, highlight signal currents are typically operated at 500 nA. Long exposures of stationary slides and leaders sometimes produce image burns in these cameras. On some Saticons it is necessary to adjust the target voltage a few volts from the nominal 50 V to correct this problem. If the retained image is positive, the correction is to lower the target a few volts. If negative, the target voltage is raised.

If a camera is uncapped during stand-by (when the camera or the beam is turned off), any stationary image focused on the photoconductor can be "burned in." However, the tube is resistant to image burn-in for very long periods stationary exposure when the beam is turned on and the field is maintained across the photoconductor. Any image burn is temporary and disappears with operational use.

**Gun Design**—The performance of the Saticon tube in a color camera is determined in great part by the design of the electron gun. The foremost innovation in gun design is the low-lag capability incorporated in the gun first used in the 18mm tube. This gun reduces the lag of the tube by reducing the beam resistance.

A word is necessary on the source of the effective beam resistance. In any vidicon tube, the

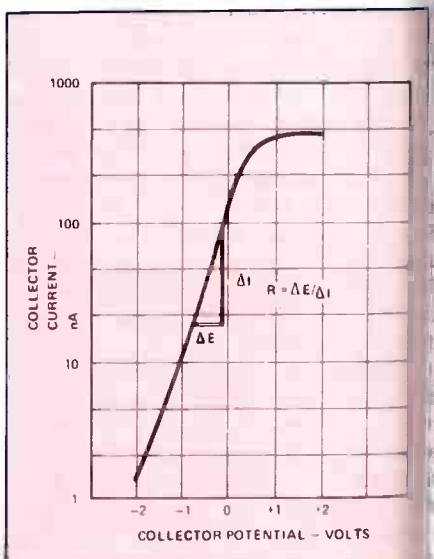



**Figure 5** The plot of beam current collected from a typical vidicon type electron gun as a function of the collector voltage reveals a $\frac{\Delta E}{\Delta I}$ beam resistance which is a major contributor to lag in many camera tubes.

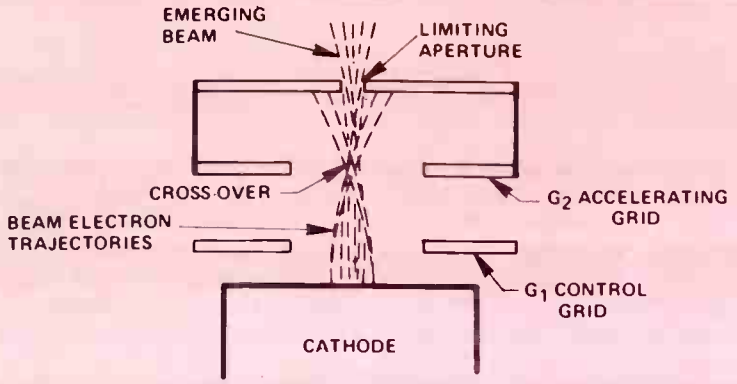



Figure 6 This schematic cross section view of a portion of a typical electron gun used for vidicon type tubes shows the trajectory of electrons and the high density cross-over region of the beam. Here electron repulsion speeds up some electrons, slows down others and produces an increase in the beams resistance when it scans the target.

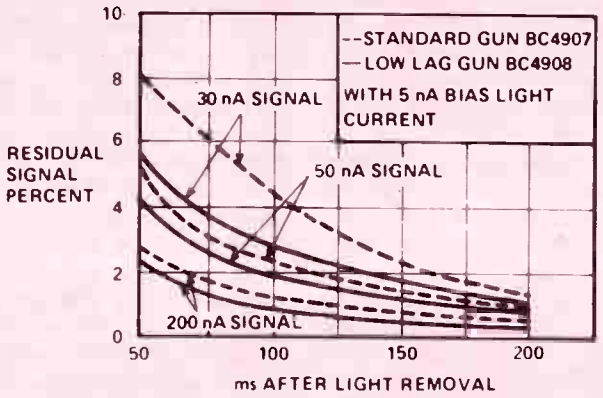



Figure 7 This plot of residual signal (lag) as a function of time after the light is removed illustrates the improvements in lag obtained by a low lag gun (solid lines) compared to a conventional gun (dotted line). The improvement is greatest at low signal levels where lag is more noticeable.

eam lands on the target with low elocity; in the absence of a positive harge, on the target, the beam ows to zero velocity and actually rns around and does not land on e target. When a positive charge encountered, electrons land on e charged area until the voltage proaches zero, when the remainer of the electrons are repelled. e electrons that land constitute e signal current.

All of the electrons in the beam o not have the same energy or elocity nor are they all directed rpendicularly toward the target. typical plot of the current llected from a beam as the llector voltage is increased from a gative to a positive potential is own in Figure 5. The beam sistance is the reciprocal of the ope of this current-voltage characristic.

It was discovered that a substanl portion of the effective spread of electron velocities was caused by electron space-charge effects in the gun. In a conventional electron gun, the electrons from the cathode cross the axis at some point in their trajectory, causing a high space-charge density at this point, Figure 6.

The mutual repulsion effects speed up some electrons and slow down others, and impart radial components of velocity to electrons around the periphery of the cross-over. The improved gun in the Saticon tubes was designed to substantially reduce the electron density in the crossover, thus lowering the beam resistance and the lag. The only operational difference between this and a conventional gun is the requirement for a more negative G1 (beam-control-grid) bias voltage (decreased from -100 to -130 V). This gun change has been achieved with no loss of the resolving power of the beam. The curves of Figure 7

illustrate the improvement in lag when this gun is used.

**Use of Bias Lighting**—Figure 8 illustrates the improvement in lag as the bias-lighting signal level is raised on the 18mm Saticon tube. The amount of bias lighting that can be used is limited by the uniformity of the background signal produced, which is determined primarily by the uniformity of the bias lighting. When cameras are operated at very low light levels and low signal levels (approximately 30 nA in the lowest signal channel), the practical bias-current limitation is 5 to 10 nA.

Even more significant in the use of bias lighting is the improvement in signal build-up. In the absence of light, there are yet a few beam electrons that have enough energy to drive a low-dark current photoconductor considerably below zero volts. When light is encountered, the target must be charged up to zero volts before the beam can begin to develop significant signal from the target. Figure 9 illustrates the build-up improvements as a function of bias lighting. It is easily seen that only a modest amount of bias lighting current is needed to improve the build-up characteristics. Poor build-up of signal in a color camera is noted as changes in the color or brightness of the leading edge of an object moving against a dark background.

Contrary to what might be expected, the use of bias lighting does not distort the tonal values of the picture developed by a linear photoconductor. Bias light adds dc signal that can be subtracted out by black-level adjustments in the video processing amplifier.

**Registration**—The need for registration of the three images of a multi-tube color camera is increasing in important as standards of quality are upgraded. Registration has two aspects: good registration over the entire scanned area and maintenance of good registration during operation.

In the Saticon tube, precision construction takes the form of precision tube parts of high resistivity and precision part-mounting techniques that hold the parts in position. Tight tolerances on gun parts allow the gun to fit snugly into the precision bore of the glass bulb. Close spacing of the G4 mesh to the target reduces edge electric-field effects which, when present, tend to pull the corners of the picture outward. The outside diameter of the bulb is held to very tight tolerances, so that the bulb fits snugly into a precision-bore coil and tube gripping fixtures. By *hard mounting* the tube in the coil, relative motion with respect to the coil can be reduced to negligible values, even under wide variations

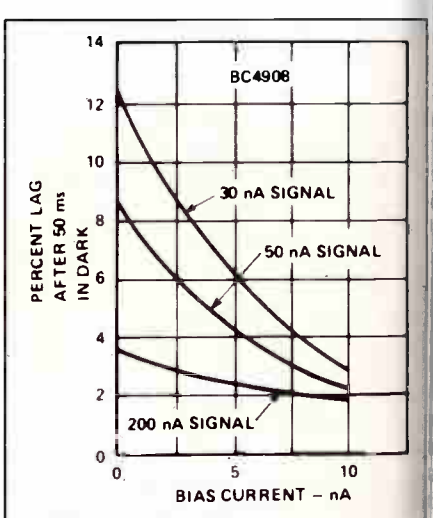
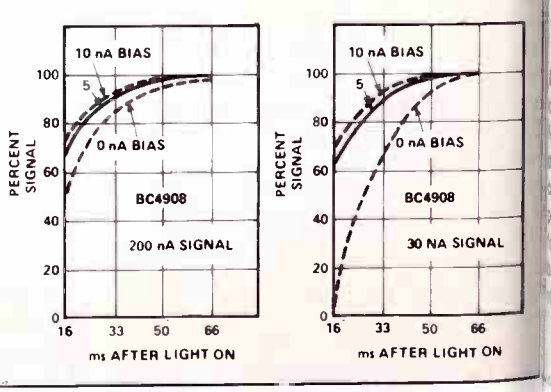



**Figure 8** The lag of a Saticon photoconductor improves rapidly as the bias light is increased.

**Figure 9** Bias affects the build-up of signal against a dark background for various values of bias light. A very modest amount of bias light produces a large improvement.



the temperature and severe shock the camera structure.

As a result of these mechanical esign features, the BC4908 8397A) Saticon tube has estabhed an excellent reputation for hieving and maintaining good gistration when operated in a mera with a coil system of equal ecision and with rigid tube mountig provisions.

**solution**—The size of the 18mm be was determined by the resolun available. The high resistivity of e photoconductor and the lack of tical dispersion produced a target pable of excellent resolution with small image size (6.6mmx8.8mm): e electron gun was designed to intain this resolution. The result i a tube with a resolution superior that of 18mm and 25mm leadide tubes and one that begins to val the resolution of the 30mm ad-oxide tube.

Figure 10 shows amplitude-resnse curves for the camera tubes scussed here. Measurements were ade in the same piece of test uipment with the same test methds. It should be noted that the mplitude response curves are not high as those quoted by other be manufacturers because the easurements were made using the A P200 slantline test chart, which minates the video-amplifier frequency-response characteristics as major factor in the measurement. e numbers developed by this test e generally more pessimistic than ose developed by other techques, but they are very reproduce from one test unit to another, d more accurately reflect the lative resolution characteristics of fferent tubes.

**Tube size and sensitivity**—The 18mm tube also has less target shunt capacitance to ground than a 25mm or 30mm tube, a factor that contributes to lower noise in the video signal. The smaller size of the tube does not affect the sensitivity; the tube produces the same signal output from the same number of lumens of light as does a larger tube. When the depth of focus and angle of view of an optical system using this smaller tube is identical to that of a camera using a larger tube, the illumination (in lumens) of both tubes will be identical; therefore, there is no sacrifice in sensitivity in employing the smaller, lighter-weight tube. An added bonus to using the smaller-size tube is the lower lag that results from the lower storage capacitance of the smaller area of photoconductor, typically 1400$_p$F in the 18mm tube.

### Users' evaluations

Reaction to the Saticon tube in electronic news gathering cameras has been good. One major network has started to switch from lead-oxide to Saticon tubes after running field tests. The two other major networks recently started evaluating Saticon equipped cameras when the BC4390 7-pin base tubes became available. These tubes do not pose the interchangeability obstacle that the 8 pin BC4908 Saticon tube presents. The improved resolution performance that Saticon tubes offer has prompted manufacturers to produce studio type cameras using these tubes. RCA predicts that this generation of cameras will be utilized in many TV studios in the future because of their lightness, simplicity and resolution that is closely approaching 30mm lead-

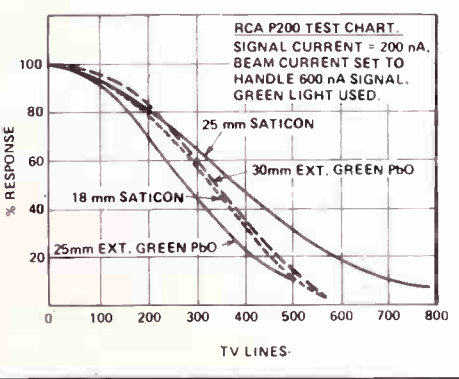



**Figure 10** Comparative resolving characteristics are shown here for camera tubes under typical operating conditions in a color camera. These data show the performance when the beam is focused for best sharpness and balanced resolution in all planes.

oxide equipped camera performance.

### Conversion to Saticon tubes

Conversion of existing 18mm tube equipped cameras to Saticon tubes is now much easier since the recent introduction of the BC439OR, B and G tubes. These employ the same 7-pin base used on lead oxide tubes. These tubes also employ a glass faceplate extender that is intended to keep any dust that settles on the faceplate well away from the plane of focus. The glass extender button on the Saticon tube is designed to avoid shadowing of the bias light which would produce non-uniform background signals.

The 7-pin tube has all of the precision gun features and structural ruggedness of the 8-pin tube and provides equal registration and stability of registration while in use. In some cameras, additional G1 bias voltage range is necessary to provide proper control of the beam.

The 25mm Saticon tube presently available is the BC4909. When used to replace sulfide vidicons in color telecine cameras, the lower lag, increased sensitivity, and lower light dispersion are quite evident. The BC4909 can be used in any 3-tube telecine camera that uses magnetically focused 25mm vidicons if the amount of bias lighting can individually be adjusted to produce approximately 20 nA of bias signal and the video processing amplifier can correct the signal to a 0.4 gamma (or lower) characteristic. The conversion of a system from vidicons or lead-oxide tubes to Saticon tubes requires that a fixed 50 V be provided for the target and that the system be recalibrated to operate with equal signal currents of 500 nA in each channel and with 15 nA of bias signal current.

### Predictions

The development of the Saticon tube is still in its infancy and more improvements are anticipated in the near future. Lower lag photoconductors are a good probability. The low lag gun will also be provided in the 25mm tube to further reduce lag in telecine cameras. Circuitry is now available for the RCA TK28 to increase the black stretch to pull detail out of high density films where black information is crushed. Improved lag will be desired with this additional black stretch.

Smaller Saticon tubes will allow the design of even smaller E.J. type cameras with no loss in performance. Lower noise in the video signal will also be provided by the use of a low shunt capacitance output from the tube. It is anticipated that a 25mm tube will also be provided that will be a replacement in existing cameras that employ 25mm lead oxide tubes with some minimal camera modifications. The bonus anticipated from this conversion will be a camera that outperforms the 30mm lead oxide equipped cameras.

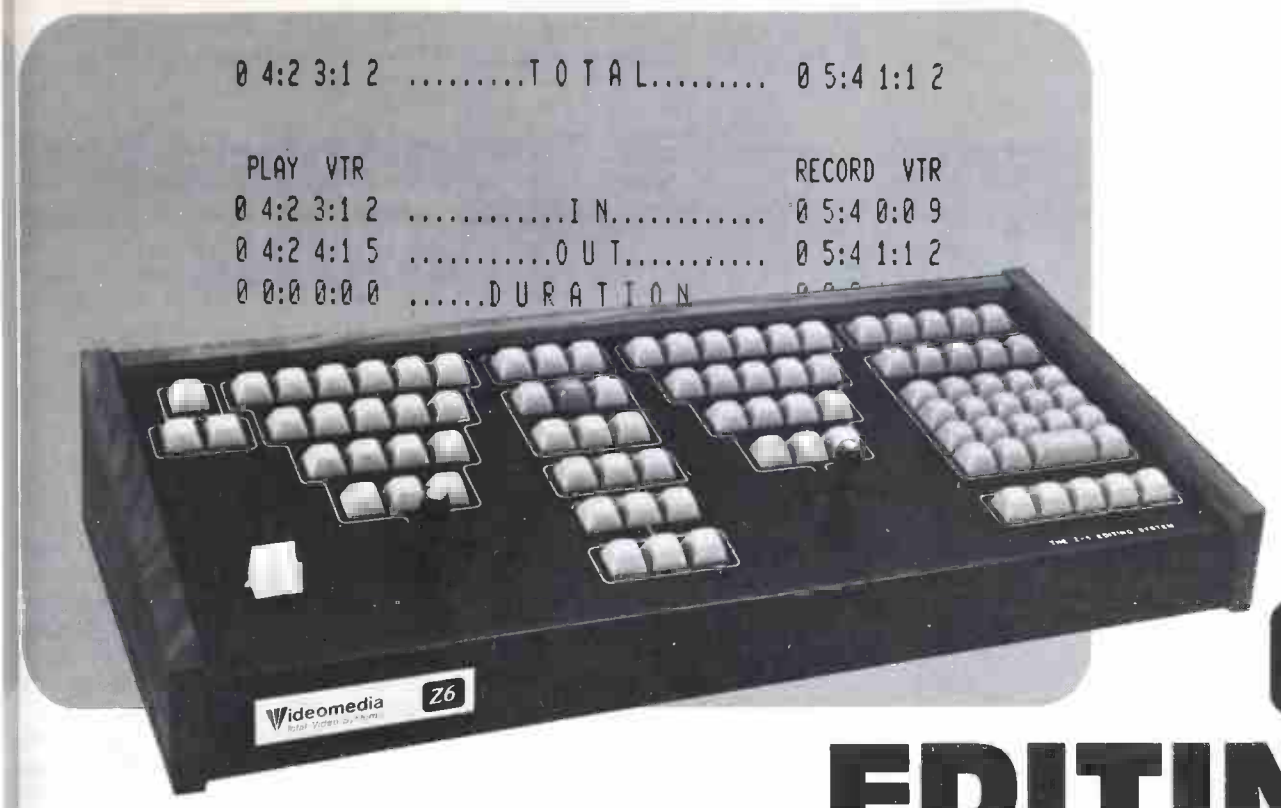
### Credits for Saticon developments

The present Saticon tube is the result of many decades of work on selenium-type photoconductors and vidicon tubes in many locations. The author claims no more than an involvement in and a familiarity with the various developmental efforts over the past years.

The Saticon-tube photoconductor was developed through the efforts of Teruo Ninomiya, Naohiro Goto and Keichi Shidara of NHK Laboratories, and Eiichi Maruyama and Tadaaki Hirai of Hitachi Central Research Laboratory. Photoconductor process development was the work of Tsutomu Fujita and Yasuhiro Nonaka of Hitachi Electron Tube Division. The precision gun design was the work of Hideyuki Sakai of Hitachi Electron Tube Division and Kyohei Fuduka of Hitachi Consumer Products Research Center.

The original selenium photoconductor and the basic vidicon tube were developed by Albert Rose, Paul Weimer, A. Danforth Cope, Stanley Forgue and Robert Goodrich at RCA's David Sarnoff Research Laboratory in Princton, NJ. The stabilization of the selenium vidicon photoconductor by the addition of arsenic and the enhancement of red response by doping with tellurium as well as the concept of stabilization by chemical designing of the substrate and effecting mechanical refinements, are the achievements of Joseph Dresner and Frank Shallcross of the same laboratory.

# CREATIVE FREEDOM

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# Case study:

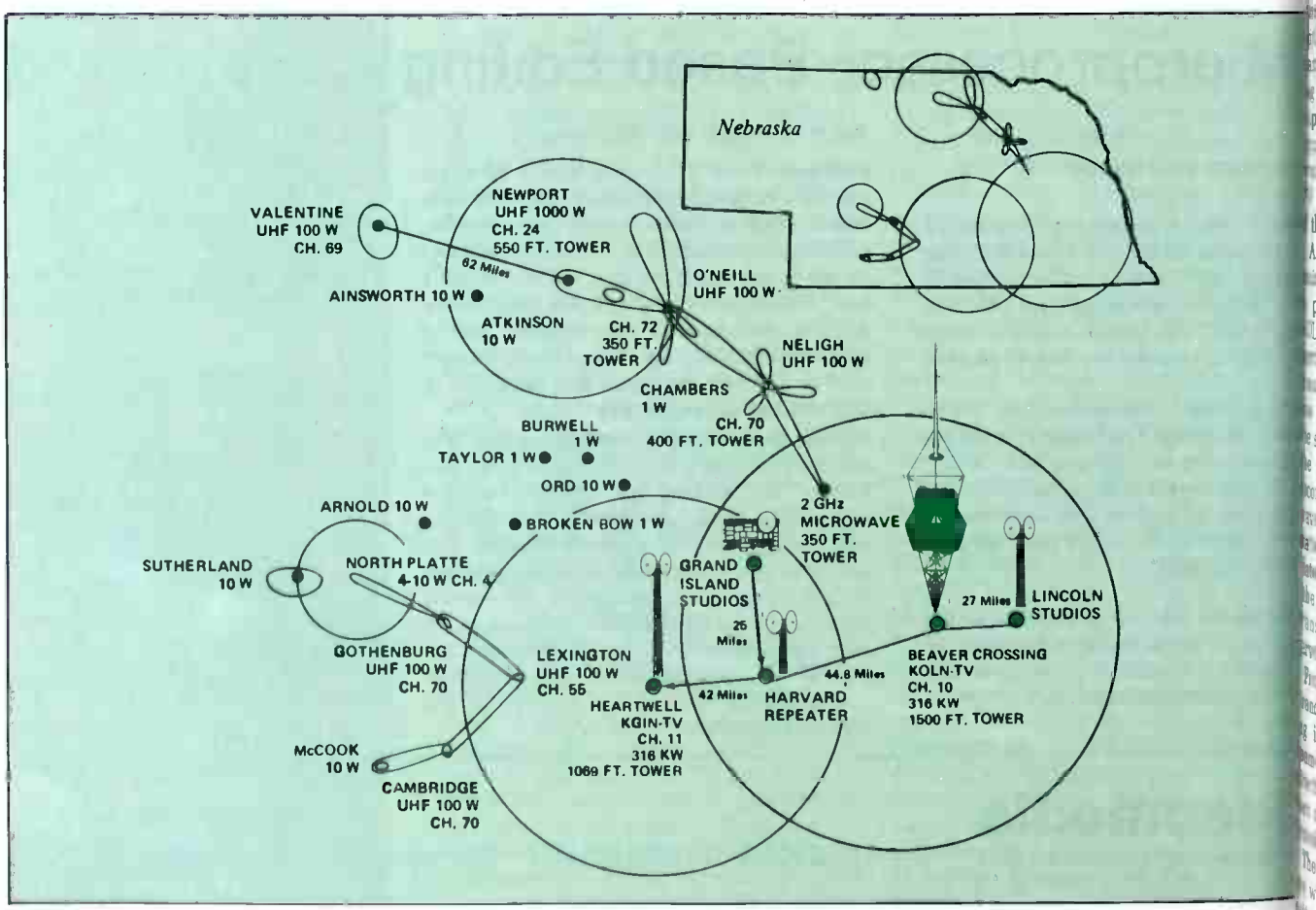
# Microwave radio consolidates TV broadcast complex

**By Ray Taylor,** consulting engineer.

Motorists traveling on Interstate 80 just west of Lincoln, NE, often are puzzled by a strange space-station-shaped structure in the distance. No, motorists are not witnessing a scene from a recent space movie. What they actually see is a microwave radio repeater station located at the 1250-ft level of a 1500-ft-high guyed television broadcast tower. Due to its distance from the highway, the tower portion of the structure often fades from view, then returns, adding realism to what appears to be a hovering space vehicle.

The unusual tower complex serves as the hub of Cornhusker Television Corporation's intercity television relay and studio-transmitter-link (STL) microwave radio network. One of the pioneers in the use of point-to-point radio for television relay, Cornhusker Television recently placed its third generation of microwave equipment into operation. With the retirement of the last hop of tube-type radio, the company reflected back on a 23-year experience with microwave relay that began in 1954 with the dedication of a single-hop STL system between the KOLN-TV (Channel 10) studios in Lincoln and the broadcast transmitter at Beaver Crossing.

Since that time, what started as a local station became regional with the addition of satellite station KGIN-TV (Channel 11) in Grand Island. In addition to the two transmitters, KOLN-TV/KGIN-TV's coverage area is extended through



e use of seven company-owned d 12 community-owned translator ations. Today, these CBS-TV affil- es serve an area covering over ,000 square miles, and currently ast one of the largest audience ares in the nation.

### Microwave network

Tying the widely separate com- ex into a single broadcast facility the function of Cornhusker's phisticated microwave radio net- ork. Operating in the 2-GHz and GHz domestic TV frequency allo- tions, the system relays local and BS-TV network programming from OLN-TV studios in Lincoln to the OLN-TV and KGIN-TV transmit- rs. KGIN-TV is a satellite of OLN-TV and the stations carry entical programming. The network so carries local programming and weather-radar picture from Grand land to Lincoln.

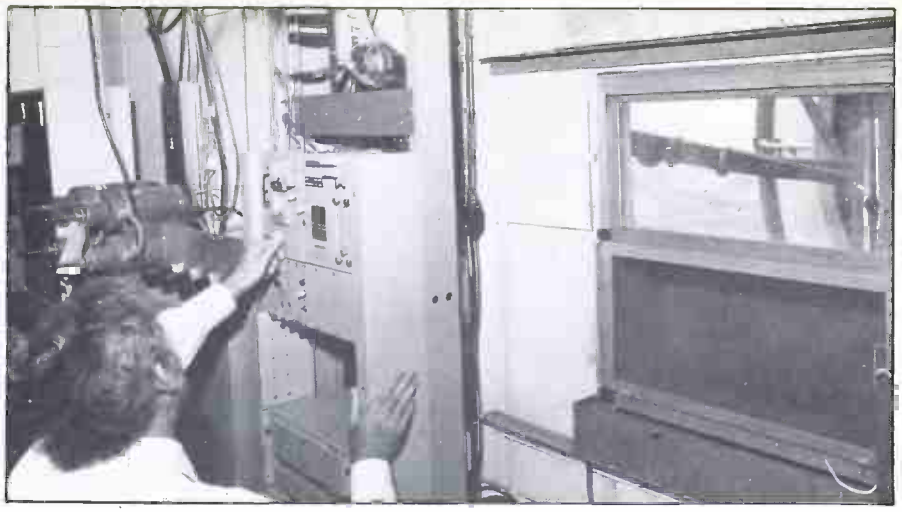
The microwave radio used roughout the STL/relay network is GTE Lenkurt. The seven trans- itters and receivers are a combi- ntion of all solid-state 78 radio and der klyston 76 radio systems. This dio is well-suited for television ansmission and has proven to be xceptionally reliable and trouble- ee during 12 years of constant peration by KOLN-TV/KGIN-TV.

Both the 78- and 76-type transmit- rs and receivers are equipped th advanced self-test and mainte- nance features with built-in meter- g facilities. GTE Lenkurt also pplied a variety of accessory uipment, including the FM pro- am channel equipment used for V audio above the video baseband the microwave radio system.

All engineering, installation and aintenance of the radio equipment performed by members of the OLN-TV/KGIN-TV engineering de- rtment. As shown in Figure 1, ansmitter feed is beamed 27 miles e west to Beaver Crossing. Here e signal is split: One output drives e KOLN-TV transmitter. The cond output is relayed via micro- ave radio to the Harvard repeater ation 45 miles away. The remod- ated signal is then beamed an- her 42 miles to the KGIN-TV ansmitter at Heartwell, which rves Grand Island.

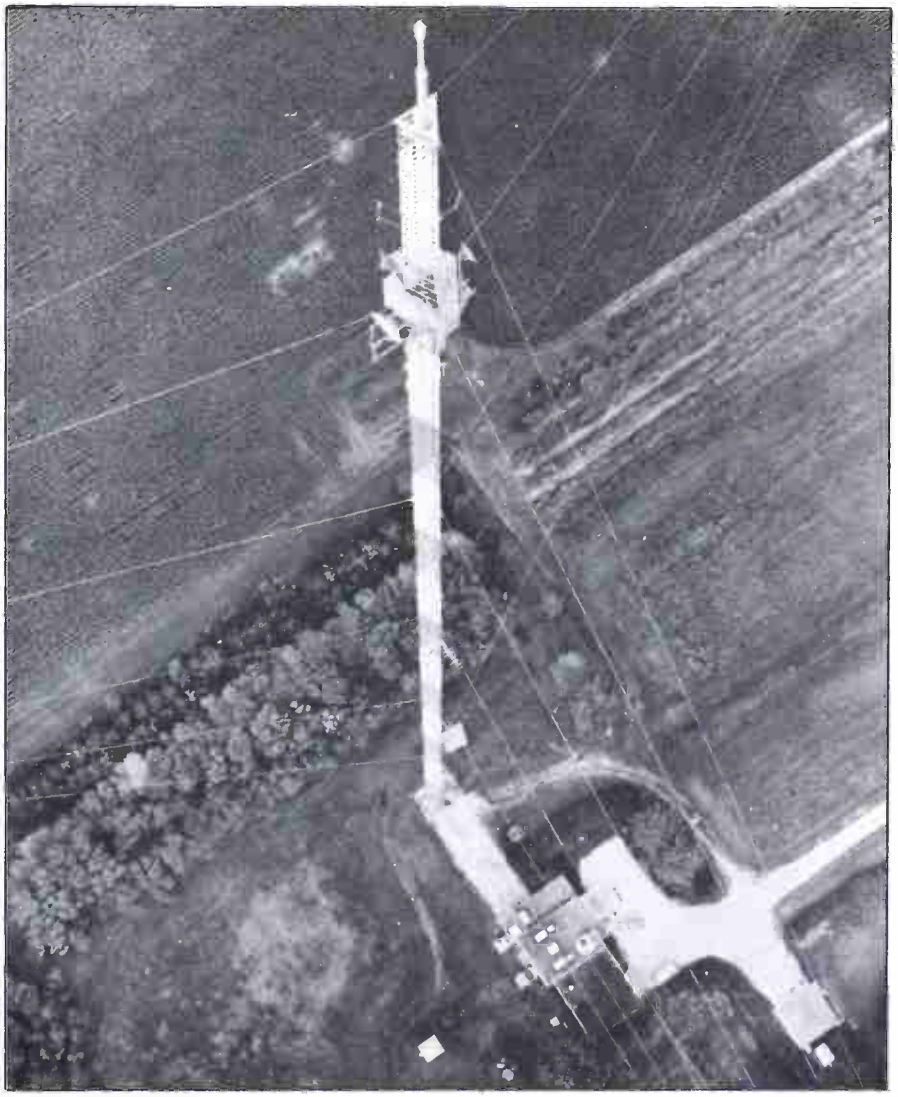
From atop the Yancey Hotel in rand Island, programming originat- g in the KGIN-TV studios is eamed 25 miles in a southeasterly rection to Harvard. The signal is en relayed to Lincoln via Beaver rossing.

The merits of microwave systems e well known to television broad- sters. Maintenance costs are low,



**As seen** through the equipment room window, waveguide runs from the tower-mounted multiplex are extremely short. Not only does this significantly reduce loss characteristics, but it eliminates the high cost associated with long waveguide runs and associated pressurization equipment.

**Reported** as being the most unusual microwave radio repeater site now operating within the US, the microwave radio that relays program feed to the KGIN-TV broadcast transmitter and from the Grand Island studios to the Lincoln studios is located in an equipment room at the 1250-ft level of the 1500-ft high KOLN-TV broadcast tower. In addition to housing Cornhusker's microwave repeater equipment, space within the equipment room is leased to various government and private concerns for mobile radio base stations.



KOLN-TV engineer Lyle O. Kaufman exercises one of the many test and metering facilities of the station's new radio link. The GTE Lenkurt 78B3 transmitter shown here features built-in test facilities to perform such checks as deviation, power, output power, FM oscillator current, AGC level, crystal current and AFC without interrupting service.

## Microwave radio

and operating systems have proven extremely reliable. Expenditure for microwave gear is rapidly recovered due to elimination of common carrier charges. Microwave networks often provide service where telephone companies would encounter difficulty, as in the case of a short notice connection, or in remote or inaccessible locations.

But the success of microwave radio for TV relays is reliability, and in this respect, the Cornhusker system excels. Through the use of a combination of frequency diversity protection, off-the-air pickups and an emergency antenna system, the reliability of the overall relaying network is more akin to a heavy-route long-haul backbone system than STL.

The signal emitted from Grand Island consists of local news, community interest features and a weather-radar picture furnished by a nearby government weather station. Since there is program backup at the KOLN-TV studio, the Grand

sland/Lincoln link is unprotected.

**Signal protection**

On the other hand, the STL portion of the network is arranged for frequency diversity protection over the KOLN-TV-to-transmitter hop. By transmitting the same information at different frequencies, complete end-to-end standby protection is provided should the primary transmitter or receiver fail.

Even the antenna system over the Lincoln/Beaver Crossing hop is protected against catastrophic failure. Under normal conditions, the microwave signals are beamed over the hop by a 10'x12' reflector mounted at the 250-ft level of the 400-ft emergency transmitter tower located behind the Lincoln studios. At the other end of the path a 10'x15' reflector is located at the 250-ft level of the Beaver Crossing tower. Should either of these reflectors receive weather damage sufficient to affect transmission, a 20-ft folding tower on the roof of the Lincoln

**What started** in 1954 as a single-hop STL system between the KOLN-TV studios in Lincoln and the broadcast transmitter at Beaver Crossing has become regional in scope with the addition of satellite station KGIN-TV. KOLN-TV/KGIN-TV's coverage area is further extended through the use of 19 translator stations. Here GTE Lenkurt sales engineer Larry Harkness (left) and KOLN-TV/KGIN-TV chief engineer Ray Taylor (center) examine the GTE Lenkurt radio equipment, while engineer Lyle Kaufman performs a routine equipment check.

**Inside** the Beaver Crossing site, transmitter engineer Richard Lorenzen monitors the sophisticated microwave radio/broadcast facilities that provide CBS-TV to 78,000 sq miles of Nebraska and northern Kansas. GTE Lenkurt microwave radio systems operating in the 2-GHz and 7-GHz domestic TV frequency allocations are used throughout the extensive STL/relay network.

studios can be erected in a matter of minutes.

The folding tower is equipped with a 6-ft parabolic antenna which is aligned to a 6-ft parabolic antenna mounted at the 1250-ft level of the Beaver Crossing tower. A special waveguide switch terminates the received signal from KGIN-TV studios and applies KOLN-TV studio programming signal to the microwave receiver in the tower-mounted equipment hut.

Protection for the KGIN-TV transmitter feed is in the form of an off-the-air pickup at the KGIN-TV tower using a highly directional shielded antenna that is orientated toward the KOLN-TV broadcast tower.

### Repeater site

An unusual microwave radio repeater site, the KOLN-TV transmitter and receiver looking west to the unmanned Harvard repeater station is located in the equipment room that, to the passersby on the interstate, seems to be floating in mid-air. Installed in 1966, the tower-mounted repeater installation has proven extremely beneficial. Waveguide runs, for example, are only six feet long. Not only does this significantly reduce loss characteristics, but it eliminates waveguide and pressurization equipment costs, which tend to make the direct radiating antenna uneconomical for use by broadcasters in tall tower applications.

Another advantage of locating the radio equipment at this height is that it permitted Cornhusker to engineer the 45-mile-long Beaver Crossing/Harvard hop in accordance with high-low path profile rules, and thus offset the effects of Nebraska's open terrain and rolling hills, which tend to act as signal-disturbing elements.

Basically, the high-low technique involves the placement of one antenna at a very high point and the other at a very low point. Providing the difference in elevation and path length is sufficient, the center of focus of reflection (reflection point)

s moved close to the low antenna, which then receives only the direct and first Fresnel zone reflected energy. Second and higher order Fresnel zone energy that might otherwise reach the low antenna is blocked by the curvature of the earth.

But purchasing a tower capable of supporting a microwave repeater just to obtain these transmission characteristics in itself seldom could be cost justified. Cornhusker Television, in order to increase the broadcast coverage area of the KOLN-TV transmitter, decided to replace the existing 1000-ft-high Beaver Crossing tower with a taller structure.

**Replacement tower**

Luckily, the replacement selected was a 1500-ft-high Dresser Ideco Company tower, with 2-man elevator, which had been originally designed and fabricated for another company, but never delivered. The design featured a platform at the 1250-ft level upon which were to be mounted 36 2-way mobile base stations and antennas. It was a simple matter to have the platform enclosed to form a 3-sided room around the outside of the tower, with an elevator going through the center. In addition to housing Cornhusker's microwave repeater equipment, space in the equipment room is leased to various governmental agencies and private concerns for mobile radio base stations.

Over the years, the mammoth tower has withstood many cruel Nebraska winters, but not without some hair-raising incidents. None, however, was more terrifying than a 1970 storm in which a combination of ice build-up and high-velocity, gusting winds caused the tower guy wires to oscillate like a school girl's jump rope. The result was a rippling effect, or standing wave motion, that ran up and down the length of the tower.

Faced with an imminent tower collapse, KOLN-TV, with local assistance, attached ropes to the guy wires at about 100 feet up the guy anchors. Tractors attached to the lines reduced both the severity and frequency of the oscillation.

Growth and modernization has been the predominate theme of the Cornhusker Television Corporation in the days since February 18, 1953, when KOLN-TV became Lincoln's first television station. A story of constant growth, Cornhusker is part of the Fetzer Group that also operates television and radio stations in Michigan and Iowa.

In keeping with its ongoing growth plan for station KOLN-TV and KGIN-TV, the company is presently assisting communities throughout northern and western Nebraska to establish community translator stations. But the accomplishments and success of KOLN-TV/KGIN-TV is due in great part to the foresight and ingenuity of Cornhusker's engineering staff in adapting line-of-sight radio to fill a variety of its television relaying requirements. □

# KPOW Radio: Remodeling for the future

By Doc DeVore, KPOW operations manager


**The KPOW studios,** transmitter and offices are all housed in this building. The front of the building was part of the complete remodeling of the radio station.

Every radio announcer should experience working from an on-air studio that, in essence, is part of the hallway. That is what it used to be like from the KPOW control room, because the only way to go from the front of the building to the engineering and storage areas in the rear of the building was through the control room. A DJ never knew from moment to moment just who would be passing by, stopping for a chat long enough to let him miss three dozen cues allowing albums to track from cut to cut.

"It didn't really enhance efforts at professionalism," said Doc DeVore, KPOW operations manager, who has been with the station for 10 years. Bill Mack, station manager, added that the studio location was only part of the problem. "Our staff had grown since the original building was expanded in 1962, and our front office practically had people sitting on each other." DeVore shared an office with the sales manager, Art Brooks, two people from the news department, and one other DJ. This office was also a heavy traffic area.

"We had done a lot of talking about remodeling," Mack said, "but it wasn't until early 1977 that we thought we could afford a project of the size we had dreamed about." At that time, Carol Mack, his wife, drew plans for adding to and remodeling the KPOW building. She is a professional artist and was then the station's bookkeeper. When her plans were complete, Mack, DeVore and Brooks, the three stockholders for Broadcast Enterprises, along with Ms. Mack sat down to make changes. The plans were left in Mack's office, and over several weeks all of the staff members fed in their own ideas about how to arrange the building.

### Engineering advice

Finally, in March, 1977, everyone was satisfied. But they knew it would take more than that to design a functional station, so they contacted the firm of Larry Ellis, PE. Ellis served as KPOW's consulting engineer, "and we wanted to make sure the engineering was right," Mack said. Joel C. Humke had just been retained by Ellis as an all-around troubleshooter with expertise in studio design and installation.

Humke flew to Powell to meet with the staff. Careful consideration was given not only to the new building, but the new equipment that would be needed to furnish it. Also contemplated was the assignment and use of existing equipment. Humke said, "Never before had I seen such a close working relationship between management and staff, where management had the foresight to actively encourage the input of new ideas from the station staff."

The building was designed with room for future expansion. The transmitter room was enlarged substantially, complete with wiring trenches installed in the poured concrete floors.

Office space in the new addition was planned with the option of using it for studios at a future date.

ectrical outlets were designed for sy access, and 2-inch copper rap was run down the walls for ture grounding. The strap lies dden beneath the thick carpeting d behind the paneling in the new fices.

### RF shielding

All of the new studio space and ny of the offices were completely shielded except for small window eas between studios. Plain chick- wire completely covered all wall, iling, and floor surfaces before e wall paneling, suspended ceil- gs, and carpeting were installed. e chicken wire was bonded gether with solder at 2- to 3-ft ervals to make each studio effec- rely an RF shielded chamber. spite unshielded openings and ndows, this technique reduces RF ld intensity within the studios by factor of 10. This is especially portant at composite sites such as OW where RF field intensities e high, and even more important ound FM transmitters.

KPOW measured in excess of 10 m field intensity in unshielded rtions of the building with a tomac Instruments FIM-41. In ielded and studio areas an aver- e of about 500 mV/m was meas- ed and never exceeded a field ensity of 1 V/m.

Needless to say, the reduction in ise in the equipment with this e of shielding was substantial. hen the studios were completed, of the switches on the audio nsole in the master control room re turned to the program posi- n, the master gain and all faders re turned wide open, and with 5000 W KPOW transmitter on air only 20 ft away, the needle the VU meter never lifted off the t peg. This kind of impressive ise rejection was possible only th the substantial copper strap unding and RF shielding as em- yed at KPOW.

The original idea for using chick- wire as a substitute for copper sh as an economical RF shield me from Rey Lark, owner of KCE Radio in Amery, WI. Lark merly spent many years on the gineering staff of KDWB in Min- apolis/St. Paul.

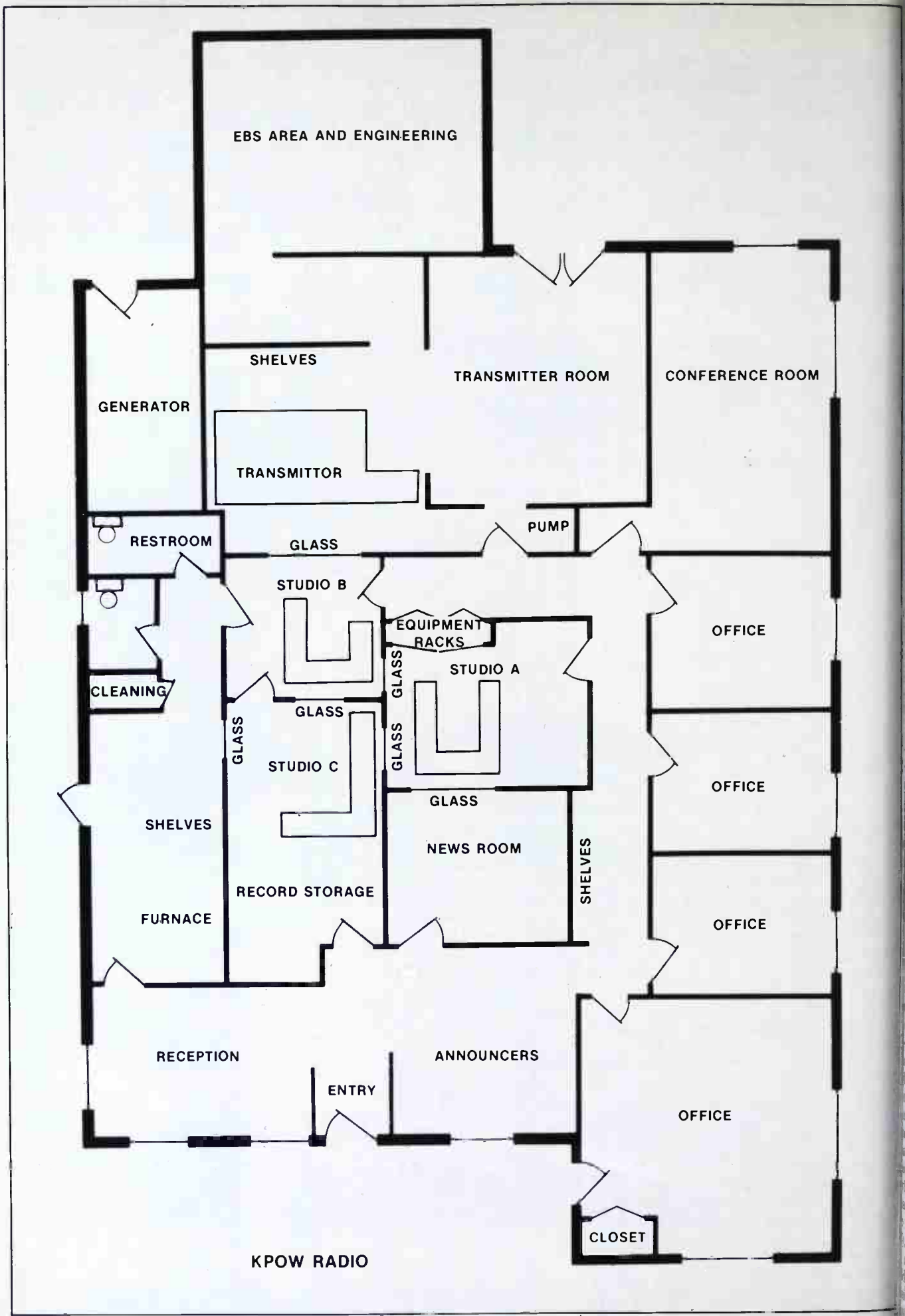
### Studio construction

The studios were constructed by berts Construction Company, who o built the studio cabinetry. The binetry was finished in fine wood- in formica, and Switchcraft il- minated switches were inlaid into wood for remote control of tape

**Studio B's** layout is similar to the control room (visible through the window). Three hinged covers provide access to the patch panel next to the recorder while keeping dirt and debris out when not in use.

**The control room** turntables are protected by a hinged cover when they're not in use. (Most music at KPOW is on tape.) The turntables are mounted on their own sand-filled pedestals, which are isolated from other cabinetry to eliminate vibration and accidental bumps.

**The production boards** in both Studio A and B slide away from the wall for servicing from behind. The curtain on the window behind can be drawn back for visual cues to Studio C.



achines and turntables. The cabi-
etry was designed so that an
nnouncer can either stand up or
t on a stool, thus allowing some
ariety to break up the strain of
ways sitting.

Acoustic feedback within the
udio was suppressed in two ways.
wo of the walls in each studio
ere covered with carpet. The
rntables were mounted in sand-
oxes which were contained inside
e cabinetry. The sandboxes were
t directly on the floor and did not
ntact the cabinetry at any point.
ch sandbox was filled with 200 to
0 lbs of sand, and according to
ewton, 300 lbs of sand at rest
nds to remain at rest.

There were two methods of moni-
r speaker mounting to consider.
ne was to mount the speakers in
nd filled floor pedestals. The
cond was to mount the speakers
n wall supports and set each
peaker in two inches of foam
bber. This was to prevent trans-
r of speaker vibration to the walls
nd other studios. The wall mount-
g was selected by KPOW as the
st for their installation.

The installation was initially sup-
vised by DeVore and Justin Kil-
ess, chief engineer for the station
nce 1945. "Doc even learned how
wire a studio," Humke com-
ented. "In December of 1977, I
ove to Powell for initial installa-
on of the main control room and
e new newsroom," he added.
ngineer Kilness added his experi-
ce, and in the wee hours of that
ek in December a new station
gan to emerge.

The station went from a very
owded 2-studio operation (one
ntrol room and one overworked
oduction room) to a modern
studio system. New office space
s added to the overall efficiency
KPOW. "We used to have a real
ttleneck in our production with
st the one studio," DeVore com-
ented, "but now that the old
ntrol room has been completely
done as a production studio, and
ith the news department now
aving its own studio, all in addition
the old production room (Studio
, we no longer line up to wait for
studio." DeVore pointed out the
d production room initially re-
eived just a facelift, but now that
ressure has been taken off, "our

## Remodeling KPOW

engineering assistant, Dave Rose, has been able to rewire Studio C, and has turned it into a more useful studio."

Studio B was the old control room, and still uses the old control console, cart decks, and turntables from the old room, "but that's where the similarity stops. Furniture, walls, wiring and quality of sound is all brand new...and excellent," DeVore said.

"We are very pleased with the final product," Mack said.

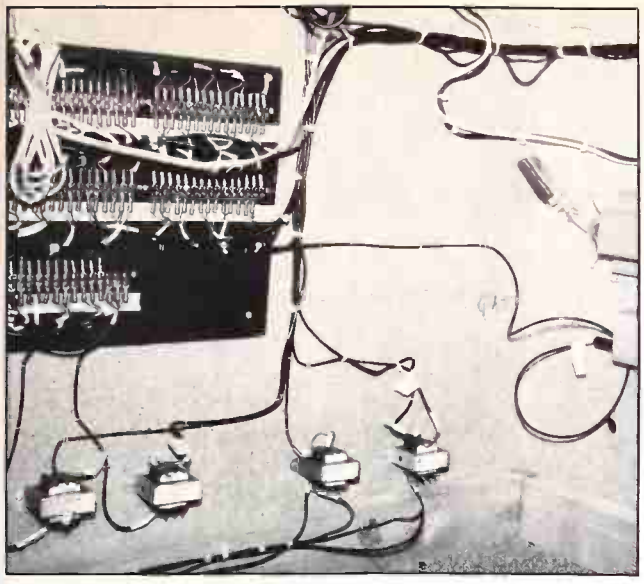
"Our on-air sound is much brighter and cleaner. Production sounds better, and is uniform in quality from studio to studio, thanks to the new wiring." DeVore added. "Also important is the use of similar equipment in the studios. ReVox A-77 decks in all studios, Shure SM-7 microphones in production and on the air, and Harris broadcast consoles throughout."

Flexibility is essential to any good operation, so KPOW installed patch panels in every studio (two in the control room). Two Nemo circuits are common to all four studios, allowing any studio to be tied with any other studio, or to be patched directly onto the air. "When a power supply failed early in 1978, that proved to be invaluable," Mack said.

### Preparing for AM stereo

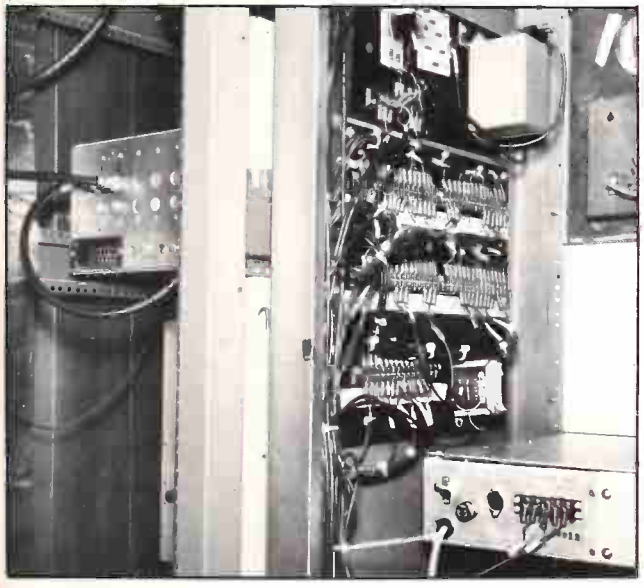
Thought was also given to the future. Not only were the new offices RF-shielded, and the transmitter room enlarged to make room for a new transmitter, but consideration was given to AM stereo. "We're ready to go as soon as the FCC makes up its mind," Mack said. According to Mack, the control room is a stereo studio, with left and right channels combined after the patch panel before going into the audio processor and transmitter. In fact, working an air shift is a lot more enjoyable for the DJs because it's all in stereo, until it goes on the air.

KPOW's management pointed out that they are not done yet. Since the installation of the studios, the station has added a Dorrough audio processor, a Belar AMM-3 modulation monitor, an ITC Triple-deck (stereo) for the control room, and has plans for more. Still to be added



**This** is the layout of cables inside the cabinetry of Studio B. The terminal board goes to patch panel in "B" and makes for easy wiring changes. The same layout was used in the other new studios.

**Tape decks,** antenna monitor, EBS monitor, extended meter panel and other audio processing equipment in the main studio are behind two double-fold doors. Access also is available from behind and outside of the studio.



**This view** into the main studio equipment racks reveals the ease of access to the terminal board and other equipment from the hallway outside the studio.

**Steve Butler** (right) broadcast local news from the newly constructed News Office/Studio as announcer Craig Willcox looks on from KPOW's main studio.

## emodeling KPOW

a new transmitter and a stereo onsole for Studio C (for stereo roduction and dubbing). The sta- on also will be adding some audio rocessing equipment for Studio B, uch as an equalizer. Mack said, We'll never really be done, but ost of the big items are out of the ay. In my 19 years here, it has ever sounded or looked better."

The station constantly receives compliments from those who see the "new KPOW" for the first time. Radio people from outside the market are amazed that such a facility exists in Wyoming. Steve Lindberg, vice president of Intermountain Network, commented when he visited the station this summer that it "Looks better and better equipped than most major market operations." After completing the last audio proof, Karl Huffman, the engineer who has done the proofs for several years, said it was "unbelievable."

It's a facility to be proud of. The work setting is pleasant, the staff is more relaxed today than ever, and the sound is exceptional. Mack said that none of it would have been possible without everyone's collaborative effort. □

# station-to-station

## Step generator for TDR measurements

By Linn Boyd WRTV, Indianapolis, IN

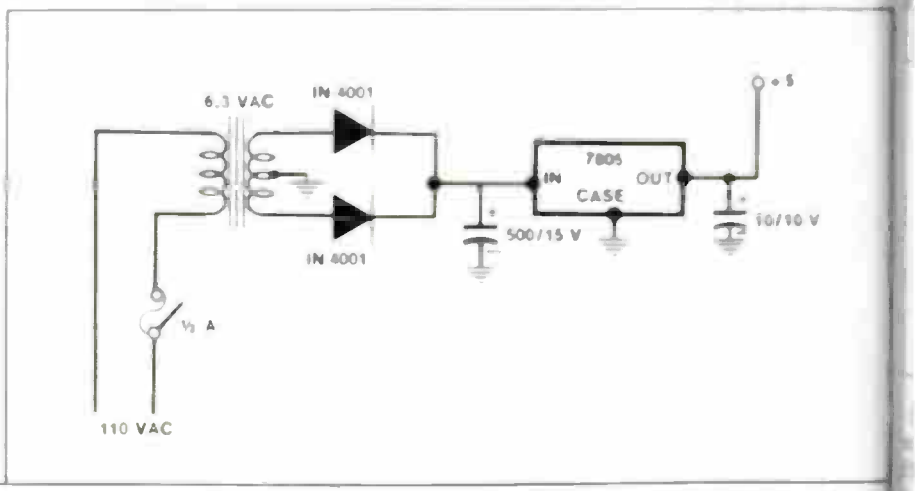
A few years ago while making routine transmission line resistance measurements we experienced an abnormally high reading on the west line. There was a loose joint in the system. On cold, windy nights the reading varied as high as 4 Ω. Commercial TDR units were borrowed, but due to the high concentration of RF in the areas, the problem was masked by noise and a satisfactory echo could not be obtained.

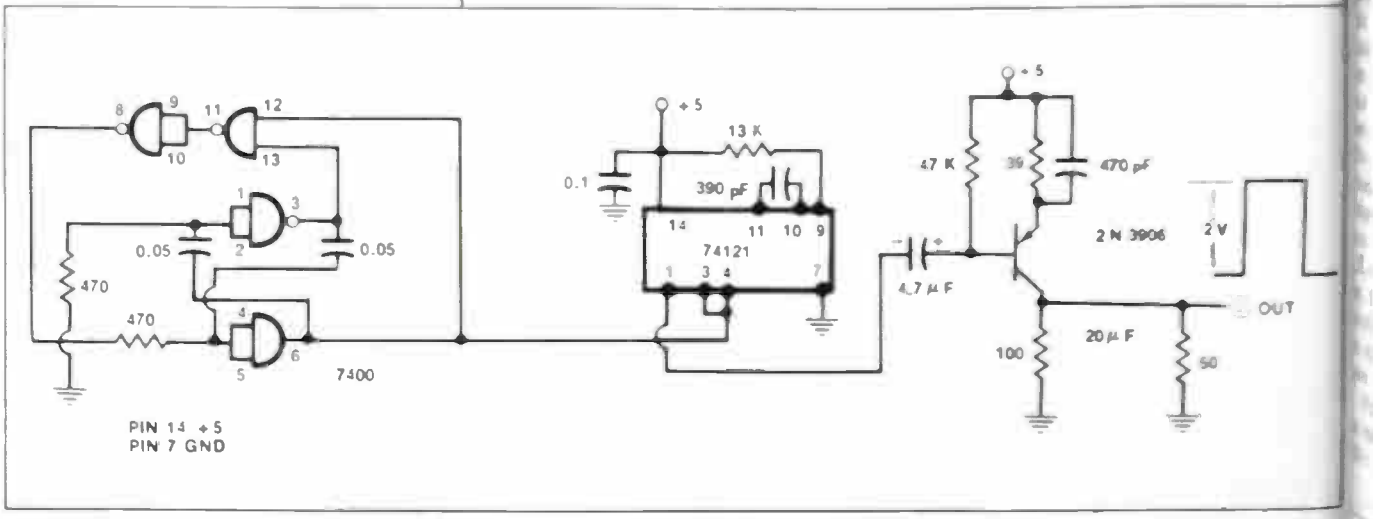
From this perplexing problem, our step generator evolved. Although the definition may suffer due to the comparatively slow rise time of the square wave and the sensitivity of the scope used, it did give us a picture of the problem—a loose joint in the matching transformer at the antenna. After replacing the transformer, the line readings returned to normal. The old transformer exhibited a large blackened area around the joint due to heating.

The device was used successfully during winter to locate an open in the line for a FM station which had its antenna on our tower. With a few inches of ice on the tower and the temperature at -10, it was imperative the location of the open be known as accurately as possible. The step pattern on the scope did indicate an open 800 ft from the point of signal injection. Due to rough calculations of the line length from this point to the tower we were off about a half line section. However, only two breaks by the tower crew were necessary before the affected section was found.

This is a go, no-go device which will indicate discontinuities of an ohm or so, as well as an open or short in the transmission line. The 7400 is used as a free-running square wave generator at approximately 13 kHz. This frequency is fast enough to allow a reasonably bright trace on the scope without masking echoes on a long line run to the antenna.

The 74121 is used to produce a step of approximately 4 μs to enable the entire system from the transmitter to the antenna to be observed. The 2N3906 couples the signal to the line. We use a "T" at the scope, feeding one side with the step signal and the other side connected to the line. For Teflon insulated line the velocity factor is 99% and practically the 0.0020832 μs/ft measurement may be used. If an appreciably long piece of RG-8 or RG-58 is used to couple to the line, a factor of 66% should be figured in for this piece.



## Five dollar remote thermometer

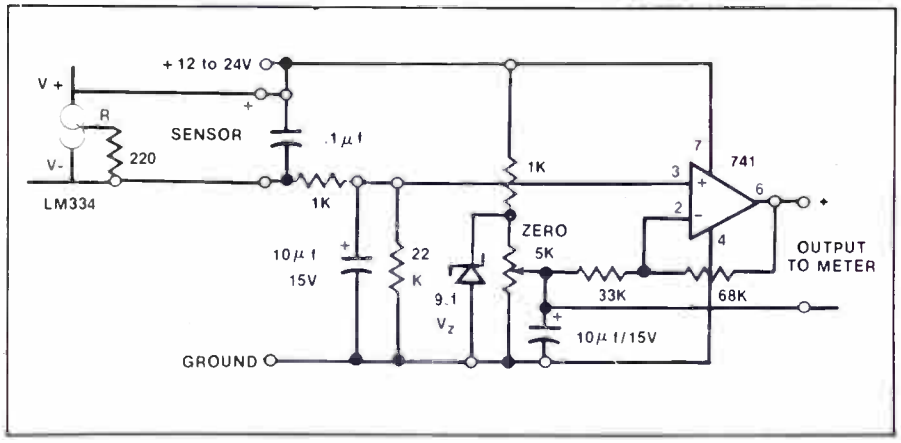
By John D. Strahler, chief engineer, KTMS-AM, FM, Santa Barbara, CA

We needed an inexpensive method f monitoring the outside tempera- ıre at our mountain top transmitter te. So, the output of the circuit nown increases linearly 3.74 V for 100 F temperature change, perfect interface to remote metering, or a cal meter by adding a milliampme- r and calibration pot.

Current source LM 334 ($2 Radio nack #276-1734) output increases 1 A/K. The circuit converts this to a ltage change across the 22 k Ω sistor, which is amplified by the 1 to 37.4 mV/F. The potentiometer nd zener regulator are used to set F, since the sensor output is zero nly at zero absolute (-460 F), which a little colder than our winter.

The amplifier is sensitive to RF terference and should be mounted a metal box with the bypass apacitors shown. We built ours ith a wire wrap socket for the 741 nd feedback resistors and the her components mounted directly to the feed-through barrier strip and pot. The LM 334 and 220 Ω resistor were soldered directly to the remote wires in a heatshrink sleeve. The ends were sealed with silicone seal. Power was taken from the remote control.

Since an output of 1.55 V would be 58 degrees, the remote meter can be set to read 58 F with a new flashlight battery connected to the metering input terminals. The circuit is then connected and its zero control adjusted until the remote meter reads the actual outside temperature.




## Tips on turntable felts

By Gerry Gibbs, chief engineer, KMNS/KSEZ FM, Sioux City, IA

If you replace your own turntable lts, you may have found it rather fficult to remove completely the ld wornout felts. It becomes a uick 5-minute job when you pour n ample amount of Isopropyl alco- ol on top of the old felt and let it t for about a minute to soak into ne glue. Next, take a razor or knife lade and start lifting the outer dge, up and away. As you proceed, ou will find the remainder will peel ff, usually in one piece. Then clean p the residue with a cloth and lcohol as needed and you're ready spread the glue and put on the ew felt.

When putting on the glue, I find it easiest to start the turntable at 3⅓ rpm and hold a bottle of glue at the center. Spiral a bead of glue out to the outer edge with about ¼-inch spacing for a smooth even application. After putting on the new felt and pressing it into place, clean up any glue which may have oozed out of the inner or outer edges.

If you don't buy the pre-cut felts (I buy a large piece of felt at a local fabric store and cut out what I need) it is very easy to achieve nice even edges on the inner and outer rim of the platter. Cut the felt in an oversized circle, or even a square with a small hole in the center to fit the 45 rpm hub at first. Then apply the glue as previously described. Stop the turntable and place your felt on it, smoothing it from inside to out for a good flat adhesion. Start the turntable again, this time at 45 rpm or preferably 78 rpm if you still have it. Take a new sharp razor blade and hold it about ½ to ¼ of an inch in from the outer edge of the rim. Slowly bring it down on the felt allowing the blade to gradually cut the felt to the metal turntable surface.

Apply gradual pressure with a steady hand, holding the blade in the same position and quickly cut away the excess in a near perfect circle. Repeat the process for the inner circle and lift out the hole piece. Again, wipe away any excess glue from the rim area. The end result is a nicely trimmed, professional-looking new turntable platter that should keep you going for several more months. □

## Letters

**From Malaysia**

We find your journal a valuable source of information, and we are anxious to receive it regularly. *Asia-Pacific Broadcasting Union, Angkasapuri-Malaysia*

**From down under**

Dibie's article on lighting techniques for *Barney Miller* (**BE**, July 1978) appears to be old hat for someone brought up in the BBC style of lighting such as used for productions as *Wings* (BBC) and *Edward VII* (ITV). Also, we have been using the single camera video production techniques here for years. I welcome Dibie's launching into US TV and hope that it can draw the lighting standards up to the English BBC standards. *Chris McKenzie, Auckland, New Zealand*

**From Florida**

Your magazine has been a most valuable source of information in our planning, operations and in our equipment selection. Keep up the excellent work. *WLOV-TV, Orlando, FL*

**From New York**

Recently, I was glancing through some old copies of **BE** and found a couple of articles which I had not read. The first article was from June 1974 and titled *Workshop in Simplifying Digital Math, Part 1.* The second article was part 3 of the same article, from the November 1974 issue.

How many issues did this series cover and how can I obtain the complete series of this article? *Sol Goldstein ABC TV, New York*

**Editor's note:** The following is the list of BE issues that included parts of the workshop article: Part 1 in June, 1974; Part 2 in July, 1974; Part 3 in November, 1974; Part 4 in December, 1974; Part 5 (conclusion) in February, 1975.

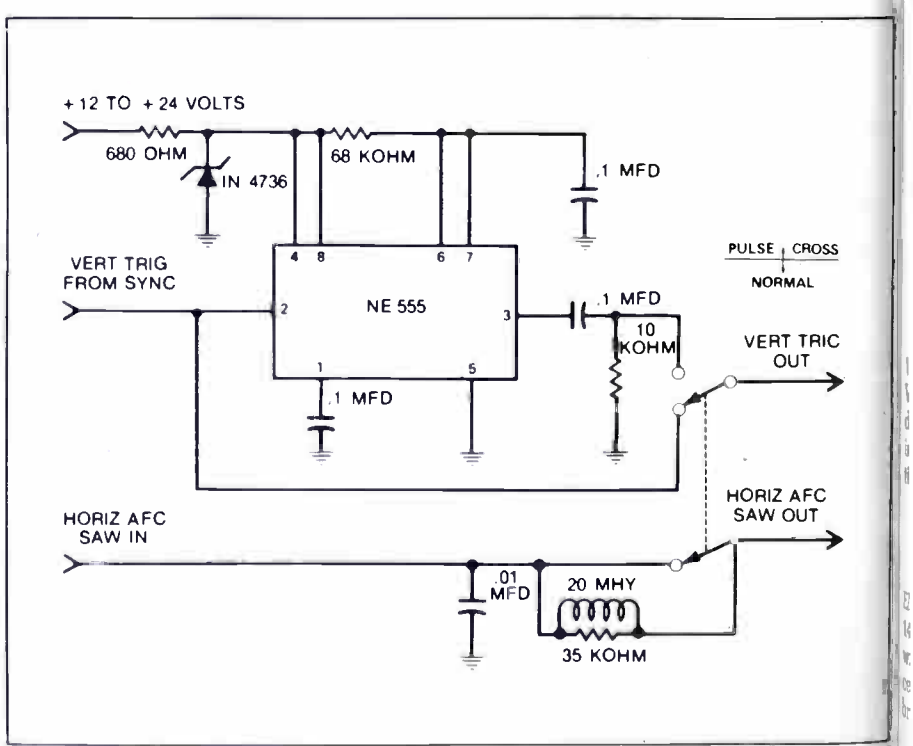
## Description of the dropout indicator in a playback videotape

By J. Mitch Hopper, Springfield, IL

The following is a simple circuit for giving a visual signal to the VTR operator of a dropout replacement in a playback videotape. It can be used to generate a rough videotape evaluation.

This circuit was designed specifically for the DOC in the RCA TR series quad videotape recorders but can be easily adapted to most VTRs. A dropout pulse is picked up by the emitter follower to provide a high input isolation and inverted into a negative-going pulse. This pulse triggers the NE-555 operating as a MSMV. The output pulse is held on for a period of time (.1 s) by the 2.2 k Ω and 47 μF combination.

The entire circuit can be constructed on a 7-pin IC socker and mounted internally on the DOC module. By watching the DOC ID LED, one can get an idea of the quality of tape stock that is being played back. For a better tape test, record a couple of minutes of fresh bars and then evaluate it. □



# new literature

### Distribution switching

*TeleMation*—The TVS/TAS-1000 distribution switching literature contains information on the CI-1060 microprocessor/computer control unit used with the distribution switcher to provide salvo switching of multiple crosspoints, real-time clock command switching and custom crosspoint status displays. Also included is information on vertical interval switching, crosstalk, input and crosspoint circuitry, output amplifiers, polling and control sequence, refresh memory and status monitoring.

Circle (100) on Reply Card

### Time code reader

*Datametrics*—Technical literature on the model SP-722 time code reader/generator/character generator includes mechanical as well as electrical specifications, features and dimensional drawings.

Circle (101) on Reply Card

### Camera heads

*O'Connor*—Product specification sheets contain descriptions, specifications and photographs of several models of fluid camera heads offered. Included are model C, for lightweight 16mm cameras; model 30, for cameras weighing 10 to 30 lbs and model 50-D, for cameras weighing 50 lbs.

Circle (102) on Reply Card

### Closed circuit TV

*Cohu*—The 1979 short form catalog contains equipment descriptions, specifications and photographs of the current line of closed circuit television products. Camera control systems as well as support equipment are included.

Circle (103) on Reply Card

### Indicator light

*Varilite*—A product specification sheet describes the Varilite indicator light system which uses a single display that changes color in response to electrical input variations. Specifications, diagrams and applications are included.

Circle (104) on Reply Card

### Resistive pads

*Electric Sound of Minnesota*—"Resistive Pads" is a 14-page publication from the audio reference series with information on adjustable "T" and "H" pads, center-tapped "H" and "O" pads, VU meter pads, bridging pads, lattice splitting pads and others.

Circle (105) on Reply Card

## New literature

### Cable guide

*Belden*—Publication No. ED79-1, is an 8-page booklet which contains information on bonded and laminated flat cable as well as bulk and prestripped flat jumper cable and custom cable assemblies. Specifications and technical data for 26 bonded constructions are included.

Circle (106) on Reply Card

### Spectrum analyzer system

*Tektronix*—The tracking generator/spectrum analyzer system is described in a 12-page brochure. Topics include system description, frequency measurements, measuring passband characteristics, return loss and SWR measurement, miscellaneous uses and errors and procedures.

Circle (107) on Reply Card

### Power supply catalog

*Wall Industries*—A 20-page power supply catalog describes the complete line of over 350 encapsulated ac/dc and dc/dc power sources. Specifications, prices and photographs are included on all items.

Circle (108) on Reply Card

### Digital delay mixer

*Lexicon*—A 4-page brochure describes the model 93 Prime Time digital delay processor mixer. Specifications, features, applications and photographs are included.

Circle (109) on Reply Card

### Primer

*Allied Broadcast Equipment*—A primer has been prepared in response to an FCC ruling which requires most 10 W facilities to increase power to at least 100 W ERP. The publication outlines the different methods by which this increase can be achieved.

Circle (110) on Reply Card

### Antenna bulletin

*Andrew*—A 16-page bulletin features technical and descriptive information on the line of linearly polarized antennas for Domsat applications. A full line of available accessories and options are described as well.

Circle (111) on Reply Card

### Mosfet transistors

*International Rectifier*—Data sheet No. PD-9.301 contains electrical characteristics, maximum ratings and thermal characteristics of the IRF100/101 16 amp high power mosfet transistor. Ten graphs and two schematics illustrate output characteristics, saturation characteristics, transconductance vs. gate-to-source voltage, power vs. temperature derating and switching waveforms.

Circle (112) on Reply Card

# new products

### Broadcast antenna

A dual-mode circularly polarized TV broadcast antenna for VHF channels 2 through 6 is available from *RCA Broadcast Systems*. A single radiator for both horizontally and vertically polarized signals is featured on the top-mounting antenna.

Circle (116) on Reply Card

### Digital decibel meter

With the digital decibel meter from *Bald Mountain Lab* it is possible to resolve either level differences or absolute levels in 600 Ω audio circuits to 1/10 dB.

The basic decibel range is +20 to -20 dB while the multiplier range is +20 to -80 dB. Reference adjustment for dB measurement and fixed reference for dBm measurement are possible with the three place readout sign.

Circle (117) on Reply Card

### Camera

*Thomson-CSF's* model MC-601, Microcam, is a 1-piece configuration featuring a 4½-inch viewfinder and remote control package for EFP

applications. The portable camera system offers high sensitivity and picture quality in a compact unit.

Circle (118) on Reply Card

### Program logger

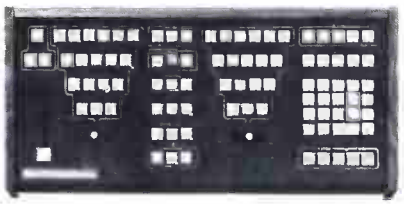
*Broadcast Electronics'* high speed program logger, Intelog, provides a convenient method to encode and edit logging data to be recorded on tape. Encoder electronics make possible electronic tabbing, full message editing capability, 32 line memory, error detection between the message encoded on tape and the message stored in the encoder's memory.

Logging data is encoded at a rate of 30 characters per second with program log printouts featuring the printing of six diagnostic codes and nine descriptions designating abnormal program execution.

Circle (119) on Reply Card

### Editing keyboard

The expanded dedicated keyboard from *CMX Systems* is designed to improve the operation of existing editing systems through a redesigned keyboard and improved software. The keyboard features



direct access to all operational parameters and a separate left side keypad which deals with the decision list and auto assembly functions.

Circle (120) on Reply Card

### Wave transmitter

The *Harris* MW-10, 10 kW medium wave transmitter features pulse duration modulation, 125% positive peak modulation capability at 11,000 W, no modulation transformer or reactor and full performance ratings at 10,000 ft.

The pulse duration modulator (PDM) produces conventional high level plate modulation providing an efficiency of 90% and eliminating large iron core components.

Circle (121) on Reply Card

### Modulator and demodulator

*McMartin Industries* has introduced the SMR-1 IF modulator and the SDR-1 IF demodulator for the satellite and microwave communications markets. The units, intended for narrow band FM services using a maximum 5 kHz audio bandwidth in a 52 MHz - 88 MHz frequency range, are applicable to both audio and data communications.

The modulator is capable of an RF output up to +10 dBm into a 50Ω load with an S/N ratio of 60 dB or greater. The demodulator delivers at least 33 dB S/N for a carrier to noise ratio of 14 dB in a 25 kHz predetection bandwidth.

Circle (122) on Reply Card

### Still frame storage

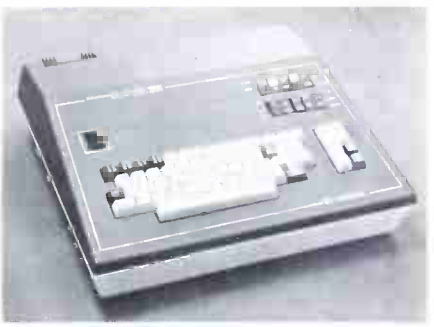
*Adda* has introduced a digital still frame storage and retrieval system designed for small-to-medium sized broadcast market stations. The ESP-100B electronic still processor is a microprocessor-based system which stores up to 200 digital stills on-line on a fixed disc.

Stored data remains unaltered during access and display operations because recall and display of any still frame is non-destructive. The freeze-frame capability allows the graphic artist to create stills from moving feeds; such as 2-inch, 1-inch or ¾-inch videotape recorders; 16mm film chain; live camera; network or satellite feeds.

Circle (123) on Reply Card

### Character generator

The Datavision/3M D-2500 from the Mincom division of *3M* is a television character generator which eliminates the need for add-on options. The unit features a video mixer, 3-speed vertical roll and horizontal crawl, two character sizes, automatic centering, work flash, character edging and an internal random-access memory.



Video gothic, piper roman and helvetica semi-bold type fonts are

# New products

available in both uppercase and lowercase characters. The internal 4-page memory provides random access to 40 lines of titles.

Circle (124) on Reply Card

### Compressor/limiter

The LM-1R compressor limiter from *TA & Track Audio* features low noise and distortion figures. Functions include compression 2:1 to infinity, attack times .2 to 20 msec and release times .1 to 2 sec.

The unit is rack mountable and features a selection switch for the VU meter function. Rear connection is made through a barrier strip.

Circle (125) on Reply Card

### Audio consoles

A line of audio consoles which feature compact packaging and Microtouch electro-mechanical switching to replace lever key switches has been introduced by *Ampro Broadcasting*. Up to 21 inputs in five and eight channel rotary and linear fader configurations with dual mono and dual stereo outputs are available.

The console is designed with a black matte finish panel with anodized markings, stainless steel top, walnut end panels and a padded armrest.

Circle (126) on Reply Card

### Telecine system

An image enhancer/encoder/automatic balance unit is featured in the model 1550B telecine system by the electronics division of *Cohu*. Features include an automatic black and white balance system, an automatic differential gamma balance system and a gamma control remote panel.

Circle (127) on Reply Card

### Surge generators

*Lightning Elimination Associates* has available two surge generator models. Model SG25K provides two autonomously operating sections, a current pulse generator and a high voltage sinewave. Model SG4KJ provides a single current pulse of variable magnitude from 1000 V, energies of up to 4000 J and a variety of waveforms selected by plug in modules.

A transient generator, designated model TG500, is also available and provides a damped sinusoidal wave output at a frequency of about 15 kHz and a peak of about 500 V at the first wave.

Circle (128) on Reply Card

### Wireless microphone system

*Sony* has introduced a portable UHF wireless-microphone tuner and matching wireless microphone and transmitter for ENG and EFP. Frequency response of 100-15,000 Hz, ±0.5 dB, up to 57 dB weighted S/N and less than 0.3% harmonic distortion are available at the tuner output.

A 3-mode meter on the tuner indicates RF input level, audio output level and battery condition. A 600-Ω balanced-line output with standard XLR-3 connector, plus a 2.5mm miniature phone jack for headphone or earphone monitoring is also featured on the tuner.

Circle (129) on Reply Card

### Noise reduction recorder

An 8-channel noise reduction decoder for broadcast playback from *dbx* offers 30 dB of playback noise reduction and 10 dB of headroom improvement.


The system, designated model 148, features transformer inputs and outputs (balanced) for each playback channel and two types of playback only modules; the 408 for tape playback and the 409 for dbx encoded discs playback.

Circle (130) on Reply Card

# professional services



# advertisers' index

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## WANTED

**WISH TO BUY** used RCA-TK44, IVC500, Norelco All Models Cameras in good condition. Call RUBIANO, (809) 724-7575, Box A-OLD SAN JUAN STATION, PUERTO RICO 00902. 4-79-2t

**WANTED:** Pre-1926 radio equipment and tubes. August J. Link, Surcom Associates, 305 Wisconsin Ave., Oceanside, Ca. 92054, (714) 722-6162. 3-76-tf

**HIGHEST PRICES PAID** for 112 Phase Monitors and for clean, 12 year old or less, 1 KW and 10 KW AM Transmitters. All duty and transportation paid. Surplus Equipment Sales, 2 Thorncliffe Park Dr., Unit 28, Toronto, Ontario, Canada, M4H 1H2. 416-421-5631. 2-79-tfn

**TOWER WANTED:** Over 500'. Jim Baughman, KINI, (605) 747-2473. 4-79-5t

## EQUIPMENT FOR SALE

**RCA VTY MODIFICATIONS KITS** for TR4/22/50/60/61/70. Splicer (single-frame), TEP Interface, Time Code Edit Interface Kit, Audio Splice Timing Mod (Audio Insert Editor), Wideband Audio Amplifiers, most mod kits, some modules available. LAWHED, LTD., 388 Reed Road, Broomall, Pa. 19008, (215) 543-7600. 4-78-tf

**EQUIPMENT FOR SALE:** G.E. Transmitter with attendent equipment Model TT59. 50 KW very good condition. Available approximately June 1. Bargain if your move. Reasonable if I move. Also, three PCP-90U cameras, excellent condition. Sold to highest bidder. Contact for details: E. B. Wright, 1018 West Peachtree St., Atlanta, Ga. 30309, 404-875-7317. 3-79-2t

**FOUR COMPLETE GE PE250/350 COLOR CAMERAS** plus extra CCU. Excellent condition. Presently in use. Should become available about June 1. $10,000.00 each. Lee Whitehurst (615) 749-2255, Wayne Caluger (615) 889-6840. 4-79-2t

**4 PC-70 TRUCK,** Ross Switcher 16 x 6, Op Amp 8 x 4, GVG terminal, Tektronics, Conrac. Cash or terms. (213) 425-3620. 3-79-3t

**(2) LDH SERIES NORELCO** color television cameras—one LDH-20 and one LDH-1 modified to LDH-20 specs. Includes camera heads, 10-1 zoom lenses, CCU's cables, local control units (tubes not included). Very good condition. Contact Lenn Block, Rush-Presbyterian-St. Lukes Medical Center, 600 S. Paulina St., AF413, Chicago, Ill. 60612, (312) 942-5185. 4-79-1t

**FOR SALE:** (1.) Harris FMC-2, two bay FM broadcast antenna with deicers, tuned to 100.9 MHZ. Excellent condition. Station moved to new frequency. (2.) 320 feet Andrew 1-5/8" HJ7-50A Heliax with connectors. Good condition. (3.) 300 ft. Windcharger Tower with 20 ft. pole at top. Lights and wiring for lights and deicers. Tower to be available on the ground April 1, 1979. Contact David S. Johnson, Technical Director, Mortenson Broadcasting Company, 619 Peoples Merchants Trust Building, Canton, Ohio 44702. 4-79-1t

**FOR SALE—NEW UNUSED:** Complete Harris Model TAB-6H 6-bay Superturnstile antenna, 46 feet in height, tuned to Channel 8, 181.25 to 185.75 MHz. Specially priced $30,000. Contact Gil Schneider or Eddy Smith, P.O. Box 1941, San Angelo, Texas 76902 or call (915) 655-7383. 4-79-tfn

**BROADCAST CRYSTALS** for AM, FM or TV transmitters, frequency change, repair or replacement of oven types. Also vacuum types for RCA, Gates, Collins, etc. transmitters. Quality products, reasonable prices and better delivery! Don't be without a spare crystal. Frequency change and service for AM and FM monitors. Over 30 years in the business. Eidson Electronic Co., Box 96, Temple, Texas 76501. Phone (817) 773-3901. 12-74-tf

**IVC COLOR VTRS**—2-760C, $600 ea; 1-820C, $750; 1-870C, $2250; SONY DXC 1600 color camera, $1700. Contact Mike at (216) 475-0516 or Steve at (216) 381-9456. 4-79-1t

## EQUIPMENT FOR SALE (CONT.)

**EQUIPMENT FOR SALE**—Transmission Line - 800 ft., 6-1/8" rigid coaxial line, 75 ohm S.W.R. K-line, EIA Flange. Center conductor and K-line bullets 2-1/2 years old. Asking $300/20 ft. section. Also, Channel 48 Jampro JZ-2DA Antenna. Contact Ed Middleton, (513) 381-4033. 4-79-2t

**TWO (2) HITACHI FP-1212 BER (3-tube)** 1-inch Plumbicon cameras with extended red tubes, 10:1, F1.8 auto iris, rear control cable drive lens. Special price—$28,800.00 for two. Phone (518) 439-7612, ask for Bob or Ted. 4-79-1t/6-79-1t

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**VIDEO EQUIPMENT**—3-M 1114 S.E.G. with Chroma Key, Sony UV-340—New 1" Helical Color V.T.R.—Full electronic editing, remote control included. Ampex VR-1560 2" helical VTR demo, Akai CCS-150S—Portable 2 tube color camera—demo, excellent condition. For special close-out prices call (518) 439-7612, ask for Ted or Bob. 4-79-1t/6-79-1t

**HS 100B, SLO MO.** We have an HS 100 B Ampex slo mo disc in excellent working condition currently being used on the west coast. We are interested in a working agreement with a production firm that can use our machine to our mutual benefit. We will consider a flat rate monthly lease, a per use arrangement with a minimum guarantee or may even consider an outright sale. If you have a recurring need for a slo mo let's talk. Fred J. Huebner Jr., Slomoco, 5760 Abbey Drive, Suite 2P, Lisle, Illinois 60532. Days—312-652-8003. Ngt.—312-968-0912. 2-79-tfn

**DORROUGH** 310 Discriminate Audio Processor. Like new. $750.00. (216) 237-9219. 4-79-1t

**PHILIPS 3240X 50 MHz** oscilloscope. Four probes. Minimally used in three years. Asking $1400.00. Jes Patel, Box 607, Michigan City, IN 46360. (219) 874-7774. 4-79-1t

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**SCULLY 280-8**—8 track reel-to-reel recorder/playback, one-inch tape, in console with remote syncmaster panel. Good condition. Need to sell. DAN BRENNAN, WRKK, (205) 870-9900. 4-79-1t

**1,200 FIDELIPAC** tape carts, 40 second - 10½ minutes. $1,000 for lot, or $100 per 100. DAN BRENNAN, WRKK, (205) 870-9900. 4-79-1t

**TWO SONY DXC-1200** color cameras, Hitachi FP-1500 color camera, Hitachi sync generator, Hitachi effects generator and switcher, Concord ½" videotape player, Telemation uniplexer, and 1X4 video D.A. Dan Plaisted, Faith Center, 1410 W. 13th Ave., Eugene, Ore. 97402, (503) 686-9203. 4-79-1t

**FOR SALE:** Approximately 1900' of transmission line. Prodelin 3-1/8" 50 Ohm, EIA flanged. Many extras—elbows, bullets, patch panels, etc. Antenna GE TY42B helical 10 dB gain; Transmitter GE TT-36A, CH - 10 50 KW, with sideband filter, harmonic filter, receiver corrective filters, some tube terminal equipment including demod (GE). Please write or call: Richard A. Swank, Chief Engineer, WILX-TV, P.O. Box 30380, Lansing, Michigan 48909, (517) 783-2621. 4-79-2t

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**TV MAINTENANCE ENGINEERS AND TECHNICIANS.** For TV Production and sports facility. Maintenance Engineer required for quad tape, W/time code editing, studio cameras, slo-mo, scoreboards and computer, IVC 9000, Eidophor video projectors, and much more. Technicians also required to work under maintenance supervisor in same areas. Contact: Bill Denton, MCI Productions, #10 Greenway Plaza, Houston, Texas 77046, (713) 627-9270. 3-79-2t

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**CHIEF ENGINEER**—University Communications Dept. to perform maintenance, repairs, designing and installation of video and film production facility. 1st Class FCC license, 4 years experience, professional training and college degree. **Send resumes only**, to Leonard Price, Communications Dept., Adelphi University, Garden City, N.Y. 11530. An Equal Opportunity/Affirmative Action Employer. 4-79-1t

**STUDIO MAINTENANCE ENGINEER**—Full time, permanent position at expanding Pacific Northwest TV station. Experience in maintenance of RCA VTR's and TCR100 required. F.C.C. 1st Class license. Small town living; big town wages. Send resume to: KVOS-TV, P.O. Box 1157, Bellingham, WA 98225. EQUAL OPPORTUNITY EMPLOYER. 4-79-1t

**CHIEF ENGINEER**—New U.H.F. T.V. station located in major Northeast suburban market requires a 1st class licensed Engineer knowledgeable in all phases of T.V. station equipment. Attractive salary, benefits. Send complete resume, salary history and references to Dept. 349, Broadcast Engineering, P.O. Box 12901, Overland Park, KS 66212. All replies strictly confidential. 3-79-2t

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An international NYSE oil company, with corporate headquarters in Los Angeles, is seeking an Audio-Visual Specialist who is a college graduate with degree in communications, journalism, or radio/television preferred. Must have at least 2 years experience in public relations, instructional television or production and management experience including planning, supervising, and producing audio-visual materials.

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BROADCAST ENGINEERING offers exceptional opportunity to experienced technical editor. Will join aggressive, expanding staff of established trade publication. Substantial experience in the electronic communications and broadcast field is required, along with familiarity of all phases of magazine production. We offer top salary, comprehensive benefits and continuing growth potential. Must be willing to relocate to Kansas City area. Please send resume indicating current compensation to:

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## HELP WANTED (CONT.)

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**WHFT-TV**
**P.O. Box TV-45**
**Miami, Fla. 33169**

3-79-3t

**TV MAINTENANCE ENGINEER**—Electronic Engineering education or equivalent experience. ENG Maintenance experience desirable. Contact Harold Wright, WVIR-TV, Charlottesville, Va. 804-977-7082. An Equal Opportunity Employer. 2-79-3t

**TV STUDIO MAINTENANCE ENGINEER**, southwestern ABC affiliate. Many benefits including paid pension plan. Minimum requirements two years technical school or military equivalent, two years responsible studio maintenance experience, first class license. Salary negotiable depending on qualifications. Send resume and salary requirements to Chief Engineer, KOAT-TV, Box 4156, Albuquerque, NM 87196. 4-79-1t

**HELP WANTED: SYSTEMS ENGINEER, FIELD SERVICE ENGINEER.** We are in need of a systems engineer to plan, and a service engineer to maintain and install MDS transmitters. We seek personable self-starters, experienced in radio transmitters with powers up to 100 watts and with knowledge of television transmission techniques and of construction practices. A 2nd Class FCC License and extensive travel are required for the field service position. The systems engineer will work in N.Y.C. We offer exceptional opportunities for growth in a rapidly expanding MDS industry. A full range of benefits, and salaries related to responsibilities involved is available. CALL NOW: Stanley P. Lapin, Vice President-Engineering, Microband Corp. of America, 655 Third Avenue, New York, New York 10017. (212) 867-9590. 4-79-1t

**KDES, PALM SPRINGS** has an immediate opening for a full-charge Chief Engineer. Must be familiar with AM directional, FM automation. Send resume and salary requirements to: Joe Tourtelot, KDES, 821 N. Palm Canyon Dr., Palm Springs, CA 92262. An Equal Opportunity Employer. 4-79-1t

**OPENING FOR STAFF ENGINEER** with consulting firm in Florida. Require good theoretical and practical background in television and FM radio. Contact Bill Kessler, (904) 376-3157. 2-79-3t

**CHIEF ENGINEER** for new Denver area public TV station. Participate in original construction. First phone, maintenance experience with older RCA VHF transmitters, ENG equipment, STL, required. Send resume, salary history, and references to: John Schwartz, KBDI, Box 4262, Boulder, CO 80306. Equal Opportunity Employer. 4-79-2t

**WTAE AND WXKX-FM**, Pittsburgh, Pa., have an immediate opening for a Chief Engineer. The position requires a BSEE or equivalent, First Class FCC license and experience in AM and FM broadcast engineering. The applicant should be acquainted with audio processing, AM and FM transmitters, FM and Directional AM Antenna Systems and Sound Studio Production methods. Applicants should have prior management experience and prior background in planning and installation. Knowledge of FCC Rules and attention to detail a must. Send resumes and salary history to Ted J. Atkins, Vice President and General Manager, WTAE Radio, 400 Ardmore Blvd., Pittsburgh, Pa. 15230. An Equal Opportunity Employer, M/F. 4-79-1t

## HELP WANTED (CONT.)

**ASSISTANT STUDIO ENGINEERING MANAGER** with responsibilities for control room, editing and record operations. Must have setup and operation experience with studio cameras, film-cameras, quad tape machines and editing. Supervisory ability important. Equipment: 9 inch plumb and 4⅔ inch cameras, 24 quads, CMX300 and 340, film cameras, DNR, TBCs. Benefits: Health insurance, 15 days annual leave, retirement plan. An Equal Opportunity Employr. Dept. 450, Broadcast Engineering, P.O. Box 12901, Overland Park, KS 66212. 4-79-1t

**TV TECH—SAUDI ARABIA.** Immediate opening for Television Technician to work in the Audio-Visual Services Department of the King Faisal Specialist Hospital and Research Centre in Riyadh, the capital city of Saudi Arabia. The Hospital, managed by Hospital Corporation of America group, is a 250-bed referral and specialist medical center staffed with professionals from the United States, Europe, and the Middle East. The candidate chosen will have an associate degree in Electronics or 2 years trade school or equivalent training in an Armed Forces school. Also required are at least 5 years relevant experience including 2 or more years in maintaining and repairing television and video systems. Salary is excellent with furnished lodging, 30 days paid vacation with free transportation, free medical coverage, and other exceptional benefits. Interested, qualified candidates should forward a resume with current salary and date of availability to: Pershing Stahlman, Hospital Corporation International, One Park Plaza, Nashville, TN 37203, (800) 251-2561 outside Tennessee, (800) 342-2110 Tennessee. An Equal Opportunity Employer. 4-79-1t

**CHIEF ENGINEER** for 1 KW FM WUNH, the student funded station at UNH in Durham, New Hampshire is seeking part-time or contractual Chief with first or second phone. Flexible schedule. Contact David Coldren, General Manager, WUNH, Durham, NH 03824. (603) 862-2541. 4-79-1t

**CHIEF ENGINEER**—We are a UHF Network affiliate in Central Virginia looking for a chief with management ability and a maintenance background. Salary in the mid-twenties plus fringe benefits. Contact Harold Wright, WVIR-TV, Charlottesville, Va. 22902, 804-977-7082. Equal Opportunity Employer. 3-79-2t

**POSITION AVAILABLE FOR VIDEO PERSON:** Chicago film and videotape post-production company needs someone to color correct film while it's being transferred to tape. Excellent new position with well-established commercial company. Contact Jim Smyth or Fred Berkover at Optimus, Inc. (312) 321-0880. 4-79-1t

**DIRECTOR OF ENGINEERING WANTED IMMEDIATELY** for 100 KW FM stereo public radio station to sign on in Mobile, Alabama. Minimum of five years engineering experience and 1st class FCC license required. Salary open. Excellent fringe benefits. Send detailed resume and references to Mr. Joseph A. Martin, Jr., WHIL-FM, P.O. Box 160326, Mobile, Alabama 36616. WHIL-FM is anEqual Opportunity Employer. 4-79-1t

**MAINTENANCE ENGINEERS** familiar with RCA Cameras and tape, Grass Valley Switching for East Coast Production Facility. Openings in studio, production van and disc unit. Resumes to Director of Engineering, E. J. Stewart, Inc., 388 Reed Road, Broomall, Pa. 19008. 3-79-2t

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# fact: this condenser microphone sets a new standard of technical excellence. & it sounds superb!

The Shure SM81 cardioid condenser is a new breed of microphone. It is a truly high-performance studio instrument exceptionally well-suited to the critical requirements of professional recording, broadcast, motion picture recording, and highest quality sound reinforcement — and, in addition, is highly reliable for field use.

Shure engineers sought — and found — ingenious new solutions to common problems which, up to now, have restricted the use of condenser microphones. Years of operational tests were conducted in an exceptionally broad range of studio applications and under a wide variety of field conditions.

As the following specifications indicate, the new SM81 offers unprecedented performance capability — making it a new standard in high quality professional condenser microphones.


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- WIDE RANGE, 20 Hz to 20 kHz FLAT FREQUENCY RESPONSE.
- PRECISE CARDIOID polar pattern, uniform with frequency and symmetrical about axis, to provide maximum rejection and minimum coloration of off-axis sounds.
- EXCEPTIONALLY LOW (16 dBA) NOISE LEVEL.
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- ULTRA-LOW DISTORTION (right up to the clipping point!) over the entire audio spectrum for a wide range of load impedances. MAXIMUM SPL BEFORE CLIPPING: 135 dB; 145 dB with attenuator.
- WIDE RANGE SIMPLEX POWERING includes DIN 45 596 voltages of 12 and 48 Vdc.
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Conventional condenser microphones have gained the reputation of being high quality, but often at the expense of mechanical and environmental ruggedness. This no longer need be the case. The SM81 transducer and electronics housing is of heavy-wall steel construction, and all internal components are rigidly supported. (Production line SM81's must be capable of withstanding at least six random drops from six feet onto a hardwood floor without significant performance degradation or structural damage.) It is reliable over a temperature range of −20° F to 165° F at relative humidities of 0 to 95%!

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