

November, 1970/75 cents

# Broadcast Engineering®

*the technical journal of the broadcast-communications industry*



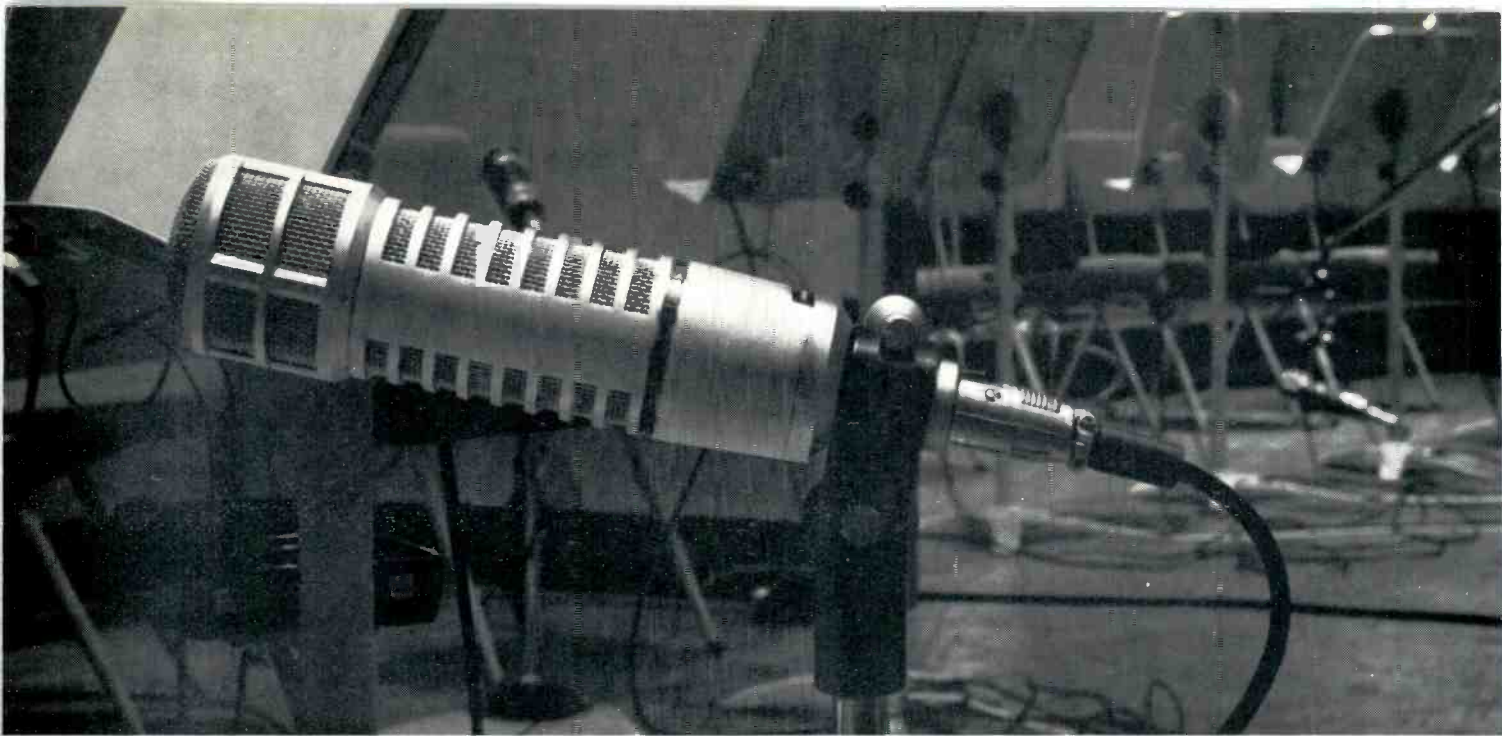
A HOWARD W. SAMS PUBLICATION

UHF  
Antenna  
Review  
page 22



**RCA Video Cart Machine**  
**Solving Color Problems**  
**Testing Transistors**





# How good is the new Electro-Voice RE20 studio dynamic microphone?

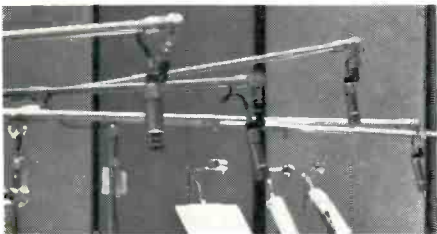
## Here's proof from the new scoring stage at Glen Glenn.

**Ey** The fine reputation of Glen Glenn Sound Company rests on their knowledge of sound... their ability to turn a full symphony orchestra into a perfect sound track for TV, the movies, or a new album. And their desire to be first with the finest.

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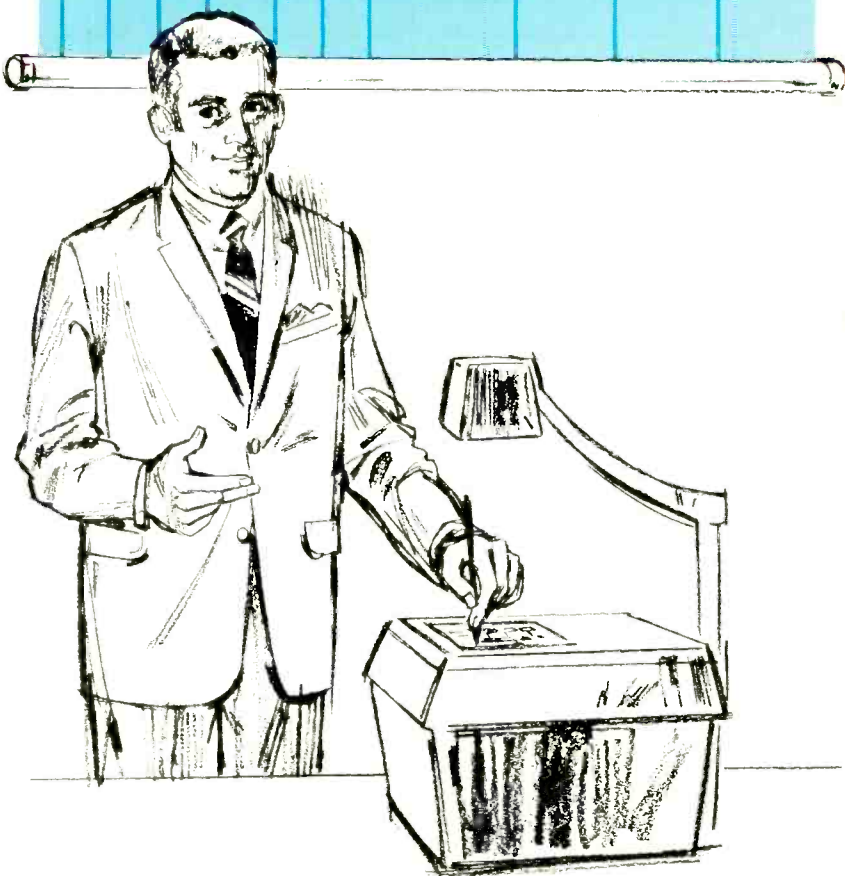
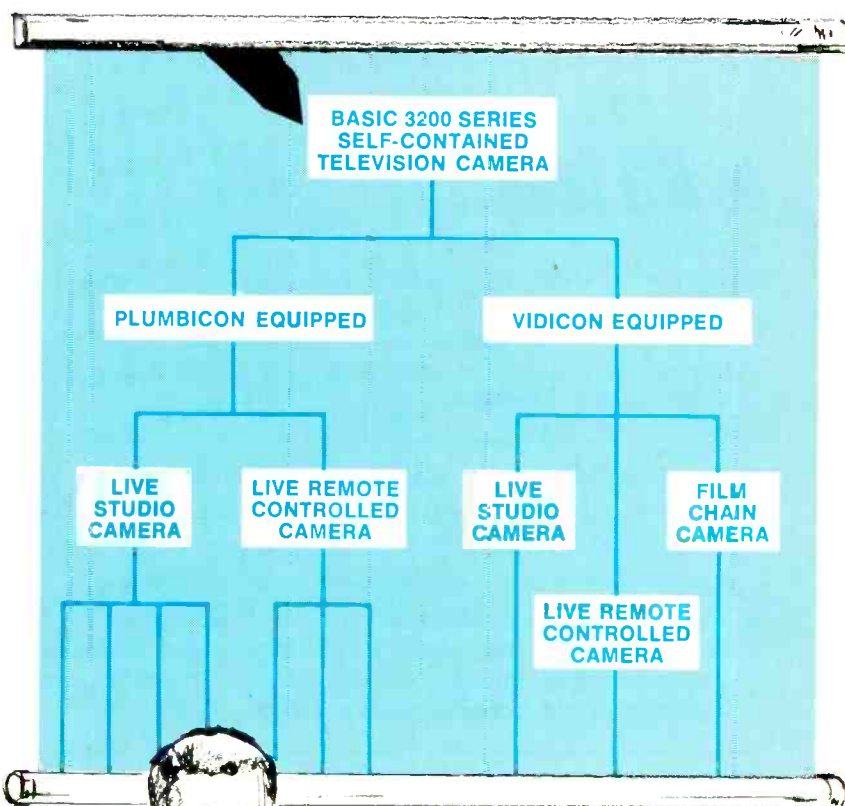
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# Broadcast Engineering

The technical journal of the broadcast-communications industry

## in this issue...

- 22 **Reviewing UHF Transmitting Antennas.** The shorter UHF wavelengths and small physical dimensions dictate different techniques in the application of antenna principles. Includes description of the types and operational theory, and goes into beam tilt. **Pat Finnegan.**

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- 28 **The First Video Tape Cartridge System.** Operational explanation of RCA's "first-of-a-kind" system, illustrated with pictures and schematics. **Harry Etkin.**

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- 34 **The Move Toward Bidirectional CATV.** BE's CATV editor details many of the practical possibilities for bidirectional communications through CATV services. Includes several examples of bidirectional systems. **Leo G. Sands.**

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- 38 **Avoiding Lightning Damage To Power Supplies.** The author explains that solid state devices cannot yet withstand the lightning hits as well as vacuum tubes and tells what he did to reduce the problem. **Horace N. Smith.**

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- 42 **Color Balance Method For Small Market Stations.** The WTMV story of how they devised a corrective method for imbalance in the shades and tints of color film, slides and cameras. **Phil Dean.**

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- 44 **Testing Transistors.** The second articles in a series describing methods of checking transistors. In this part BE's technical editor covers the Beta test and gives schematic for circuit that will give turn-off, turn-on, and ohmmeter tests without moving ohmmeter or transistor clip leads. **Carl Babcoke.**

### ABOUT THE COVER

Several antenna manufacturers are now testing television antennas at outdoor test sites before delivery. This site shows an Ampex antenna under test. For a review of UHF antennas, see article on page 22. (Photo courtesy of Ampex)

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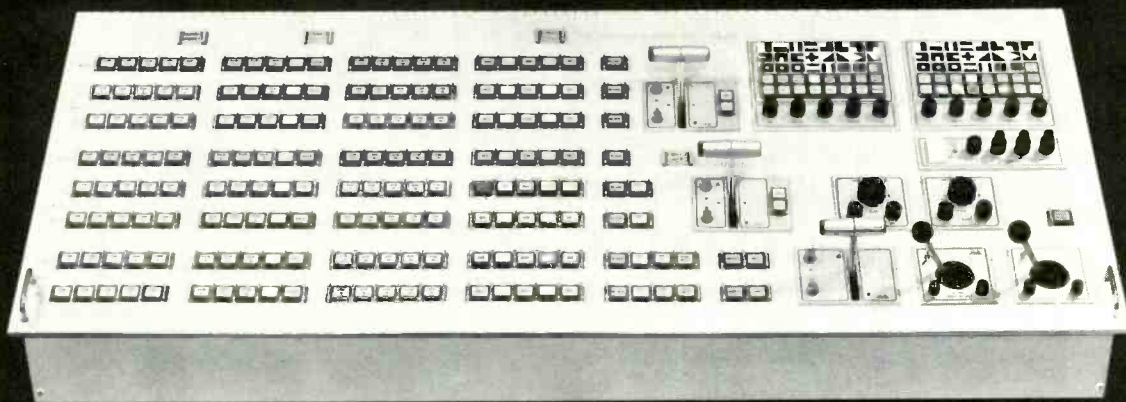
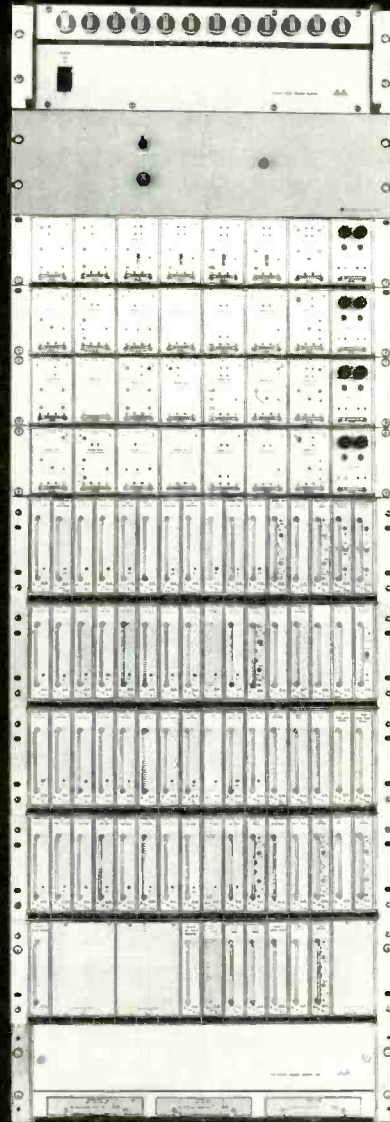


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# DIRECT CURRENT FROM D. C.

November, 1970

By Howard T. Head

## Mexican Treaty Ratified, New AM Rules in Effect

The Mexican Senate has ratified the new treaty with the United States governing AM radio operation in the two countries. The treaty had already been ratified by the United States. With the exchange of the ratification documents in Washington on October 15, the Commission has issued new rules putting the provisions of the treaty into immediate effect.

The new Commission rules provide, among other things, for the presunrise operation of more than 200 daytime-only stations operating on the Mexican clear channels, and for daytime power increases to 1 kW for Class IV stations on local channels operating near the Mexican border. Stations of these classes wishing to take advantage of the new provisions must file applications with the Commission supplying technical details.

In the case of daytime-only stations wishing to operate prior to sunrise, a letter requesting presunrise service authorization (PSA) is required. This letter must be accompanied by an engineering showing. Class IV stations wishing to increase daytime power are required to file a formal application on FCC Form 301. Complete technical details must be furnished in response to the requirements of the application form.

## White House to Assume Greater Role in Telecommunications

The White House has established a new Office of Telecommunications Policy (OTP). Named Director of the new Office is Dr. Clay T. Whitehead, Presidential Adviser, whose recommendations led to the establishment of the new Office. Although the OTP will not have direct control over broadcast or other matters within FCC jurisdiction, Dr. Whitehead has made it plain that neither he nor the President will hesitate to make their views known to the FCC on policy matters such as frequency allocations, satellite communications, and cable television policy.

The Presidential order establishing the new Office provides that OTP will place "primary" reliance on the Department of Commerce for technical advice. The group principally responsible for the provision of such advice will be the former Institute for Telecommunications Sciences (ITS) headquartered at Boulder, Colorado.

Veteran broadcast observers will recall that this group, formerly part of the National Bureau of Standards and known as the Central Propagation Radio Laboratory (CRPL), has been engaged in a long-standing dispute with the FCC regarding such matters as broadcast

*(Continued on page 6)*



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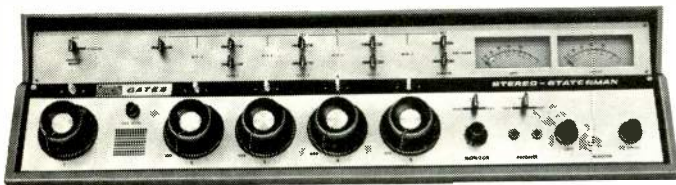
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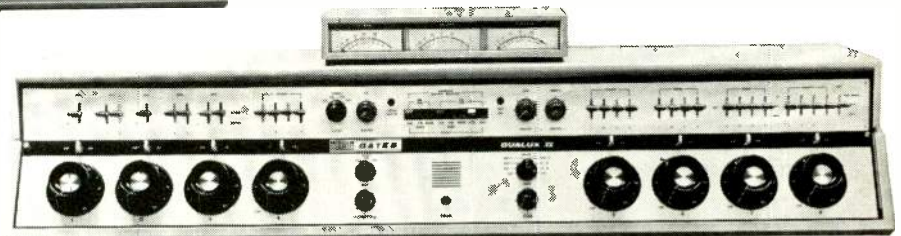
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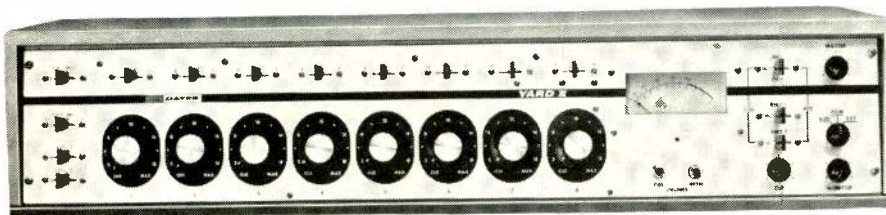
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(Continued from page 4)

channel allocations, land mobile operation, and even such topics as the sale of frequency spectrum to the highest bidder. Considering the background of the new Office, broadcasters and other licensees under FCC jurisdiction can expect an interesting future, to say the least.

#### New FM Interference Group Being Formed

The Commission, at the request of a major television trade association, is organizing a new Advisory Committee to study the problem of FM interference to television reception. The committee will include engineers from the FM broadcast industry, the television broadcast industry, and the receiver manufacturing industry, as well as from the FCC.

The Commission has been receiving an increasing number of complaints from the public in recent years of interference to television reception from FM and other sources. The number and seriousness of these complaints are on the increase, not only because of the growth of FM broadcasting, but also because of the much greater sensitivity of color television transmissions to interfering signals. So many complaints are being received (25,000 to 30,000 per year) that the Commission is no longer able to respond to individual cases except with general guidelines.

#### Color TV Improvement Under Continued Study

The Joint Committee for Intersociety Coordination (JCIC), studying sources of degradation in color television pictures, has issued a report of its findings from tests in Chicago area. These tests covered the portion of the television transmission system from the studio output terminals to the receiver input terminals.

These tests showed this portion of the television system to be an important source of color signal degradation. Measurements were made of burst-to-chroma phase shift, chrominance-luminance ratio, differential gain and phase, chroma-to-burst amplitude ratio, color burst effects, and multipath effects. In each case, significant transmission errors were found. One disturbing conclusion is that in many instances systems operating within FCC signal tolerances were still incapable of producing satisfactory color pictures.

Signal observations were made at several test points ranging from the studio output through the transmitter input and output to the receiver input terminals. Phase and amplitude errors occurred in all portions of the transmission system, with a disturbingly high proportion apparently associated with the propagation path between transmitter and receiver.

Meantime, reports are accumulating of experience with the vertical interval reference signal (VIR) devised by the Broadcast Transmissions System Committee (BTS) of EIA, currently being tested by the three major television networks (See June, 1970 D.C.).



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# LETTERS TO THE EDITOR

## How Much — How Soon?

**Dear Editor:**

It's good to see the industry still has Chief Engineers like Mr. Snyder at WJOY in South Burlington, Vermont. After some fifteen years broadcasting, I have seen many radio stations. Those that were clean and neat stayed on the air and sounded like a broadcasting station. These stations, for the most part, had a fulltime Chief Engineer, not a 90-day-wonder or a manager turned engineer, or a contract engineer, but someone who took pride in being able to see his face in the front glass of the transmitter.

Where have these great radio broadcast people gone? Television, naturally, took its share and many others entered into industry. Why? Simply because many station owners were not able or refused to pay the price a professional person was entitled to receive. Now, we are paying the price; we have an industry that lacks enough truly qualified engineers and is flooded with bums who have nothing more than a blue piece of paper.

Let's not do away with the legitimate engineers, let's do get rid of the phonies in the business. Let's pay our engineers what we pay our announcers and program directors.

The only product a station has to sell is sound; pay your engineer a decent salary and he can worry more about making your station sound better instead of how he's going to make ends meet at the end of the month.

As someone who came up through the ranks from sweeping the floor in my father's station to a quarter ownership of my own station, I believe a good engineer is worth more to you than anyone else in your station.

Treat your engineer like a professional or he's liable to join the mass exodus from broadcasting.

**William K. Hoisington**  
Station Manager  
WKYV-FM  
Vicksburg, Miss.

**Editor's Note:** When we start discussing the economics of broadcasting, we run into heavy traffic. But one thing is for certain: far too many engineers never heard of a 40-hour week. (Doctors are asking now, what is a house call?) When trouble comes, does a day ever end?

The engineer can and will move around . . . as a reaction the changing technology and the growth of related industries. And he soon will be forced to make more moves based on salary increases.

As far as dropping from AM and FM is concerned, the irony of it all is that they will return . . . more often than you think . . . as factory reps or contract engineers. In the end, there is no way to avoid paying for engineering excellence.

## Prices Wanted On Product Literature

**Dear Editor:**

On many occasions I mail in your "Reader Service Card" requesting information on items of interest to me. For this service I am very much thankful. However, I have one gripe about which I have been meaning to write to you for some time. This is not against your fine magazine, but to the manufacturers of the products for which I ask for information.

(Continued on page 10)



"THINK OF IT, HOMER. WE'LL BE THE FIRST TO SET FOOT ON TOP!"



# IN MAKING RECORDS STANTON IS THE STANDARD



Photographed at Capitol Records.

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For complete information and specifications write Stanton Magnetics, Inc., Terminal Drive, Plainview, L.I., New York.



Circle Number 8 on Reader Reply Card

(Continued from page 8)

The gripe is this. Why don't the advertisers of the products for which information is requested, send along the PRICE or PRICES of the items?

There is nothing that gripes me more than to have to take time out to write a second time to get a price of some product that I may be interested in buying.

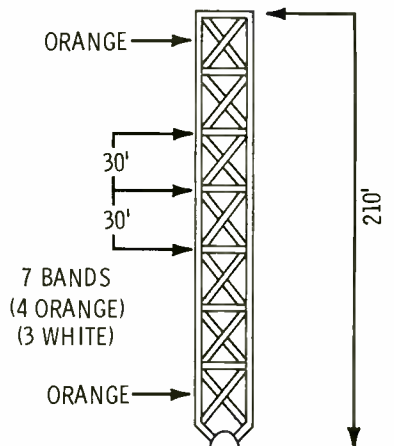
**Antonio Vaccaro**  
Chief Engineer  
Radio Stations WHEB/WPFM  
Portsmouth, N.H.

### Tower Painting Error

A few gremlins crept into the act in the September issue of BE. In the "Outside Maintenance" article on page 39, second column, line seven, the sentence should read: The TV antenna must have a 6 MHz bandpass, so there is room for standing waves to appear in the sideband area that will not necessarily show up on the VSWR indicators.

Also, Figure 4 on page 41 there is a tower painting problem. The tower is a radio tower and should

not have included a TV antenna. The total tower height is 210 feet. As it is shown in the drawing, the color bands would be wrong. The top and bottom bands must be orange. Eliminate the TV antenna and show the tower height as 210 feet and it will be correct.



In line with tower painting, the reader should be aware of the fact that the Commission has proposed a change in the width of the color bands. The proposed rule would make the maximum width 100 feet instead of 40 feet.

**The Editor**

### Screen Examinees With Interview

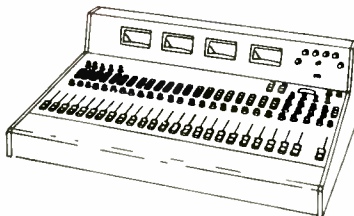
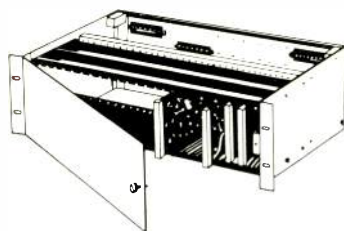
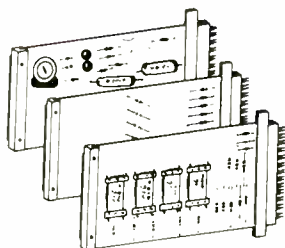
**Dear Editor:**

I would like to add my idea to the present controversy concerning the licensing of broadcast engineers and the relaxing of the "First Phone" rules.

The possession of a "First Phone" license in itself seems to mean nothing except the holder is able to retain a certain amount of information long enough to set down and answer a group of questions. This does not mean that he even understands the questions, let alone the answers. In my experience as a Chief Engineer, I find that most "Third Phone" holders know as much about a transmitter as a "First Phone" holder who received it through a fast memory course. In the light of that statement, it seems the relaxing of the rules to permit "Third Phone" holders the right of transmitter watches on directional antenna and higher powered transmitters means little one way or the other, technically.

In fact, I know of broadcasters

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who are using announcers who hurt the 'sound' of the station simply because they have a "First" and are the only ones available to operate since the station feels they cannot afford an announcer and engineer both at the same time for many shifts.

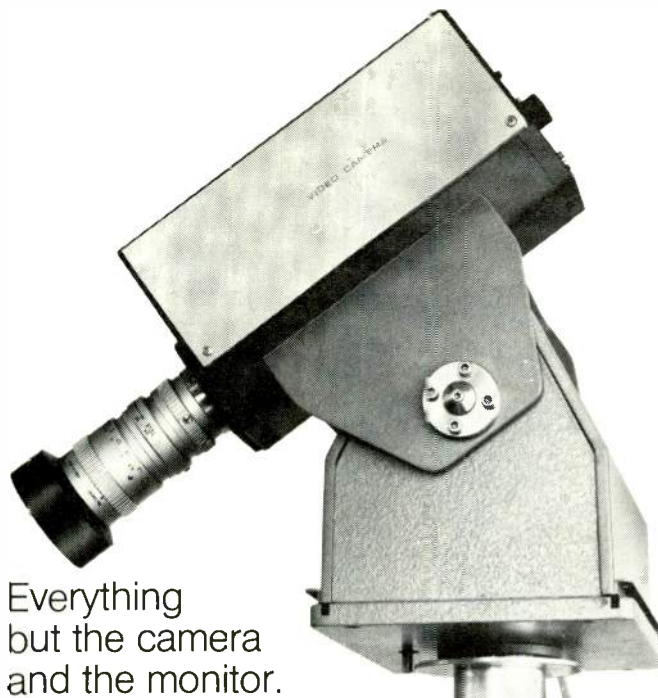
It seems a practical solution for the FCC to find out who can maintain a radio station, would be in addition to answering the "First Phone" questions, an engineer must also have an interview with a FCC inspector who knows radio and radio stations. It certainly doesn't take me but a few minutes to find out if a prospective engineer knows engineering. A few questions about equipment, transmitters, transmission lines, impedance matching, consoles, phone lines, etc. would certainly let an inspector know if the applicant was familiar with radio broadcasting and could be responsible for the maintenance and repair of a transmitter and antenna system. I would welcome such an interview with an inspector in order to have an indorsement on my license which means that I could be employed for the maintenance of radio station equipment. It would seem to be better to up grade the licenses of those qualified rather than merely relaxing the rules to allow a lower grade of operator to be on duty at a station.

I'm sure the FCC inspectors would not like the extra time for interviews, however, if such a change is made so that the "First Phone" license is not needed they would certainly have more time to interview prospective Chief Engineers, since the long lines of "First" Class license applicants would be eliminated.

**Horace N. Smith**  
**CE for WERK and**  
**WCTW AM/FM**

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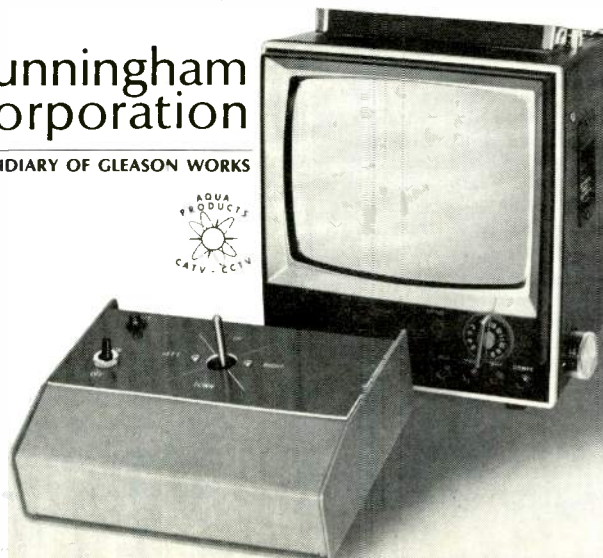
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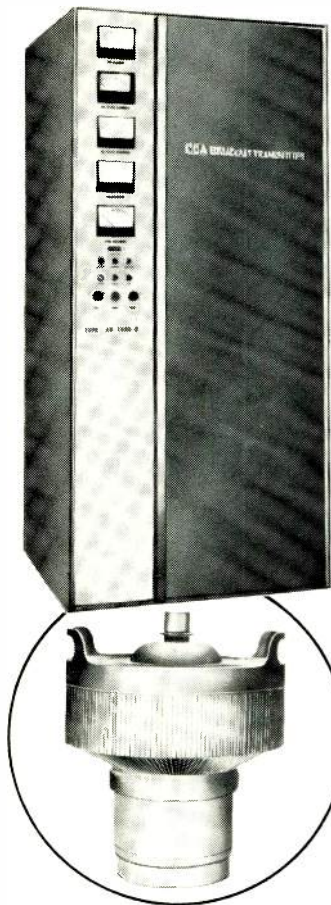
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## Boosters, Too

# Approval For FM Translators

Use of FM boosters and translators by FCC stations has been authorized by the Commission in an amendment to Part 74 of the rules (Docket 17159). Establishment of low power translator and booster stations will help extend FM radio service to areas receiving poor service because of distance or uneven terrain. Translators are in regular use to extend TV coverage, but in the past, FM translators have been authorized only on an experimental basis (Translators retransmit an originating station's signal on a different frequency. Boosters are repeating devices that amplify and retransmit a signal on the same channel as the originating station.)

The rules allow FM boosters with transmitter power output of up to 10 watts nationwide and FM translators with transmitter power output of up to 10 watts west of the Mississippi River except for Zone I-A. East of the Mississippi River and in Zone I-A, power will be limited to one watt.

The new rules provide that commercial FM translators will be authorized only on Class A small com-

munity, channels designated in the Commission rules. Noncommercial educational FM translators will be authorized on the 20 FM channels, (201 through 220, 88.1 MHz through 91.9 MHz) reserved for noncommercial educational use. FM translators will not be permitted to rebroadcast commercial FM stations on channels reserved for noncommercial educational use.

FM translators or boosters will not be authorized within 20 miles of the Canadian border without permission from the Canadian government and, until an agreement can be reached with the Mexican government, no translators or boosters will be permitted that will serve an area within 200 miles of the Mexican border.

Except when specifically indicated in the rules, the same rules will apply to FM boosters as to FM translators.

FM translators, like television translators, will be authorized on a no-interference basis. FM translators will be required to protect television translator stations against interference.

## Burch Wants Diversity By Competition

FCC Chairman Dean Burch, speaking at the 66th Annual Meeting of the American Political Science Association in Los Angeles said that the task of the FCC is to keep broadcasting an "open" medium of expression, to supply the framework within which the industry can—and must—present a diverse fare of information and views on significant public issues." He said the Commission's primary challenge was the encouragement and development of "structural diversity through new and competing modes of expression."

The Commission has sought to provide for diversity of expression

for many years, Chairman Burch stated. It has worked to prevent concentration of control through its multiple ownership rules. He pointed to the Fairness Doctrine, which requires presentations of contrasting views on controversial issues of public importance, as insuring that a station will not become a one-sided platform. He stressed, however, that it is now most important to concentrate on new modes of expression to promote diversity—media with a different economic base than broadcasting as we now know it—with the capability of responding to specialized audiences.

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# Get "in" gear

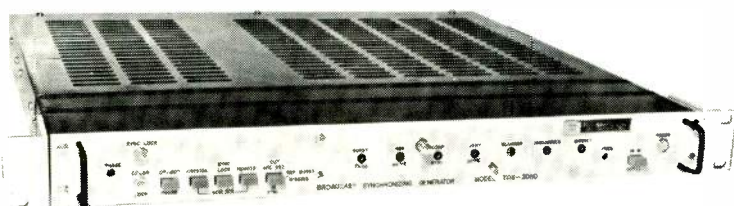
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(Continued from page 12)

# Schools Computerize Net

Chairman Burch cited subscription television, CATV with its multi-channel capacity and its potential for specialized services and programing, and educational television and its ability to offer programs not dependent upon advertiser support, as examples of the potential for diversity. He added that fuller use of UHF television would provide additional opportunities for public service.

Chairman Burch, noting that satellites would also offer opportunities in the near future, stressed that it was the job of the FCC to promote such developments, to give the public greater access to the widest range of information. By concentrating on this area, he concluded, the Commission can best carry out its mandate to give the public the resources it needs to do its own thinking and make its own decisions.

**See Page 34  
For CATV  
Bidirectional Patterns**

College students and instructors in Texas are attending distant classes and solving problems on a remote computer without ever leaving their own campuses.

The long-distance instructional and problem-solving capabilities are made possible by a pioneering new microwave network that spans 4,000 square miles and serves several Texas colleges and universities.

The network, operated by TAGER (The Association for Graduate Education and Research) enables these institutions to pool their instructional capabilities and scientific resources through closed circuit television and a central IBM computing facility linked to several remote campuses by microwave.

"With closed circuit television, scientists, engineers and college students can 'attend' graduate classes during the normal workday without ever leaving their plants or campuses," said Don Simons, the as-

sociation's academic coordinator. "Students and faculty members also can jointly work on problems using a single IBM computer."

The computing center is at the University of Texas at Dallas and is being used by Texas Christian University in Fort Worth and Austin College in Sherman. Texas Christian University has its own IBM system but can communicate with the larger computer in Dallas for increased problem-solving capacity. Other institutions in the network are able to add typewriter-like terminals as needed and connect with the central IBM system by microwave.

TAGER network participants also include Southern Methodist University, whose own computer facilities are accessible through the system; Bishop College in Dallas; the University of Dallas; University of Texas Southwestern Medical School at Dallas; and Texas Wesleyan College in Fort Worth.

Circuits are also available at the University of Texas at Arlington for future expansion of both the teaching and computer capabilities.

Closed circuit television and high-speed computer data transmission between campuses can be operated simultaneously on a single microwave band.

Dialogue exchange, considered vital in an educational process, is preserved through two-way voice communication built into the network. A student at a distant campus or plant taking a televised course can see the instructor and visual aids and also can pose questions during the lecture. All students can hear the questions and responses.

Through a technique known as time-sharing, several persons at the campuses served by the computer can solve problems simultaneously on the IBM System/360 Model 50 on the UT Dallas campus.

"This network once was just a grand idea, as it still is throughout most of the country. But we abandoned our individual campus ties and jointly turned the idea into a valuable and functioning system,"

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said Simons. "We're still expanding and developing the network, which represents an investment of more than \$1.5 million, and exploring other educational potentials it offers."

"The computer jumps from one problem to another and back again, but the speed is so great that each individual user has the impression that the computer is working solely for him," said John Carpenter, director of the IBM Center at UT Dallas.

## Fair Labor Act May Give Equal Treatment

Amendments to the Fair Labor Standards Act should provide equal treatment for small broadcast stations and small newspapers under the minimum wage provisions, an official of the National Association of Broadcasters has told the House Subcommittee on Labor.

In a letter to Rep. John H. Dent (D-Pa.), subcommittee chairman, Paul B. Comstock, NAB vice president and general counsel, said that one of the bills pending before the subcommittee would remove the minimum wage exemption now enjoyed by small newspapers. Another bill would retain this exemption to small newspapers but would not grant equal exemption to small market broadcasting stations.

Comstock said that NAB "urges that competing media in the same market receive equal treatment un-

der the law."

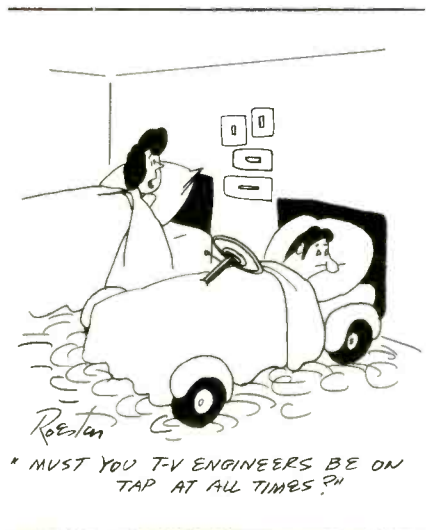
"To remove the minimum wage requirement from only some of the industries which are in competition with one another is to create an unreasonable burden on the industry still covered," he said in the letter.

Comstock explained that advertisers often decide whether to place their advertising in newspapers or on radio and television stations on the basis of relative cost. The present law, he said, "favors the small market newspaper in this competition for advertising business."

Comstock also said that while

many small market stations pay wages well above the minimum, others are in areas where the wage scales for small business are lower than the standards set by the Fair Labor Standards Act. The cost of these small operations may make it "prohibitive to hire additional personnel in some cases if the employer is bound by the minimum wage requirements while his competitor is not," the NAB vice president said.

Both bills would continue the exemption from the overtime provisions in the Fair Labor Standards Act.



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# FM's Near Relocation Rule Changes

Amended rules requiring specific FCC authorization for relocating the main studio of an FM broadcast station outside the community of license have been proposed by the Commission in a rule making notice.

The action would amend Parts 1 and 73 of the Commission rules and would conform with rules gov-

erning television main studio relocations. Present rules imply but do not specifically state that FCC approval is required for moving the main FM studio outside the licensed community, the Commission said.

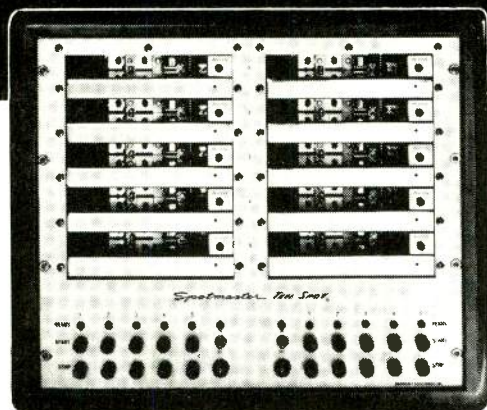
Proposed rules would permit an FM licensee to locate a main studio outside the principal community to be served, where an adequate show-

ing is made that good cause exists and where it is shown that the move would be consistent with the operation of the station in the public interest. No relocation of main studio to a point outside the principal community to be served, or from one such point outside the community to another, would be permitted without the licensee's first securing a modification of construction permit or license. FCC Form 301 would be used for the application.

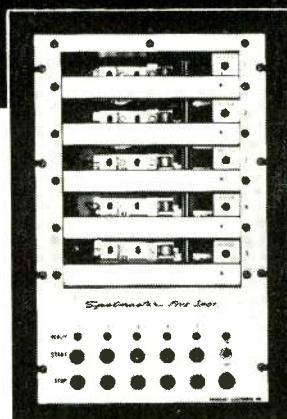
Specific Commission authorization would not be required to relocate a main FM studio within the principal community to be served, or to move the main studio from a location outside the community to one within it, but the licensee would be required to notify the Commission promptly of the relocation.

Present rules require the main studio of an FM station to be located within the principal community to be served, but also provide that the main studio may be located at the transmitter site irrespective of its location. Other rules require FM licensees to obtain specific authority to move a main studio to a different city from that specified in the license. The result, the Commission explained, has been uncertainty on the part of the licensee as to when specific authority for FM main studio relocation is required.

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### CATV Seminar Slate

A recent NCTA "Bulletin" announced a three-day program origination seminar for association members to be held November 2-4 in Atlanta, Georgia.

Plans are being made for additional origination seminars, also to be conducted by equipment manufacturers, in four other major cities. Sessions have been scheduled in Chicago, December 7-9; San Francisco, January 18-20; Dallas, February 15-17; and Boston, March 1-3. The seminar series is being coordinated by Larry D. Bowin, assistant to NCTA President Donald V. Taverner.



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The Sony ECM-51 is available at select Superscope Special Application Products dealers. For their names, as well as complete details and specifications, please write Special Application Products Division, Sony/Superscope, 8150 Vineland Avenue, Sun Valley, California 91352.

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# EDUCATIONAL BROADCASTING

Looking Inside Non-Commercial Broadcasting

By Walter Jung

## NAEB Highlights

### Professional Emphasis Groups

If you are attending this year's National Association of Educational Broadcaster's convention in Washington you will find the programs being undertaken by NAEB of major importance to you as an engineer in the educational broadcasting field. And even if you are not one of those fortunate enough to be on hand to witness and participate, this year's activities provides significant new opportunities to become involved in some very progressive programs.

One of NAEB's major 1970 developments has been the formation of "Professional Emphasis Groups", aimed at encouraging greater involvement of responsible professionals from the field in a variety of specific areas. These groups are: Research and Evaluation; Music Programming; Public Program Production; Graphics-Staging Design; Promotion/Public Relations; Engineering/Engineering Design; Industrial and Military Training; Operational Management; Broadcast Education; Minority Programming; Instructional Design Development; and Business Affairs. Obviously, the wide scope of these activities can mean a great deal to a lot of people, and this is the intent, to promote greater involvement. Programs are under way in all of these categories, and workshop meetings of the various groups will be taking place during the course of the convention.

The engineering programs of the convention promise to be highly interesting to the technically minded conventioneer. The engineering committee, chaired by F. Lee Morris of the Mississippi Authority for

ETV, has a program of 21 papers to be presented in 7 separate sessions. These sessions are headed up by such industry leaders as:

#### **NAEB Engineering Committee**

##### **Chairman**

Mr. F. Lee Morris  
Director of Engineering  
Miss. Authority for Educational TV  
Post Office Drawer 1101  
Jackson, Mississippi 39205  
Phone: 601-982-6656

##### **Advisors**

Mr. Oscar Reed  
Consulting Engineer  
Washington, D.C.  
Phone: 202-296-6400

Mr. Alan McIntyre  
Director of Engineering  
North Carolina ETV  
Chapel Hill, North Carolina 27514  
Phone: 919-933-2088

##### **Committee Members**

Mr. William J. Kessler  
Consulting Engineer  
2929 13th Street, N.W.  
Gainesville, Florida 32601  
Phone: 904-376-3157

Mr. Fred D. Edwards  
Director of Engineering Services  
WOED Channel 13  
Fifth Avenue  
Pittsburgh, Pennsylvania 15213  
Phone: 412-683-1300

Mr. Jim French  
Director of Engineering  
Colorado State University  
Fort Collins, Colorado  
Phone: 303-491-5416

Mr. Gerald T. Plemmons  
Chief Engineer  
KOED  
525 Fourth Street  
San Francisco, California 94107  
Phone: 415-391-1000

Mr. Henry R. Owen  
Director of Engineering  
Eastern Educational TV Network  
381 Elliot Street  
Newton Upper Falls, Mass. 02164

Mr. Bud Untiedt  
Vice President, Engineering &  
Production Services  
Community TV of Southern Calif.  
1313 North Vine Street  
Los Angeles, California 90028  
Phone: 213-466-4212

Mr. Harvey Aderhold  
Director of Engineering  
Georgia ETV Network  
1540 Stewart Avenue  
Atlanta, Georgia 30310  
Phone: 404-758-8701

Mr. William Woods  
Director of Engineering  
WTTW-TV  
5400 North St. Louis Avenue  
Chicago, Illinois 60625  
Phone: 312-583-5000

Mr. Marvin Rahm  
Director of Engineering  
National Educational Television  
2715 Packard Road  
Ann Arbor, Michigan 48104  
Phone: 313-971-3600

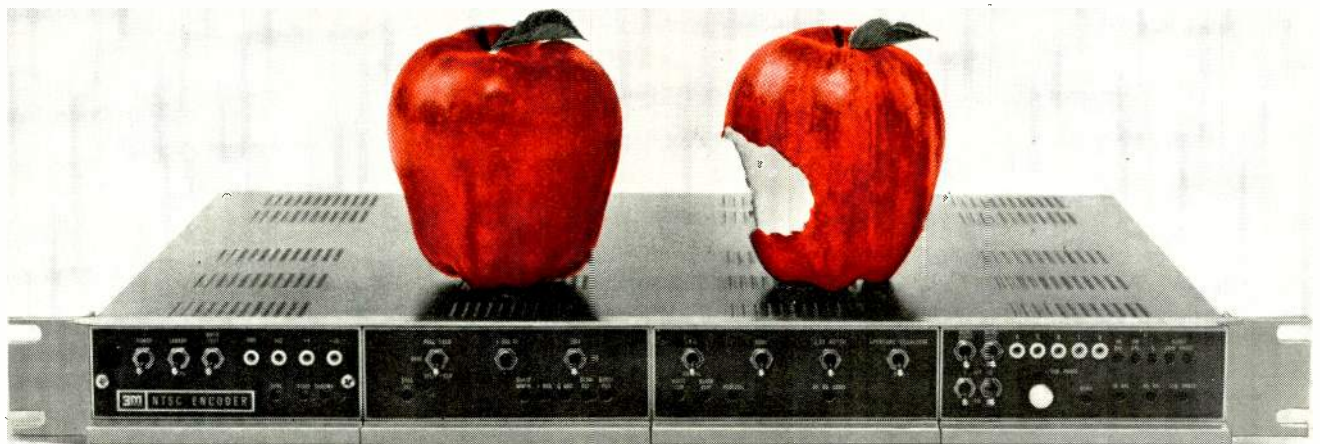
#### **Technical Papers**

Among the topics to be covered are: Minority Employment; Union Affairs; European Broadcasting Satellite Experiment; Transmitter Remote Control; FM Antenna Polarization; Slow Scan FM; Future Concepts of ETV Network Distribution; Latest FCC Developments in Broadcasting CATV, ITFS, etc.; Latest Engineering in ITFS and CATV; Colorado State ITV System; Wisconsin Experiment on Remote VTR Operation; Slant-Track Recording—an Engineering Viewpoint; a report from PBS; a report from CPB and a report from National Public Radio; and finally, Lighting and Quality Production.

In the Engineering PEG session (November 9th, 1:00-2:30) the main focal point will be aimed at



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Another unique fact is that the 3M Color Encoder considers smaller, lower cost cameras as well as the big expensive ones. A method of input clamping is used on video signals that eliminates low frequency hum and noise and other unwanted effects on the matrix. If you have access to an SMPTE color test film (hand test over colored bolts of cloth) you can determine whether your camera needs clamping. If it does, you're in clover with this 3M Encoder.

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Luminance enhancement at the flick of a switch assures a sharp picture even if registration is not perfect. With a 4-tube camera, enhancement is from the luminance tube. The green channel is used for enhancement in 3-tube cameras. Switching is on the front panel, as are **all** operation and setup controls, including notch filter.

Overall, you'll find that the 3M Brand Color Encoder is equal or superior to anything on the market yet costs somewhat less. Could we send a brochure?

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development of an action committee for the promotion and advancement of broadcast engineering education. This is hoped to be through formal courses and school curricula to be brought about in the near future. To give some idea of the background behind this activity, we go right to the very "charter" of Engineering's PEG as set forth by F. Lee Morris, Field Coordinator. Basically there are three main tasks which are the responsibility of the PEG on Engineering on an annual basis, outlined as follows:

#### **In-Service Training 1)**

A frank and confidential analysis of significant professional skill deficits among specialists in Engineering, done with an eye to our recommending corrective in-service measures the NAEB could undertake through its Educational Broadcasting Institute. (Special attention should be given the particular needs of members of minority groups.)

#### **Pre-Service Education 2)**

A detailed identification of the dynamic skill prerequisites for the new practitioners coming into our own area of professional responsibility, done for the purpose of having the NAEB, the Association for Professional Broadcast Education and other national leadership groups help our colleges and universities devise more relevant and effective curricula for graduates in our particular field.

#### **Convention and Publications 3)**

An inventory and advisory assessment of the topics, issues, personalities and formats indicated to be timely and pertinent for inclusion in the future programs of the annual NAEB convention and other NAEB conferences. This assessment should also apply to the content of the Educational Broadcasting Review and other NAEB publications.

It is easy to see that these three tasks bear responsibility towards the development and maintenance of proper engineering. The accomplishment of these goals can only come through dedicated and meaningful contributions from the leaders of the field. This is exactly why the emphasis is on professionalism.

These general areas of examination are by no means all, there are specific tasks to be accomplished also. These are:

"To explore in very considerable detail, the present adequacy of technical training programs and subsequently to make recommendations on suitable curricula and program levels for broadcast technician training; to assist in the development of the Equipment Exchange Briefing; to solicit professional papers for presentation at the National Convention; to explore items of interest in engineering operations, maintenance and management; to find ways and means of providing information and service to the profession at large on state-of-the-art developments in equipment and technique and to develop a vehicle for providing feed-back from the membership to the Association's Engineering Committee."

If you are attending the NAEB convention, we encourage you to attend these sessions which are crucial to proper growth and the solving of engineering problems facing the public broadcaster. You may benefit in a variety of ways, one in particular by becoming involved in a PEG. There is no better way of efficient problem solving than through exchanges such as these where things can be brought out in the open and examined. You may have problems similar to those being engaged by the PEG, or you may be able to contribute towards effecting a solution. The key importance here is getting the leaders of the field to meet the challenge being presented. Get involved in this PEG. If you are not now a member of NAEB, join and give them your support in the accomplishment of these goals. You may find you can play an instrumental part in the building of an engineering program which is really worthwhile. There is an unquestionable need for just such a thing in this field and this formative period is where your efforts can make the biggest contribution.

While we are encouraging your support of NAEB, the engineering program, and its PEG's, particularly engineering, BE also would like to hear your views on these matters. Let us know what you feel is needed in the field, and/or what you would like us to tackle. As you

can see we are behind PEG's as a step in the right direction. But, before any problems are solved they have to be communicated. If you are at NAEB, take the first step there, if you are not, write NAEB at 1346 Connecticut Avenue, N. W., Washington, D. C., 20036. If you are interested in Engineering's PEG, write to F. Lee Morris, at the above address. In any event, we hope you are motivated to take an active part.

## **Educom Award to Idaho Student**

Denver R. James, a junior at the University of Idaho, Moscow, Idaho, has been selected as the recipient of the Visual Electronics Corporation Fourth Annual Educom Scholarship Award.

The presentation of the scholarship grant and plaque will be made in the presence of educational broadcasters by Hartford N. Gunn, a member of the NAEB Executive Board of Directors and General Manager of WGBH-TV, Boston, Massachusetts, during the 1970 National Association of Educational Broadcasters Convention in Washington, D.C. November 10th.

Announcement of the award was made by James B. Tharpe, President of Visual Electronics Corporation. James, whose home is in Heyburn, Idaho, won the award on the basis of his scholastic achievement in his current communications courses, augmented by an essay explaining why he desires a career in the field of Radio and Television.

His interest in communications, scholastic achievements and his essay, which competed with those submitted by many colleges and university sophomore students throughout the country, were judged by a distinguished panel of leaders in the field of educational broadcasting. The judges panel included: Dr. Richard B. Hull, Director of Radio and Television Broadcasting, Telecommunications Center of Ohio State University; Dr. Harold Niven, Assistant to the President and in charge of educational activities, National Association of Broadcasters (NAB); and Dr. Samuel Becker, Director of Radio/Television/Film, University of Iowa and Member of the Board of Directors, National Association of Educational Broadcasters (NAEB).



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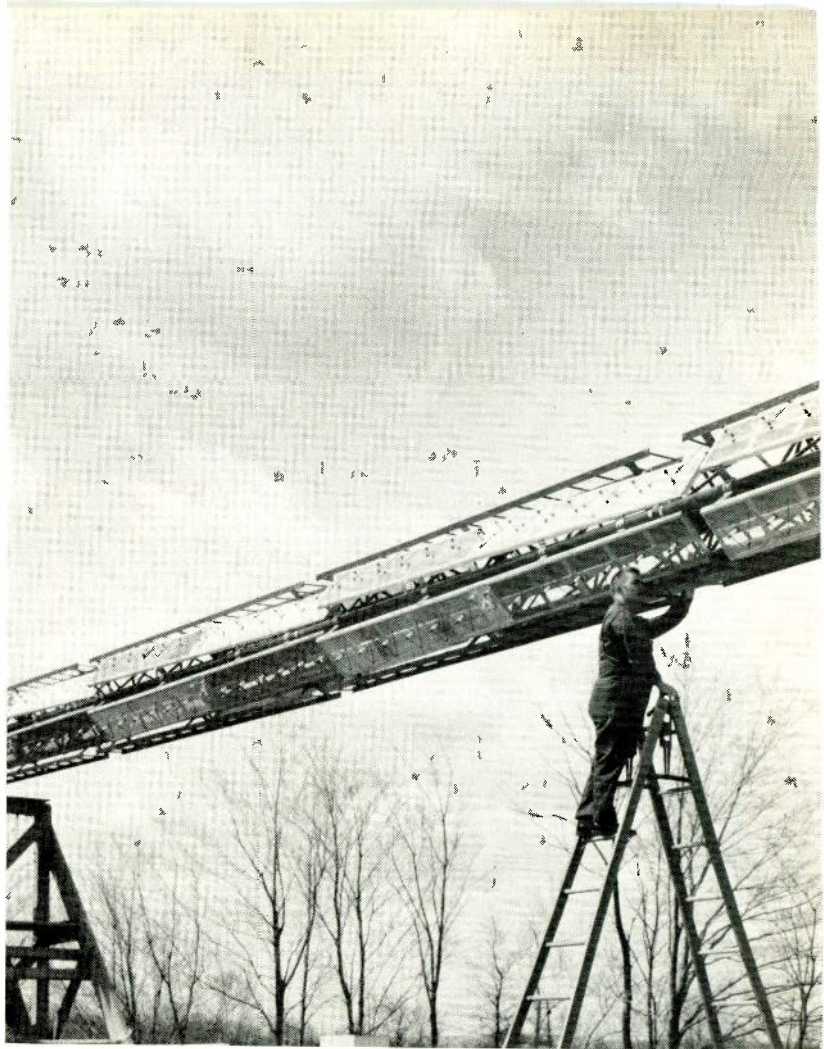
COMMUNICATION / COMPUTATION / CONTROL

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Workmen adjusting and testing a complete Zig-Zag antenna at the General Electric testing location.

# Reviewing UHF Transmitting Antennas

By Pat Finnegan\*



There is nothing especially mysterious about UHF antennas. Basic antenna theory applies to these just as it does to low frequency antennas. The shorter UHF wavelengths and smaller physical dimensions do dictate different techniques in the application of the antenna principles.

The small physical dimensions permit the application of antenna techniques which would be so unwieldy at low frequencies as to be impractical. The small dipole at UHF is limited in the amount of power it can handle safely. And severe propagation losses at UHF require high powers to make up these losses. Due to the UHF dipole's small physical size, it can be stacked into an array that will not only handle the applied input power, but also will give a tremendous power boost by the gain achieved.

The power handling capacity is achieved by distributing the input power to many small antennas. The limiting factor on power input is basically what the feeder system

and individual components of the array can withstand.

The power gain is achieved by stacking, but how does it happen? Stacking will reduce the energy normally radiated off the ends of the antenna in a direction along the antenna's axis. This end energy is redirected into the direction perpendicular to the antenna so that it reinforces the energy radiated in that direction. This reinforced energy is the antenna gain. This reinforcing action creates a lobe of main energy, along with nulls clustered close to the antenna.

Nulls are areas of very weak signal near the antenna and appear at different short distances from the antenna. Unfortunately, these nulls can occur in the major primary coverage area. The distance and position of these nulls depends upon the amount of stacking that has been to create the array. In most cases, nulls cannot be ignored. The signal never drops to zero in these null points because there is some signal reflected into them from nearby buildings and other structures. Even so, receiving the signal

in a null is difficult and hard to explain to an irate viewer.

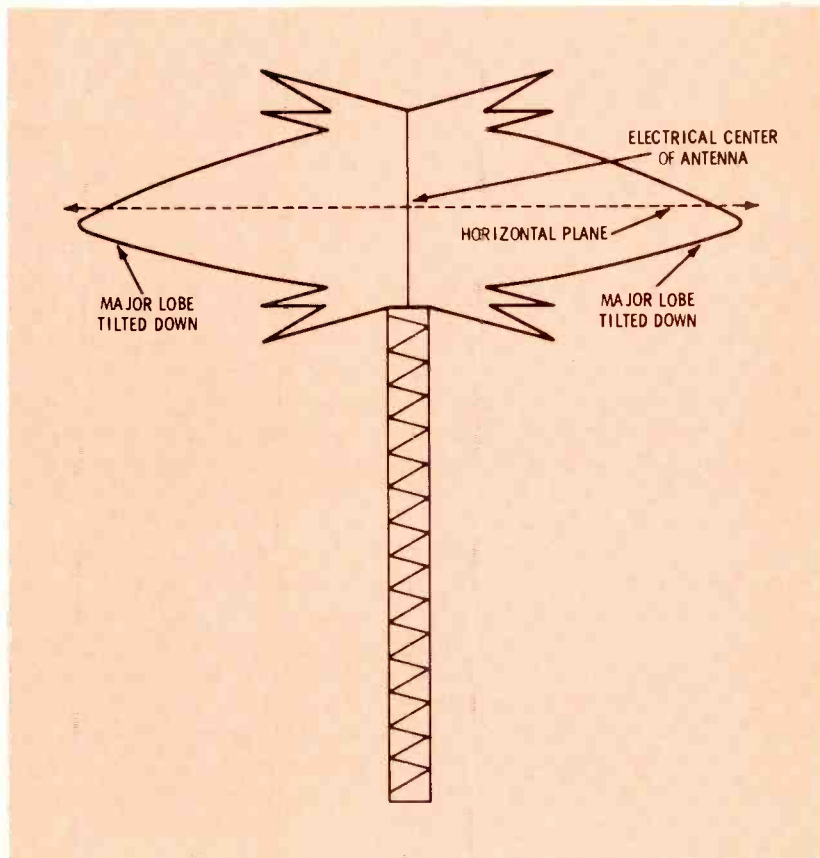
## Beam Tilting

Beam tilting will produce some null fill-in. This fill will not bring the signal level up to that of signal levels outside the null, but in most cases it will provide an adequate signal. A very low power transmitter could still experience trouble, however.

Electrical beam tilting is accomplished by adjusting either the amplitude or phase (or both) to the various radiating elements in the array. (See Figure 1). This tilting has the effect of raising or lowering the major lobe of the signal equally around the antenna. The point of the major signal lobe is dropped to a point below the horizon. All UHF antennas use a small amount of beam tilting both to fill in nulls and to direct the lobe below the horizon. Signal energy that is radiated past the horizon is wasted energy because the signal will not follow the curvature of the earth. Instead, it travels in a straight line. Hence, little will reach viewers be-

\*BE Maintenance Editor and Engineering VP for WLBC, Muncie, Ind.





**Fig. 1** Electrical beam tilt moves the major signal lobe down toward the horizon. Field strength is lost in the horizontal plane, but better coverage is attained out to the horizon.

yond the horizon.

Mechanical beam tilting simply tilts the antenna mast physically by inserting small shims under its base. This type tilting is sometimes used to overcome local terrain problems. For example, a mountain top installation may use some mechanical tilt to better direct the signal into the valley it serves below. Only small amounts of mechanical tilt are used. Tilting will change the "overturn moment." The "overturn moment" concerns the ability to stay on top of the tower under stress from the wind, ice, and its own weight.

### Basic Types

Commercial UHF television has been serving the public for approximately 18 years. The majority of antennas in use today are basically the same two original types, the slotted and helix, while the zig-zag is a close second. While the modern antennas are more refined, they still use the basic principles of the originals. The zig-zag arrived commercially about seven years ago and it is a close cousin to the helix. There are several versions of the zig-zag

which go by different names according to the manufacturer. Other antennas have been used, such as dipole arrays, and there have been some custom built antennas. These types are in a minority compared to the basic types.

There is one major difference between the slot and the solid resonant antenna. The polarization of the fields will be opposite, that is, the electric field of the slot will be in the same direction as the magnetic field of the solid antenna.

You might better visualize how the slot works if you consider this analogy. Visualize an isolated farm house at night with a light on in only one room. The light will shine through the window and light a small portion of the lawn. Consider the light as the RF energy, the window as the slot and the window glass as a radome.

Practical slot antennas make use of many slots and at different places on the antenna structure. By properly placing the slots, the direction of the signal can be controlled and by increasing the number of slots, the amount of energy radiated is

increased. Thus, both antenna gain and direction can be accomplished.

### The Slotted Antenna

Those who have worked with RF circuits know how difficult it is to confine RF energy. The slightest opening in shielding will allow the RF to escape.

The slot antenna is designed to do just that—allow the RF energy to escape from its containment, but in a prescribed and efficient manner. (See Figure 2). In a waveguide or transmission line carrying RF energy at UHF frequencies, if a slot is cut in the outer conducting surface and if the slot is correctly proportioned, RF current will flow lengthwise in the slot creating a field across the width of the slot. This field will have the same dimensions as the field produced by a solid resonant antenna. The length of the slot must be at least  $\frac{1}{2}$  wavelength long to radiate efficiently.

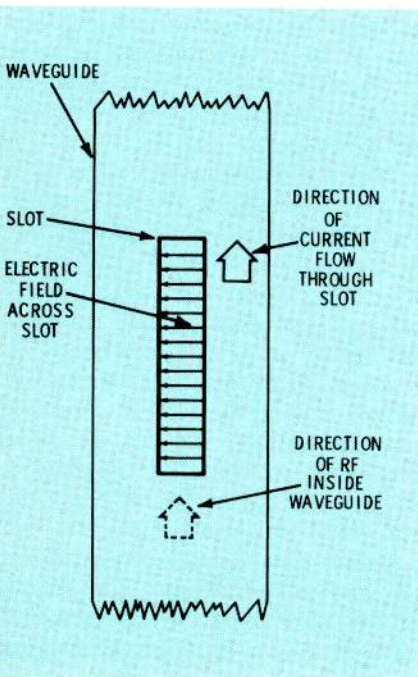
### The Pylon

The pylon antenna is a slotted type. The pylon forms a large transmission line. The steel outer cylin-

der forms the outer conductor, while the copper center line forms the center conductor. The center is held properly spaced from the steel pylon with teflon mounting pegs. The RF signal is fed either to the base of the pylon or two a midpoint of the antenna through the center conductor, depending upon the particular type of pylon involved.

As the RF energy travels along inside the pylon, part of the energy is radiated from each slot. Rather than depend upon the RF naturally flowing through the slot, a small loop or bar is used at each slot to "scoop up" RF energy and more efficiently couple it into the slot. The slot has a polyethylene cover which acts as a radome.

All the slots are normally fed in phase, which produces a broadside array and the normal pattern is circular. When electrical beam tilting is used, the phase of the RF fed to various slots is adjusted so as to produce the desired results in the vertical pattern. The early models had an adjustable center conductor harness so that beam tilting could be accomplished in the field. The new models preset the desired beam tilt and this can't be changed once it has been set at the factory.



**Fig. 2** A half wave slot cut in the side of waveguide. The RF current will flow longways in the slot, creating an electrical field across the slot.

### The Helix Antenna

The helix antenna works on the principle of a traveling wave in a long wire. (See Figure 3). When an RF signal is fed to one end of a wire that is many times the length of the wavelength of the applied signal, radiation will take place as it travels along the wire. The amplitude of the signal will diminish as it progresses due to this radiation. If the wire is long enough, very little or no signal will reach the end, and there will be no reflections. Therefore, such a wire may be left opened or grounded and there will be no problems. Such a long wire is a non-resonant device.

The length of the helix used in a commercial antenna is about 12 wavelengths long at the RF frequency. There are six turns of the helix, and each turn about two wavelengths long. The helix is spiraled around a steel pole, so positioned from the pole as to aid the radiation from the helix.

The practice with commercial UHF helix is to use two helices per bay, opposed to each other and both fed from a common feed point. The RF is fed from inside the steel pole, and the feed point at each pair of helices is about 100 ohms. With each helix opposed to its partner, the vertical components cancel out, leaving only the horizontal components, which produce a broadside array.

Bays may be stacked up to a total of five and will produce a gain of 25. They may be rotated in relation to the other bays, or the length of the feeder lines may be varied to produce a shift in phase to individual bays to accomplish electrical beam tilting.

The horizontal pattern may be directionalized by attaching small stubs to the helices at appropriate places so as to distort the pattern into the desired shape. These small stubs act as radiators to redirect the RF energy into the directions needed.

### The Zig-Zag Antenna

This antenna also works on the traveling wave principle. In this antenna, the long wire is bent at half wave intervals. When the wire is bent in this manner, phase reversals take place at each interval which cancels out the vertical components

of the signal. The zig-zag is a panel containing the bent wire insulated from the panel at approximately 0.1 to 0.2 wavelength. The panel works as a ground plane to aid the radiation from the wire.

There are different varieties of the zig-zag made by various manufacturers and they go by different names, such as the Zee Panel, V-Zee Panel, etc. Each type has its own refinements. The V-Zee for example, is also bent into a V shape.

The zig-zag antennas have become quite popular because of their versatility. Any number of panels may be used (within reason) and almost any pattern for the signal may be developed. A station may order a complete antenna from a manufacturer, which comes on its own mast section and adjusted for the desired horizontal and vertical pattern needed. This is a complete unit just as are the pylons and helix antennas.

The panels may be mounted around an existing tower structure. In addition to all the directional horizontal patterns possible with the zig-zag panels, a circular pattern may also be obtained.

Besides the stacked dipole arrays and other customized antennas, there has been a recent entry into the field. This one makes use of the slotted antenna principle coupled with parasitic elements to produce horizontal pattern shaping. Each bay is fed internally from separate feed lines from a power divider at the base of the antenna. By varying the phase to various bays, electrical beam tilting may be accomplished.

### Vertical Pattern

Charts or curves which display the vertical pattern are usually a profile view and then from only one side of the antenna. If one were to turn the chart from its standard configuration to a position so that the depression degrees are on the vertical side of the chart, then the lobe would point horizontally to the horizon. This will give a better visualization of the main lobe of the pattern.

Nulls are created in the vertical pattern by stacking of antennas into an array. Each antenna has a curve supplied with it to show the vertical pattern of that particular an-



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tenna. The chart will also show the nulls. Electrical beam tilting will fill in these nulls somewhat. A small amount of tilting will not reduce the antenna gain too much, while large amounts can reduce this gain.

In all cases, the gain in the horizontal direction will be reduced. The signal in the main lobe will be the same amount, but it will now point down slightly to the horizon. You can check this from the vertical pattern chart or curve. The horizontal direction is along the zero degrees line, and you will note that when beam tilt is used, the maximum signal along the zero degrees line has been reduced somewhat. If you have the vertical pattern for a standard antenna without beam tilt, and then compare the pattern for this antenna with its beam tilt, you will note that the nulls are not as deep. The slight reduction of signal in the horizontal direction is more than compensated for by the better signal coverage out to the horizon.

The distance to horizon may be roughly computed from the formula  $D = 2h$ , where  $h$  is the height of the electrical center of the antenna above ground. This formula is based on a smooth plane earth. Such as smooth section of the country is not found too often, so the distance to horizon will be approximate in most areas. For example, a 500' antenna over a smooth plane earth will find the horizon approximately 31.6 miles away. But if there is a mountain taller than the antenna at 20 miles away in one direction, as far as the signal is concerned, that mountain is the horizon in that direction. ( $D = 500 \times 2 = 1,000 = 31.6$  miles)

Distance to nulls can be computed from the formula:  $D = \frac{.0109 \times h}{A}$

In this formula,  $h$  is the electrical center of the antenna above ground (smooth plane earth) while  $A$  is the depression angle.

The null points on the vertical pattern chart are shown at the

angles they appear. Select a null that you need to know how far it will be from the antenna and from the chart. Use the angle shown for the null in the formula. For example: the vertical pattern for an antenna which is 500' to its electrical center has a deep null at a depression angle of five degrees. In this null there is only one percent of the radiated signal. Thus:  $D = \frac{.0109 \times 500}{5} = \frac{5.45}{5} = 1.09$

miles. Therefore, at a distance of 1.09 miles from the antenna there is a null which theoretically contains only one percent of the radiated signal.

The other nulls can be computed in a similar manner for a given antenna. Without null fill in by the use of beam tilt, such weak signal points could be a problem in coverage if such areas are well populated.

De-icing of the pylon type antenna is accomplished by the use of calrod heaters mounted on the outside of the steel cylinder and bolted directly to the steel for good heat transfer to the steel. The helix and the zig-zag antennas use a 60 cycle current fed right through the antenna wire itself to heat the wire and melt the ice. Automatic sensors are used on most heaters so that the heaters work on their own, according to the weather conditions which can cause ice to form.

Lightning protection is a natural built in feature with these antennas since they are grounded to the tower. Lightning rods are normally mounted above the beacon. The only requirement is that the tower has a good ground at its base.

#### Maintenance

UHF antennas are durable and do not require a great amount of maintenance, but they should not be neglected.

Physical inspection of the antenna should be made at several intervals during the year. Depending upon the type of antenna, the inspection should include the slot covers, insulators, radomes, and any connections that may be used. If any area appears to have been burned, this should get a closer inspection. Any insulator that has been burned or cracked should be replaced as soon as possible. Slot

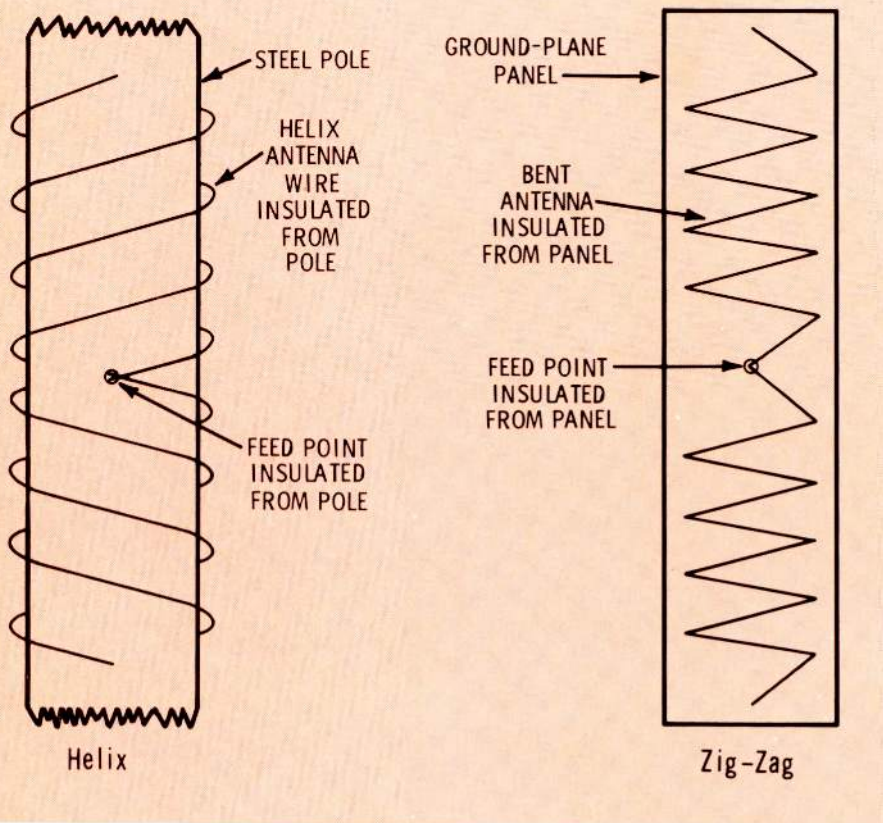


Fig. 3 There are similarities between the helix and Zig-Zag antennas. Each bay of the helix uses two opposed helices with about six turns in each for a total of twelve per bay. The Zig-Zag panel uses two bent wires per panel, opposing each other and fed from the mid point. There are six to seven bends or "cycles" on each side of the feed point or about 12 to 14 per panel.



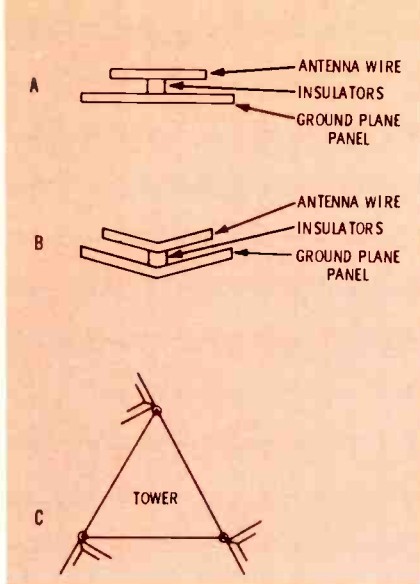


Fig. 4 Part A shows an end view of a Zee Panel. Fig. 4b is an end view of a Zee-Vee Panel bent Zig-Zag antenna. And Fig. 4c shows how Zee-Vee panels may be side mounted around a triangle tower. Here the panels are mounted so as to "fire" at a tangent to the tower.

covers that may be missing or cracked also should be replaced as soon as possible.

Painting of the antennas should be done with care. The painters should be careful to avoid painting insulators on the slot covers. If these areas are painted, the efficiency of the antenna will be impaired.

When workmen must climb over the antenna to make inspections or to change the beacon lamp, they must be careful to use the climbing spikes and not climb on the antenna elements.

The impedance match of the antenna should be good across the bandpass. These are broadband antennas for the channel, but damaged elements, moisture and dirt inside a pylon, cracked insulators etc. can change these characteristics so that a good impedance match may not be retained across the bandpass.

The antenna should have a check-out before installation on the tower. This will show up any damage that may have occurred in shipment. This checkout is the same as the transmission line checkout for VSWR. An RF signal generator, slotted line and detector are used to check the VSWR across the bandpass. These original figures should be preserved for future reference.

After the antenna is installed on the tower and the line itself has

been checked out into a dummy load, the antenna should be attached to the line and then an overall check of both line and antenna made. The combined VSWR readings may vary slightly, because in most cases the antenna will not present as good a load as the dummy load. Should there be any marked changes in the readings, further investigation should be made of the antenna. It may have had some damage while it was pulled up and mounted on the tower. Again, this original set of readings should be preserved for future reference.

The line and antenna system should be checked at least once a year for any changes in the VSWR readings across the bandpass. A good time to do this would be at the annual Proof time.

When de-icers are used, they should be checked out each fall before the winter season sets in. These should be turned on so that they have a chance to heat up while the climber is going up the tower. You should feel these to determine that all of the heaters are working.

When heaters are separate elements, one or more individual elements may burn out. This can be worse than no heaters at all, as parts of the antenna may be iced while part is clear. It would be better that the antenna is done evenly, whether it be iced or melted clear.

Antenna problems can show up as a mismatch to the line. Mismatch on the line will cause reflections back down the line and there will be ghosts in the picture, and the VSWR readings will increase. Problems in the line itself can appear in the same manner at the transmitter location, so it is sometimes difficult to determine which one is at fault. The only sure way to isolate the problem to antenna or line is by breaking the line and terminating it with a resistive dummy load.

Outside maintenance programs are vitally important. But we tend to forget about towers, antennas, transmission lines and dog houses. And as simple as this type of maintenance may seem, trouble outside can keep you off the air longer than most inside problems. ▲

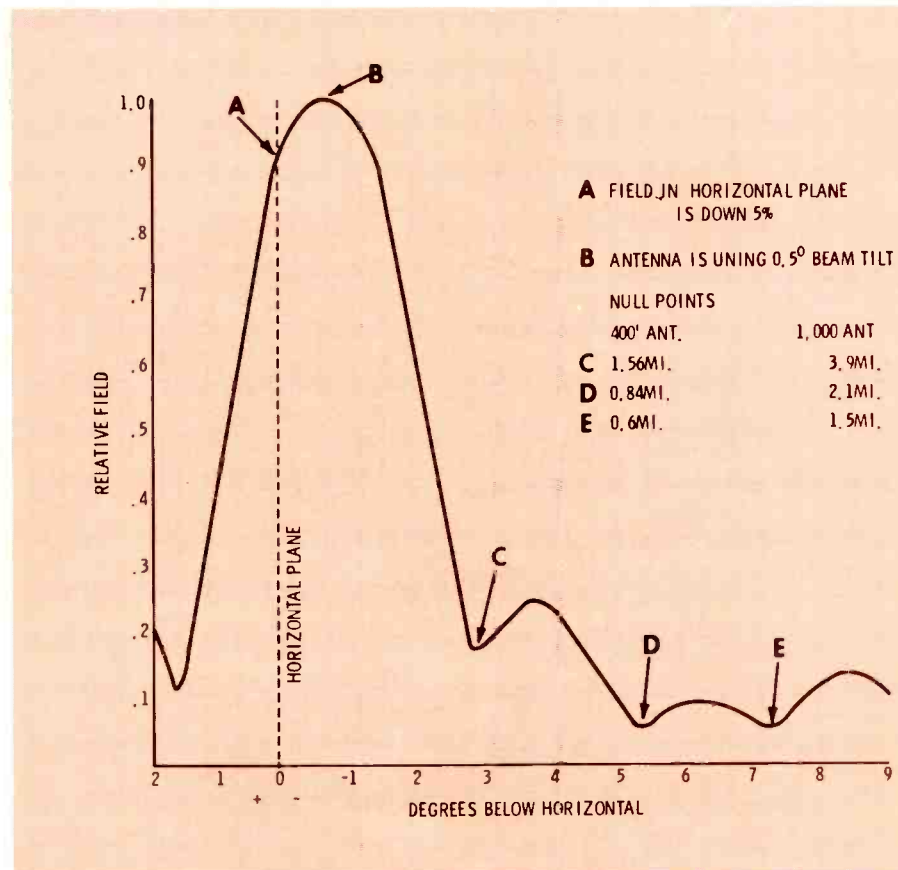


Fig. 5 A typical vertical pattern chart for a medium gain antenna. This pattern shows that a 1/2 degree beam tilt has been employed and shows the result. Distance to the three null points have been computed for two antenna heights. Distances are approximate and have been rounded off.

# The First Video Tape Cartridge System

*Here is another interest leader in the long line of equipment being developed today that may become the necessity of tomorrow. Since the introduction of this machine, Ampex, as expected, has developed a video cart system.*

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By Harry Etkin\*

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One of the equipment "stars" of the 1969 and 1970 NAB conventions was the Video Tape Cartridge System by RCA. A "first" in the broadcast equipment industry, the system was introduced in 1969 as a prototype and demonstrated as a pre-production model at the convention just passed.

The cartridge system provides an automatic facility for recording and playing back any type of program material in segments of up to three minutes duration. The possible applications of this equipment go beyond the obvious station-break format. The new machine will handle sports clips, promos, news features or any other short segments of up to three minutes.

Up to this time, the trend in video tape machines was to provide complex and expensive equipment, with the broadcaster obtaining less em-

\*Levittown, Pa.

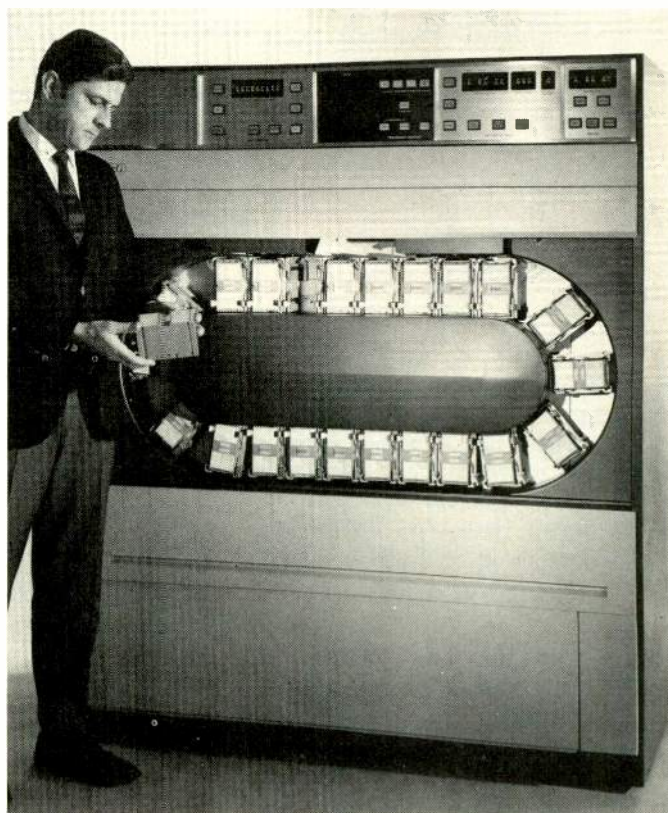


Fig. 1 RCA video tape cartridge unit, 1970 version.

phasis in schedule flexibility. Further, market studies show that on the average the useful time of video tape machines is only 12 percent; the rest of the program day is spent in "standing by" for an on-air cue or in awaiting a taping assignment.

The new video tape cartridge system promises to change this. Just what does it have to offer? The purpose of this article is to discuss the basic technical principles and provide a summation of what the video cartridge can do for the TV station.

## Basic Capabilities

The new Cartridge System consists of a video tape cartridge which is utilized as a carrier for each recorded segment. This equipment is not just used as an automatic cartridge playback unit, but it can also record cartridges. In normal use it has the capability for playing back the cartridges one after another producing a complete, continuous program. The system will replay as

many as 22 video tape cartridges, each containing up to three minutes of commercials, news or other programming, automatically and in any pre-determined sequence according to the way the cartridges are loaded. This is achieved by including two tape decks or playback stations within the equipment. Feeding these two tape decks is a cartridge changer mechanism holding 22 tape cartridges. (See Figure 2.)

The equipment is programmed to play a sequence merely by placing the appropriate cartridges in the changer mechanism in the order in which they are to be programmed. The equipment is started by activating a play cue-up mode, the appropriate sequence command is entered, and a play command is initiated by a single push button. This description introduces the basic equipment capability, to help understand the full range of programming possibilities in this equipment the various concepts of the system will



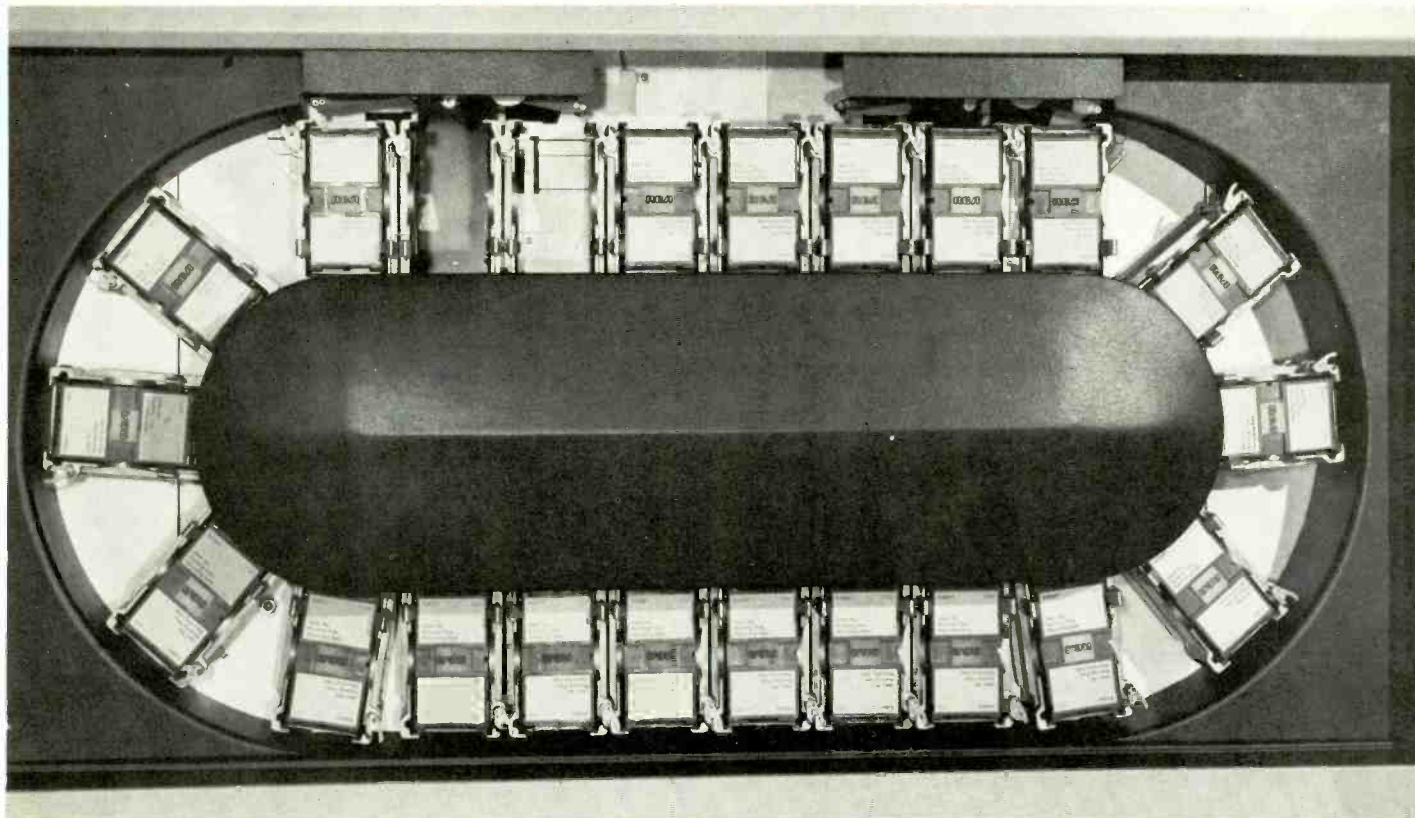


Fig. 2 Cartridge changer mechanism.

be discussed in greater detail.

#### Cartridge Unit Assembly

The tape cartridge shown in Figure 1 consists of a protective molded plastic covering and approximately  $2\frac{1}{2} \times 3\frac{1}{2} \times 5$  inches, which holds two small spools of two-inch quadruplex video tape. Although the cartridge is miniaturized, it provides proper tape handling when placed in the equipment and further adequate tape protection outside of the equipment. The tape is completely protected against damage or deterioration by doors on three sides of the cartridge which are normally closed but open automatically when the cartridge reaches the playing station of the equipment.

The presented maximum tape capacity of the cartridge is usually 236 feet of usable tape length plus leader and tail, which carries a program playing time of 3 minutes with one recording standard and one tape speed at 15.0 in/sec for 525-line

television systems. The recorded program contains several cue marks which are necessary for the proper operation of the system. These cue marks are placed on the tape automatically when a cartridge is recorded. The recorded presentation on the tape is the same as the

highband quadruplex reel-to-reel tapes.

#### Automatic Cueing

Note that in Figure 3 the cartridge tape is controlled by two permanent mechanical cue marks located near the ends of the tape. The cue marks are normally used to pre-

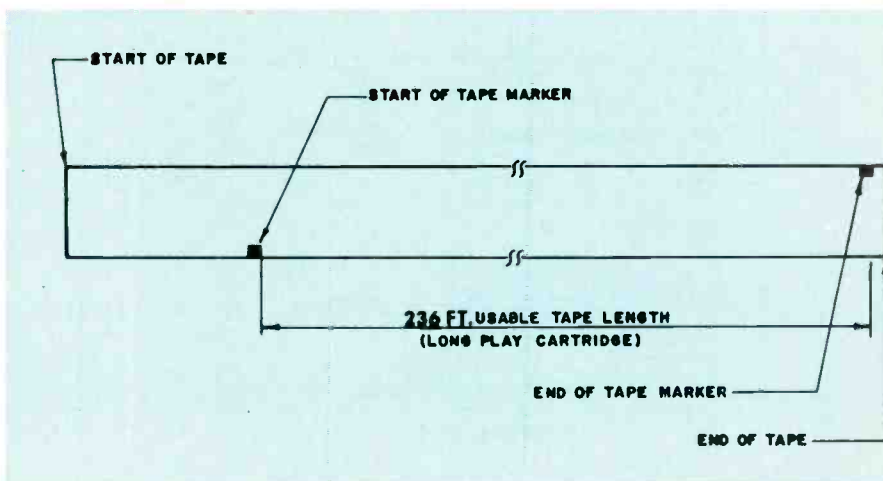


Fig. 3 Cue marker locations.

vent the tape from being completely unwound under any condition in the equipment. As a matter of fact the start-of-tape marker provides a bench mark for recording.

To place the unit in a recording position, the start-of-tape marker is automatically located and the tape is prepared to begin a recording. As seen in Figure 4, the recorded tape needs two additional magnetic tone marks on the cue track to perform these important functions. This provides exact determination of the location and duration of the actual program segment.

The start-of-message (SOM) tone mark is located exactly two seconds before the start of the active pro-

gram. This tone mark determines the exact point where the equipment will start the playback operation. During normal operation the unit must be given a two second pre-roll command when playing the cartridge system. It will start up and provide a fully synchronized color picture in less than two seconds so that the signal could be put on the air two seconds after start up.

Ten seconds before the end of the program an eight second end-of-message (EOM) tone mark is located. It is positioned during recording by establishing the system's duration of program time. The mark can also be repositioned to correct an improperly recorded tape. The

trailing edge of the eight-second tone mark is provided for the start pulse to the next cartridge in a sequence so that the two second pre-roll is automatically provided.

### Threading Mechanism

The cartridge system equipment includes a tape transport and an automatic threading mechanism which is illustrated in Figure 5, and functions in the following manner. In order to thread the tape through the vacuum guide and around the rest of the tape path, a special mechanism extracts a loop of tape from the cartridge and places the tape in the operating path. The threading mechanism then retracts so that it does not interfere with playback, record, or rewinding of the tape in the normal tape path. When the play or record cycle is completed, the tape is automatically rewound past the start-of-message mark. Therefore, the threading mechanism extends and removes the tape from the tape path, and the tape loop is drawn back into the cartridge. This completes a threading cycle and the cartridge is then available to be removed from the playing station.

### Changer Mechanism

Figures 2 and 6 present the Cartridge Changer mechanism which carries and handles 22 cartridges. A belt with 22 bins and two transfer stations is located above the entrance to each playing station. Transfer station A is on the top left side and transfer station B is on the top right side of the belt changer mechanism. The cartridges are transferred from the bin to the playing station by a pair of arms which move downward to engage the cartridge on its recessed plate at the rear. The arms then move horizontally back into the equipment to put the cartridge into the playing position. When a play or record cycle is completed, the transfer arms then engage the cartridge and move it back into the bin with the doors closed.

### Sequence of Operation

The video cartridge tape recorder is compact, versatile and simple to operate. On a cartridge, preloaded with one to three minutes of tape, there is enough time to handle commercials, promos and news clips.

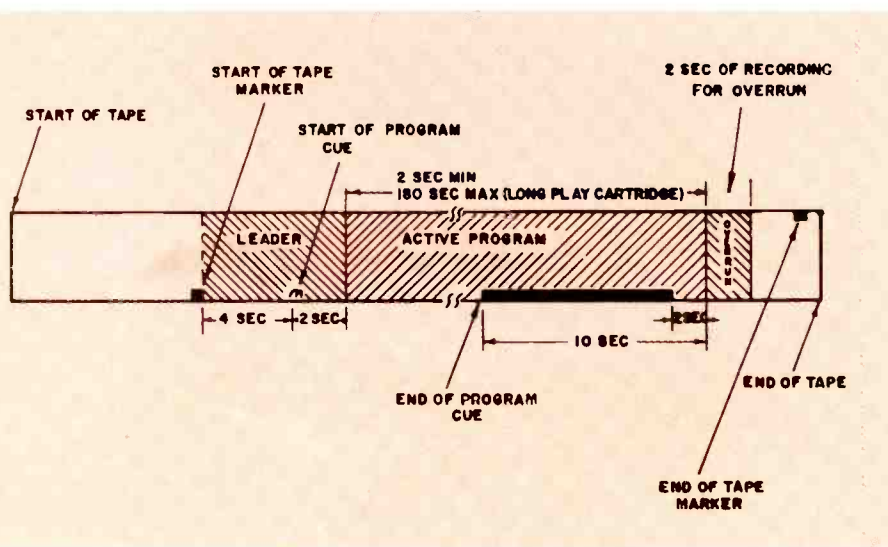


Fig. 4 Sequence of marker operations.

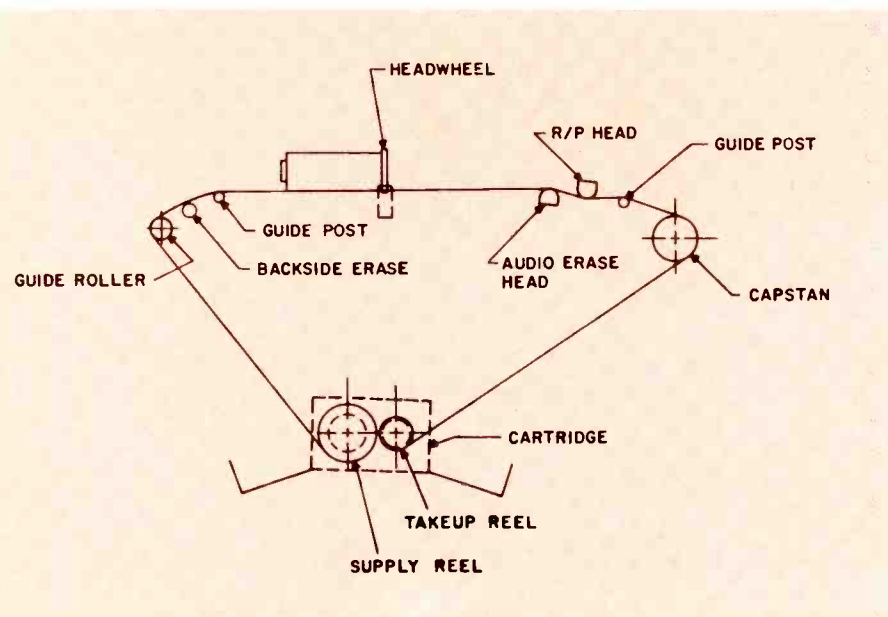


Fig. 5 Tape transport and automatic threading mechanism.



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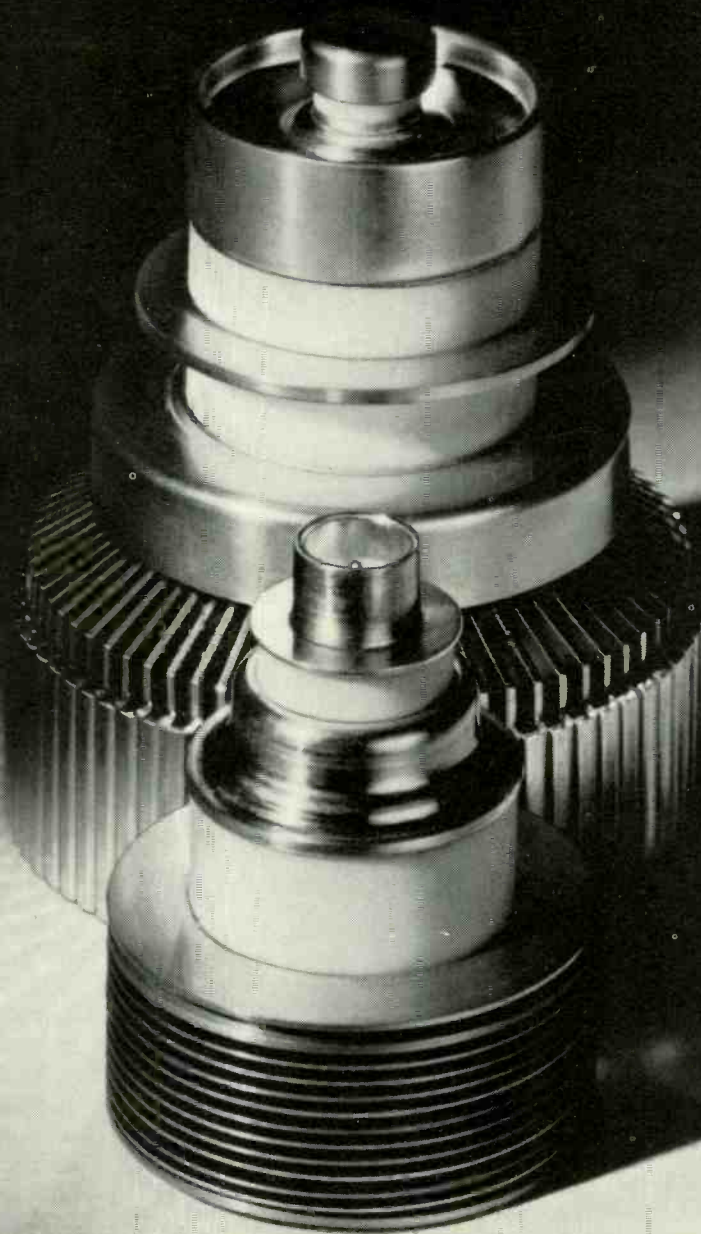
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Now let's look at how this mechanism is controlled to play a sequence of cartridges. Here is a step by step description of the various operational functions of the RCA video cartridge tape recorder.

The equipment control system provides all the facilities for playing cartridges in a continuous sequence, when they are properly loaded in the belt. Normally, the cartridges are loaded into their bins on the belt starting with Bin Number 1. Figure 6 shows the numbering of the sequential bin locations in the belt. When the HOME mode is activated, the belt will move so that Bin Number 1 is indexed at play-

ing Station A. To play a sequence, the PLAY CUE mode is activated. This starts a sequence of operations which results in both A and B playing stations being loaded, threaded, and cued up. After this cycle of operation is finished, indicators will show the operator that the PLAY CUE function is completed, and the unit is now ready to accept a play command.

The PLAY CUE mode operation causes cartridge Number 1 to be loaded in Station A. After this is positioned, the belt moves three spaces to the right which then positions Bin 2 at Station B. The Bin 2 cartridge is then transferred into

Station B and the belt at once shifts three spaces back to the left. This operation prepares the change mechanism to accept cartridge Number 1 back in the bin after it has been played.

As each cartridge is transferred into a playing station, that particular station will automatically thread the tape into the tape path and then advance the tape in a forward run direction until the start-of-message cue is located. The tape will stop at this point and the playing station is now ready for a play command. Station A is then started in the play mode when the play command is given. (See Figure 7.)

The equipment servo system should produce a fully synchronized color picture in less than two seconds. Two seconds after start the active program material will follow. After Cartridge 1 is played through, the end cue of Cartridge 1 is detected at ten seconds before the end of the program on Cartridge 1. The trailing edge of Cartridge 1 end cue then starts the B playing station at two seconds before the end of the program on Cartridge 1. Two seconds after the start of Station B it will be fully synchronized and the program will be automatically switched from Station A to Station B. This program switch process is accomplished during the vertical blanking interval.

After the program switch to Station B, Station A automatically rewinds Cartridge 1 until the start of message cue is passed. When Cartridge 1 has stopped and unthreaded from the tape path it is unloaded back into Bin 1. The belt then moves two spaces to the left which brings Bin 3 into position at Station A. Again the thread and cue cycle is activated on the cartridge in Bin 3 which has been transferred into Station A. When threading and cueing of Cartridge 3 is finished it is ready to accept a start trigger. After Cartridge 3 has been transferred, the belt moves five spaces to the right. It then puts Bin 2 at Station B ready to receive Cartridge 2 when its cycle has been completed.

As Cartridge 2 continues to play in Station B and when the trailing edge of the end cue from this cartridge is passed, a start trigger is directed back to Station A. Station A, which now contains Cartridge 3, begins running and after two sec-

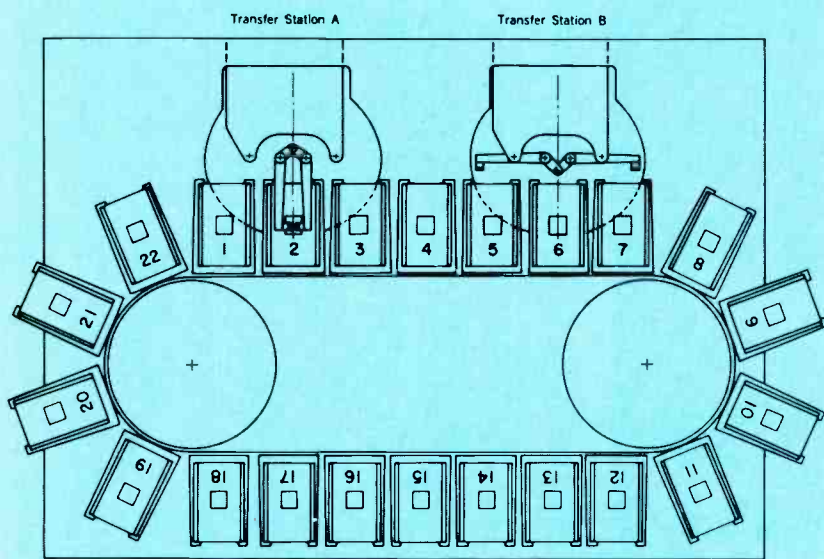


Fig. 6 Belt changer mechanism.

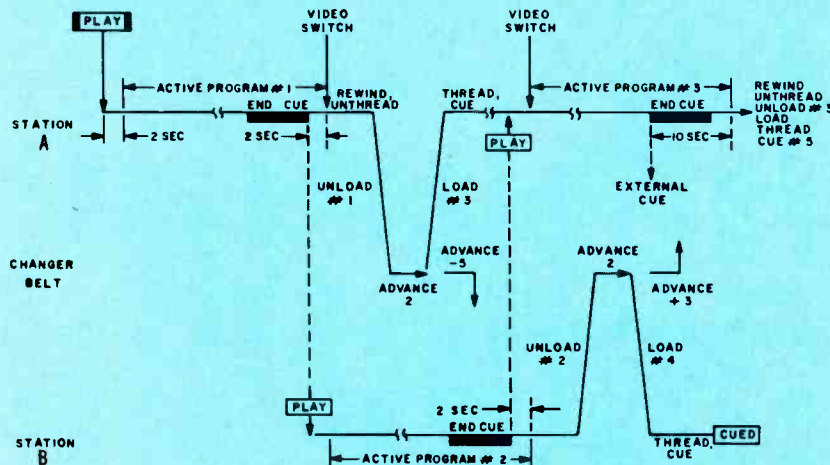


Fig. 7 Cartridge sequence of operation.



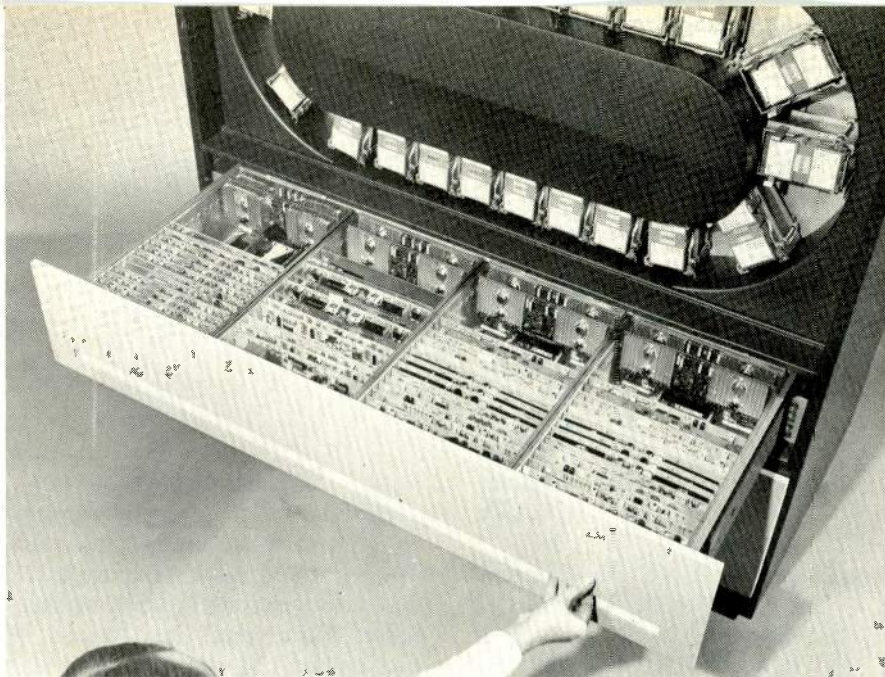


Fig. 8 Display of the electronics layout and cartridge tape belt.

onds the program switches back to Station A. Now Station B goes through the cycle of rewind, unthread, unload, advance belt, load, thread, and cue to ready Cartridge 4. The operational cycle of removing one cartridge and readying the next one in the same playing station should take a little less than 20 seconds. Therefore, the shortest program segment which can be sequenced continuously is 20 seconds, although either the first or last segment in a sequence can be produced at a shorter length of time. In many cases, the cueing system is capable of handling segment lengths down to two seconds.

The "Automatic Sequence Register (ASR)" provides a means to program the number of commercials in a given sequence. This is a desirable feature because the sequential process described above would be endless once started with one cartridge triggering the next one. This condition would continue until an empty bin was reached or the equipment manually stopped. The operator normally adjusts the system to indicate how many cartridges to play in sequence for each play command.

In the "Master/Slave Mode" two independent automated VTR systems are coupled together with a common control and video processing. As the video playback signal electronics are identical to those in presently available highband VTR's, economy is achieved when the cartridge system uses the signal electronics from the existing reel-to-reel

VTR. In this mode the cartridge system is the "slave" to the reel-to-reel VTR which then becomes the "Master". The Master/Slave self contained system is performed by modifying the master equipment to provide an FM switch to provide a switching facility between the normal FM output of the reel-to-reel electronics and the output of the cartridge slave unit. This procedure is arranged to switch during the vertical blanking interval with the servo system of the master unit modified so that an excellent video switch transition would be possible between the master equipment and the cartridge.

With the Master/Slave system it is assumed possible to insert a sequence of cartridges and go from master machine to the cartridge playback, change or re-cue the tape on the master while the cartridges are playing, then go back to the master unit at the end of the cartridge sequence.

#### Recording Techniques

The broadcaster will note that the cartridge system contains facilities for easily recording any type of material on a cartridge including film or live segments in a sequence, without complications. Related to the basic part of the system is the capability of placement of cue-marks on the tape during a recording session. The system also provides a means for pre-roll of external equipment during recording so that a recording can be accurately started. Looking at Figure 4, it will be seen

that exactly seven seconds of the signal should be recorded on the cartridge ahead of the active program material. If a program was being recorded from a reel-to-reel tape, it would be necessary to cue up the tape recorder at less than minus six seconds so as to insure that it would be fully stabilized by the time the minus six second point is reached. The cartridge unit at this point should be started in the record mode.

An automatically recorded format for a VTR needing a six second stabilization time and a required 13 second pre-roll will be described. The VTR would be cued 13 seconds prior to the start of the program; by using the proper control on the control panel it would be placed under remote control of the cartridge recorder. The RECORD button is pressed; this will then produce a PLAY trigger which will start up the external VTR.

After six seconds the cartridge machine will start in the RECORD mode and begin recording. Two seconds later the start of program cue will be recorded and at 13 seconds the program will begin. The program is now being recorded and at ten seconds prior to the end of the program the end of the program cue then begins recording. This will continue for eight seconds and up to two seconds before the end of program. The video and audio continues to be recorded until two seconds beyond the end of the program. The system then automatically rewinds the cartridge and sets it up in the PALY CUED condition for the desired preview by the operator. If a preview is not required, a reject condition is installed.

The Video Cartridge Tape Recorder, can be used as two automated video tape recorders, an automatic cartridge changer and a programmable control R-R system. Figure 8 presents the electronics layout of the VCTR.

A less complex and lower priced VCTR should be developed and introduced for use in CATV, educational/instructional, public broadcasting, research, medical and laboratory outlets. This would provide a challenging facility and put a new dimension in the recording and playing of any type of material, including programming possibilities with a wide range of applications. ▲

# The move toward bidirectional CATV

By Leo G. Sands\*

The FCC has joined the advocates of maximum utilization of CATV facilities. This can only be achieved by providing bidirectional transmission facilities. The original purpose of CATV was to pipe television programs into areas where direct off-the-air pickup of TV stations was poor or not possible. Now CATV systems are in operation, or are to be installed, in areas served directly by TV stations, including major cities. In such areas there is often a need for bidirectional transmission capability.

The concept of bidirectional CATV is not new. A few years ago the author wrote a series of 12 articles about CATV for a telephone industry magazine in which it was stressed that telephone companies planning to install CATV transmission facilities should seriously consider making them bidirectional. It was pointed out that the same facilities could be used for bidirectional telephone, data and CCTV transmission, in addition to unidirectional TV program transmission.

Shortly thereafter, the author's firm was engaged by a blue chip corporation to conduct a study to determine the feasibility of installing a two-way coaxial cable system to serve a metropolitan area with a population of almost 1,000,000. When asked what capabilities were required, the client's representative said "surprise us."

It was found that the client could offer the following facilities and capabilities to the community:

- (1) nine channels of programs picked up from commercial and educational TV stations, two closed circuit educational TV channels, one local-origination TV program channel, FM band ra-

dio, and a music channel, for transmission to CATV subscribers.

- (2) two or more closed circuit TV and audio channels for transmission to subscribers to special services (business news, medical, etc.).
- (3) 50 private telephone channels for use by the city government.
- (4) closed circuit TV surveillance of parks, schools, major intersections and other public properties.
- (5) bidirectional closed circuit TV transmission between schools.
- (6) bidirectional data transmission between schools.
- (7) bidirectional data transmission between hospitals.
- (8) bidirectional data transmission between hospitals and doctors' offices.
- (9) bidirectional data transmission for business and industry.
- (10) Pickup of signals for low-power police walkie-talkies and transmission of the audio to police headquarters.

## Trunk Cables

Because of the large geographical area to be covered, trunk cable lengths would have been excessive if the conventional system configuration were employed. Instead, it was determined that the head end should be in the center of the city, adjacent to the railroad station. From the head end the plan called for running eight trunk cables through railroad-owned underground ducts in the downtown area and attached to railroad-owned telephone poles in other areas. The distribution cables would be run underground in some areas, on power company poles elsewhere.

All trunk cables would be equipped for bidirectional transmission. Distribution cables and drops would be unidirectional except those to be used for picking up signals. The head end would function as a switching center where signals coming in on one trunk at frequencies below 46 MHz could be routed out on one or more trunks at frequencies above 50 MHz.

The basic system plan calls for bidirectional through a single cable instead of separate cables for each

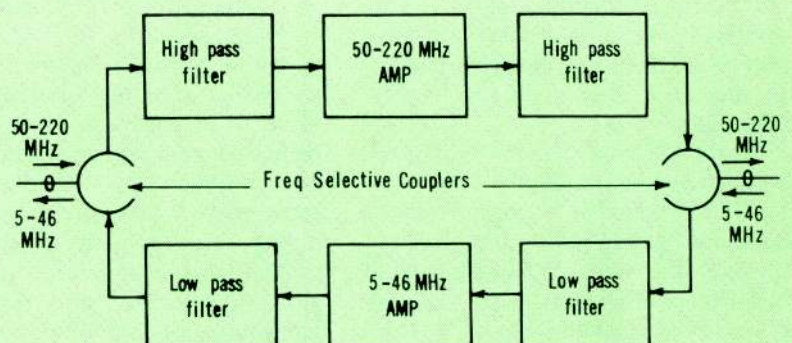


Fig. 1 Bidirectional repeater.

\*BE CATV Editor and president of Leo G. Sands & Assoc. N.Y.



direction of transmission. Signals above 50 MHz are to be transmitted outward from the head end, and signals below 46 MHz inward to the head end.

Where to get all of the necessary hardware was a problem. It still is, but will become less of a problem when equipment manufacturers can see that the market for two-way CATV hardware is not too far off.

### Trunk Cable Repeaters

The plan calls for two basic types of trunk cable repeaters—one type consisting of two amplifiers and filters, as shown in Figure 1—the other type consisting of one amplifier and a filter network, as shown in Figure 2. Every trunk repeater amplifies signals in the 50-220 MHz range. Some also amplify signals in the 5-46 MHz range (Figure 1); others simply pass signals in the 5-46 MHz range around the 50-220 MHz amplifier (Figure 2). Two types of repeaters are required since signals in the 5-46 MHz range require amplification at fewer points than higher frequency signals. Filters are required to prevent "singing."

To insert signals for transmission inward to the head end, a repeater such as shown functionally in Figure 3 would be required. And to both drop and insert signals, a repeater configured as shown in Figure 4 would be required. Hardware for assembly of these various types of repeater stations is available.

The greatest difficulty was finding a source of telephone circuit channelizing equipment. If conventional telephone carrier equipment were to be used, it would have been necessary to provide group modulators, and the equipment would have been costly. When various telephone equipment manufacturers were asked if they could supply modulators that would operate within the 42-46 MHz range, and demodula-

tors that would operate within the 72-76 MHz range, the answer was "no."

A radio equipment manufacturer, however, offered to design and furnish low-power AM or FM modulators and demodulators at much lower cost than conventional telephone carrier equipment. Each telephone circuit would be terminated

as shown in simplified form in Figure 5. At a police/fire call box, no bell would be required. Taking the handset off the hook would activate the modulator and demodulator. The modulator carrier signal would cause an off-hook indication to be received at the switchboard. At those locations where a telephone bell would be required, in-band or

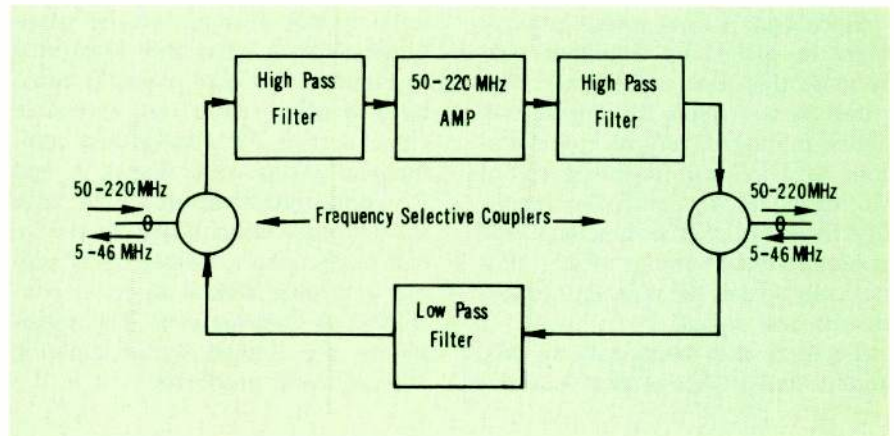


Fig. 2 A repeater with passive low band path.

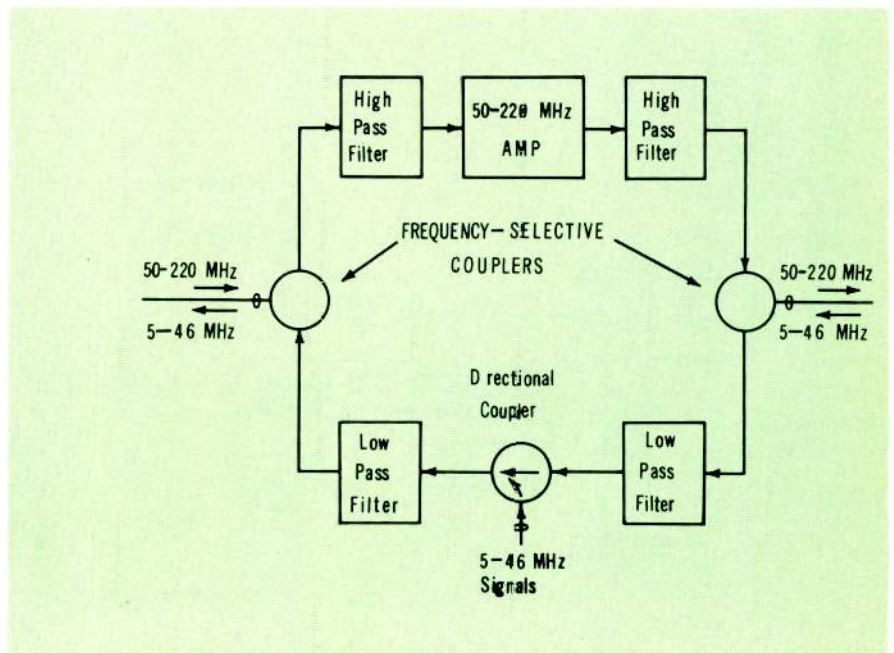


Fig. 3 Repeater with signal insert facility.

out-of-band electronic signaling would be used.

Numerous cities now furnish police officers with walkie-talkies which can receive signals from a high-powered base station at almost any location within the city. But, from many locations, signals from the low-powered walkie-talkies cannot be intercepted at the distant base station. This problem was solved by calling for installation of satellite radio receivers in the outlying parts of the city. At each radio receiver location, the audio output of the receiver would be fed to a modulator operating within the 42-46 MHz band, or lower frequency, for transmission through the CATV system to police/fire headquarters.

Since signals from a walkie-talkie might be picked up simultaneously by more than one satellite receiver, provision was made for remote, selective muting of any receiving station, as illustrated in Figure 6. Muting could be controlled manually from police/fire headquarters, or by a "voting" circuit which automatically selects the receiver delivering the best signal.

To drop and insert data signals, suitable modulators and demodu-

lators, as well as data terminals, were called for. Outward data signals could be transmitted at carrier frequencies above 216 MHz or between TV channels 6 and 7. Closed circuit television signals would be applied through TV modulators operating at frequencies not used for public TV program transmission. In this particular system, which has not yet been installed because of the major market "freeze," inward bound signals would be demodulated and fed to modulators which would feed outward bound signals into the trunk cables. For some purposes, frequency translators could be used.

Conventional single-trunk CATV systems can be initially designed or converted for bidirectional transmission. An example of the capabilities of such a system is illustrated in Figure 7. Schools A and B could have bidirectional or reversible closed circuit TV and/or data communication, as could banks A and B. Police headquarters could have a telephone switchboard linked to call boxes, and a master traffic signal controller linked to local controllers at intersections. The possibilities are limited by imagination and technical problems.

Bidirectional CATV is being used in Montreal, for example, for transmitting locally originated programs toward the head end where the programs are transmitted from the head end to subscribers on other frequencies. In the not-too-distant future, as many have predicted, CATV facilities will be used for automatic reading of utility meters, transmission of facsimile newspapers, automatic polling of program audiences, and direct telephone or push button means for summoning emergency assistance, as well as shopping and possibly even voting without leaving home.

### Microwave

Furnishing of common carrier communications services is no longer limited to Western Union and the Bell and independent telephone companies. The major breakthrough came when the FCC ruled that Microwave Communications, Inc. was eligible for a license to install a microwave system and to charge others for use of microwave channels in direct competition with Western Union and the telephone companies. And as a result of the "Carterfone Decision" by the FCC, telephone companies are required to permit use of "foreign attachments" on their lines.

Unless the FCC rules otherwise if the telephone companies protest, it should be possible for CATV systems to interconnect with telephone company circuits. For example, an advertiser might want to transmit a TV program via a Bell System circuit to one or more CATV systems which would in turn distribute the program to CATV subscribers. Also, it should be possible for CATV systems to be linked together through telephone company facilities for exchanging local-origination programs. Furthermore, telephone company inter-city data transmission circuits could be extended locally through CATV facilities. The economic benefits of bidirectional CATV facilities could be of great significance.

### Technical Problems

Here, the author has suggested technical approaches for implementing bidirectional CATV. There

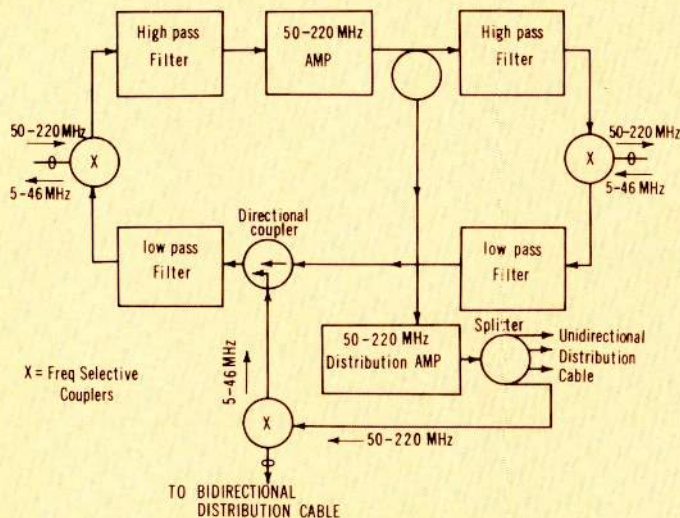


Fig. 4 Repeater with drop/insert facilities.



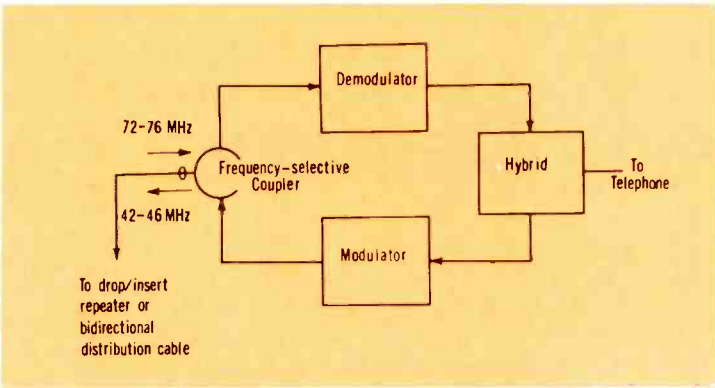


Fig. 5 Telephone circuit termination.

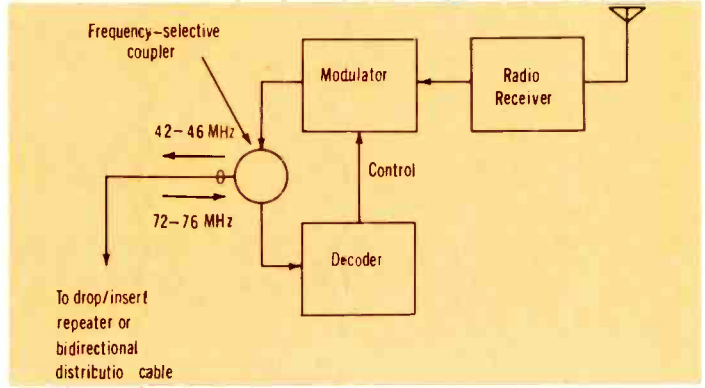


Fig. 6 Radio receiver terminal.

are problems, however, since coaxial cable is not a perfect transmission medium nor is all of the necessary hardware fully adequate and available off the shelf. Great strides have been made in improving CATV amplifier performance, making it practical to use frequencies other than TV channels 2 through 13.

Many of today's technical problems, encountered when using analog transmission, will not exist when digital transmission techniques are refined. Marconi (in England) has already announced the development of a PCM (pulse code modulation) system capable of simultaneous transmission of up to 200 color TV channels through waveguide. It should be possible to transmit a lesser number of channels through coaxial cable. A sister company, Canadian Marconi, is marketing a PCM system for transmission of data and up to 120 voice channels which can use microwave or coaxial cable as the transmission medium. It should be feasible to use such PCM equipment in a bidirectional system by applying the head end bound PCM signals directly to the cable, and the outward bound signals through an RF modulator. It should also be possible to transmit television and other analog signals over the same cable at the same time.

### One Cable Or Two?

The \$64 question is: "should one cable be used for bidirectional transmission, or should separate cables be used for each direction?" From the standpoint of simplification of technical problems, the answer is:

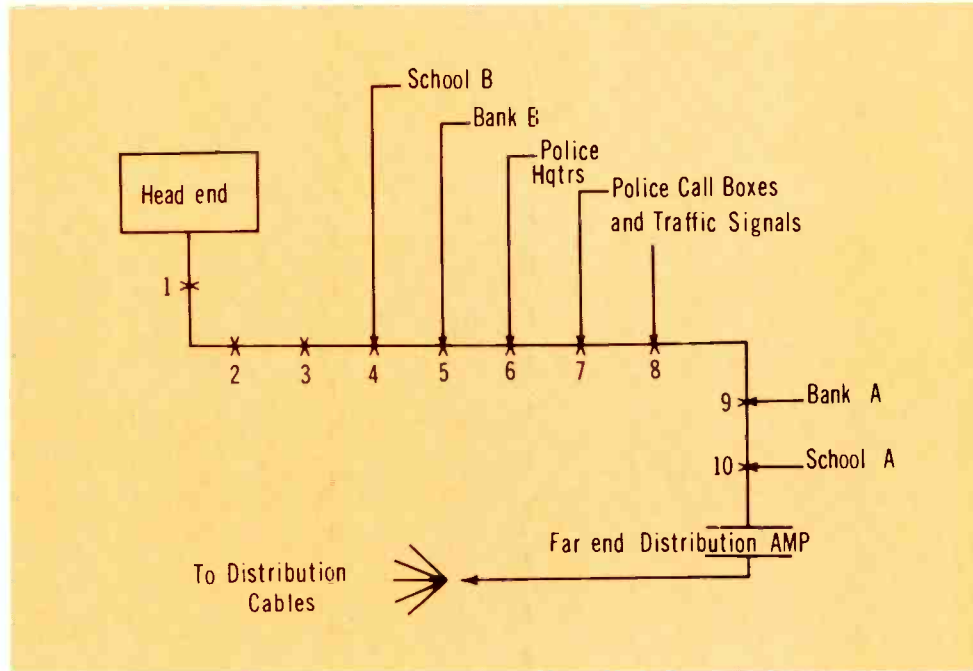


Fig. 7 Example of bidirectional CATV capabilities.

"two cables, if not more." Considering the cost and vulnerability of electronic hardware to failures, it might be more economical in the long run to use two or more cables.

The simplest way to convert a unidirectional CATV system into a bidirectional system is to piggyback a second system, transmitting in the reverse direction, on the same poles. This doubles the investment in cable and amplifiers, and could pay off if the operator has a large enough market for special services and is an aggressive salesman. The less costly alternative is to have a consultant, or an equipment manufacturer, redesign the system for bidirectional transmission through the existing cable.

When starting from scratch, it is a different ball game. Cable installers can almost as readily install a dual or multi-tube coaxial cable as a single-tube coaxial cable. It doesn't cost much more for labor to install two amplifiers instead of one at each amplifier location. Which route to take should be resolved on an individual case basis. What is best under one set of circumstances, might be folly under another. The main point to bear in mind is that a single coaxial cable can handle up to about 300 MHz of information. Two can handle up to 600 MHz. Economically, it's a matter of how much revenue each MHz will produce, and at what initial and operating cost. ▲

# Avoiding Lightning Damage to power supplies

By Horace N. Smith

With the coming of any new device in engineering (such as solid state devices), there are always things that come up unexpectedly that the designer cannot foresee.

In the case of solid state power supplies for medium powered transmitters that operate from three phase power lines, it seems very simple to replace the six rectifier tubes with solid state silicon diodes and eliminate the tubes and extra filament transformers. In actual practice, this is true most of the time. However, there is one application that apparently needs more capacity built into the system than the ordinary specifications call for.

The case in point is a transmitter power supply using a 220 volt three phase power line circuit to provide 4100 volts DC at 1 amp. In the conventional three phase entrance system from the power company there are three complete transformers, either wound separately or wound on one set of laminations. In either case, there are three primary and three secondary windings. These are usually connected in either a "Y" or a "Delta" connection or a combination of both. In Figure 1 the primary is Delta and the secondary is connected "Y". There are other ways to make the connections, depending on the customers' need for various types of current and voltage combinations, or sometimes circuits are different due to the choice of a power company engineer.

The secondaries in Figure 1 will provide 220 volts between any two of the "hot" wires and 110 volts between any hot wire and the grounded neutral. The 220 volts split with a grounded neutral is the conventional voltage used in most homes and businesses. Also, 220

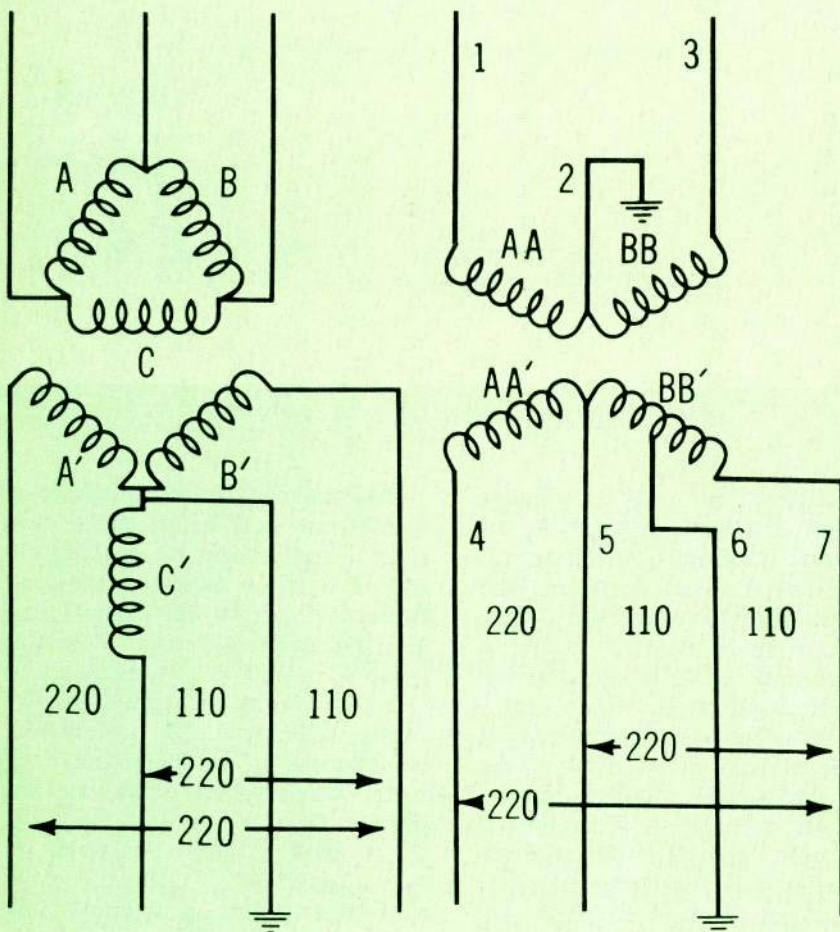


Fig. 1 left 7200 volt primary, 3 phase.

Fig. 2 right 7200 volt primary with 2 phases, each above ground.

\*Chief Engineer at WERK and WCTW.



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**Other features unique with the AKG system are:**

**A) Stabilized operating voltage:** The DC supply voltage to the microphone is not required to be particularly well regulated nor is it rigidly tied to a specific voltage. In fact, it may vary by  $\pm 15\%$  since the C-451E preamplifier will stabilize the operating voltage. There is no limit to the number of microphones to be powered off your console.

**B) Constant 60 volts polarization voltage:** 60 volts is the optimum polarization voltage for highest performance standards, specifically sensitivity; resulting in more gain without increase in noise level and better signal-to-noise ratio. The C-451E supply voltage is not simultaneously the polarization voltage (too low). The microphone preamplifier provides a constant 60 volts polarization voltage and fluctuation in the supply voltage will not change the output level of the microphone.

There are no short cuts in the AKG C-451E circuitry!

### HOW DOES IT SOUND?

Interestingly enough, its pick-up characteristics are being compared to the quality previously obtained only with large diaphragm condenser microphones.

The newly developed CK-1 capsule incorporates a metallic alloy diaphragm (similar to the diaphragm material used in measuring microphones) and is absolutely smooth between 30-18,000 Hz with unequaled transient response characteristics and wide dynamic range.

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volt three phase is available power by using all three hot wires. The power company may use a smaller transformer on one side of the three phase line to complete the three phase circuit with larger transformers on the side or phase that supplies the single phase power to the station. This allows both single and three phase power from the one set of transformers.

The exception to the typical circuit hookup is found when a radio station is located in a rural area or on the outskirts of a city where only two phases of a line are available or where there is only single phase power and the power company wants to run only one more phase to the station to save on construction costs which could run into thousands of dollars. In this type of situation there are usually two phases plus a ground or neutral supplied in the primary circuit of the power line.

In a small or medium powered station, the two phase hookup will provide ample power at a savings to the power company. When the two phases are provided, the hookup is usually made as in Figure 2. The primaries and secondaries are connected in an "Open Delta" style. The angle between the phases is  $120^\circ$ , with two phases provided making  $240^\circ$  used, this leaves  $120^\circ$  across the remaining open circuit which is correct for three phase operation.

The voltage across the secondaries in Figure 2 windings AA' & BB' have 220 volts each and are in series. However, due to the phase difference, the total voltage across them on wires 4 and 7 is another 220 volts which completes the three phase supply and will operate equipment just as any three phase conventional hookup will do.

In order to get 220/110 volt

single phase power for other use, one of the 220 volt windings is split with a center tap and grounded for a neutral as is winding BB' with wire 6 in Figure 2. This leaves wire 4 with about 205 volts above ground; however, this poses no problems for a three phase transformer or motor, since their windings are isolated from ground. Transformer BB' and BB is usually larger since it provides the single phase current for the station such as light, heat and other power.

The problem with this type of connection apparently shows up only during a lightning storm or when the power company is making and changing connections. As you can see in Figure 2, there is no third winding across either the primary or secondary transformers and this leaves the connection between wires 4 and 7 in series with the windings. If any power surge, such as a lightning hit or unusual connection change is made, where a current is induced in both windings at the same instant and in the same direction, a double voltage will appear between wires 4 and 7 even if there are provisions by the power company to keep all voltages within certain limits.

This extra surge of voltage has never caused much of a problem with rectifier tubes since they will withstand a great voltage surge without damage for the very short period of time involved. However, with silicon diodes, any voltage over the rated PIV may cause damage even though it may last only a few thousandths of a second. In the power supply at WIUC, Winchester, Indiana this voltage surge would knock out one side of the rectifier bank each time the sky would get black and lightning was noticed in the community. The rectifiers were rated at 10,000 volts PIV and were

providing 4100 volts DC. In the average circuit and conventional hookup, this rating would seem more than adequate. But the voltage across the open side would rise high enough to damage the rectifiers, since there is no winding there to absorb any extra current and keep the voltage down.

After checking out the transmitter circuits and making a drawing of the power company's connection, it appeared that a simple solution would be to increase the peak inverse rating of the rectifiers. This was done with a complete set of rectifiers installed in series with the ones already in service. This increased the PIV of each diode section to 20,000 volts. Actually, the rectifiers across the side where the open voltage appears would be all that is necessary for the modification. It did seem advisable to reinforce the entire set of rectifiers to prevent any further trouble. During the last two summer seasons there have been numerous electric storms and for the first time since the station went on the air, they have had no problem in a storm and apparently no power supply damage. There is no change in transmitter operation due to the modification and no change in performance.

Some "Open Delta" circuits would be more susceptible to damage than others, depending on the type of area, the distance of the lines involved and many other things such as power factor angle, and power company condensers to keep the voltage and current in phase. If any station is having this type of difficulty, it might be well to check and see if the situation is similar to that of WIUC. (See Robert Jones' article on tower static in the October, 1970 issue of Broadcast Engineering.) ▲



# for small market stations

the field lens position of the multiplexer. The results were amazing. In fact, Weisensell and Clyman, who had battled the color imbalance for four years, were amazed at how unbalanced the light sources were.

The specially purchased GE gray scale which is used for adjustments of the lamps of both the slide and film projector, showed that there was an excess of light in the film chain. Both the slide projector which uses a 500 watt lamp and the film projectors which use 300 watt lamps had more than enough light needed to operate effectively, and the imbalance between the two light sources was marked.

The WMTV engineers did not

discover this earlier, according to Weisensell, because the film projectors were adjusted by a gray scale that was purchased in 1966 and could only be used in adjusting the film projectors. The new gray scale, which is used in adjusting both the film and slide projectors, led the WMTV staff to try filtering of the slide projector light and then adjusting the light source of the film projectors.

"We knew we had too much light on the slides," stated Weisensell, "So we figured if we decreased the light in the TP-7 projector, we could begin balancing the slide and film color."

With a Kodak CC 30C filter on

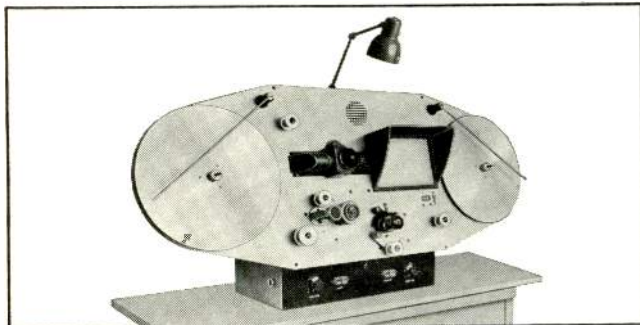
the slide projector and voltages adjusted on the lamps by means of Variacs in the TP-66s and by adding a Variac to the TP-7, the projectors could be balanced and the color problem was virtually solved.

The ultimate touch was the decision to use the same Ektachrome stock for slide and develop it in the same chemicals as the film. The final solution to color imbalance at WMTV was a story of cooperation and a combination of skills and techniques.

A similar system for color balance is planned by Weisensell for WMTV's sister station, WSAU-TV, a Forward Communications station in Wausau, Wisconsin. ▲

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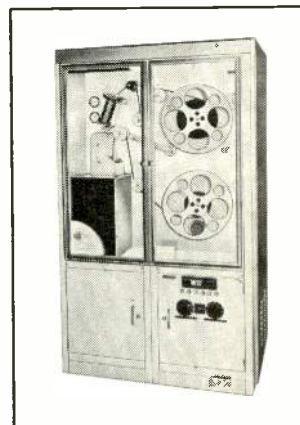
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# Testing Transistors

By Carl Babcoke  
BE Solid State Editor

No bench should be without a commercial transistor beta and leakage tester. If transistors replaced the vacuum tube, something must replace the tube checker. In this series we think you'll pick up main and backup methods for checking transistors. Let's try the beta test.

DC beta is the ratio of collector

current versus base current. Most commercial transistor testers vary the base current until a pre-determined amount of collector current is read on the meter, then the meter is switched to read the base current. The meter scale is calibrated as DC beta.

We should understand the significance of such tests to avoid mis-

**Table 1—Ohmmeter and beta tests of three power transistors.**

		negative lead to:	positive lead to:	meter scale:	reading in ohms:
<i>2N408 germanium PNP low power-low voltage output transistor DC beta 150—all leakages normal on transistor tester</i>	forward	base	emitter	X10	31
	forward	base	collector	X10	29
	leakage	emitter	base	X10K	1M
	leakage	collector	base	X10K	700K
	C/E forward	collector	emitter	X100	6000
	C/E leakage	emitter	collector	X1K	200K
<i>2N301A germanium PNP high power-medium voltage transistor DC beta 130—slight, normal ICEO leakage</i>	forward	base	emitter	X10	16
	forward	base	collector	X10	15
	leakage	emitter	base	X1K	45K
	leakage	collector	base	X1K	33K
	C/E forward	collector	emitter	X100	70
	C/E leakage	emitter	collector	X100	8K
<i>NPN silicon medium power-high voltage transistor DC beta 70—all leakages normal on transistor tester</i>	leakage	base	emitter	X1M	500M
	leakage	base	collector	X1M	200M
	forward	emitter	base	X10	110
	forward	collector	base	X10	104
	C/E leakage	collector	emitter	X1M	21M
	C/E forward	emitter	collector	X1M	180M

Ohmmeter function of a VTVM used for measurements; battery 1.5 volts.



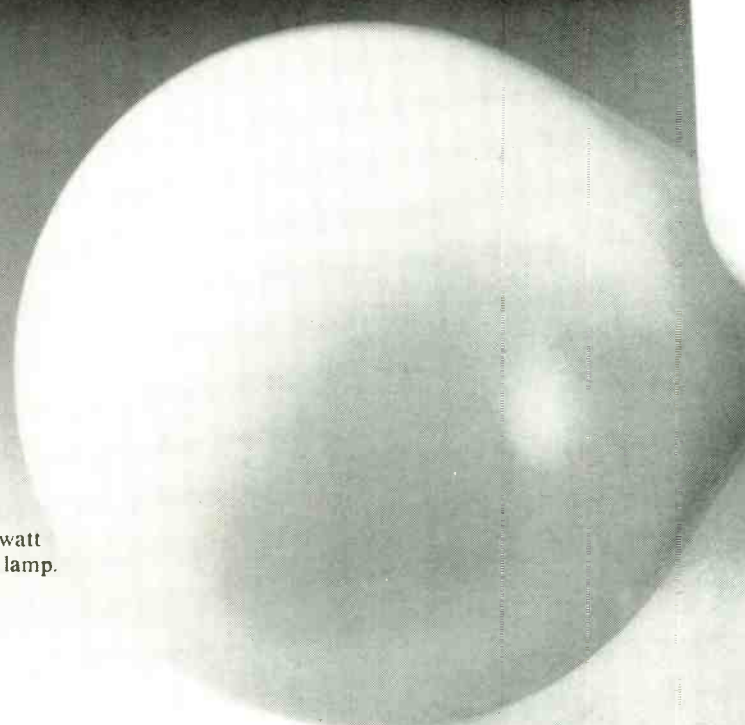
**Our new krypton-halogen replacement for the PS52 fits the same fixture, lasts twice as long and maintains constant color temperature for life.**

**That's some replacement.**

New DSF 1500-watt  
krypton-halogen studio lamp.



PS52 1500-watt  
incandescent studio lamp.



When you replace a PS52 studio lamp you can replace it with something better.

The something better is Sylvania's DSF krypton-halogen lamp, which fits the same fixture as the PS52.

Its average rated life is 250 hours. More than twice the life of the PS52.

And that's useful life, because the DSF is as bright at the end of its life

as it was at the beginning. There's no darkening with age as in the PS52.

And its 3200° K color temperature is there right from the beginning. And it's still there 250 hours later. Constant.

The DSF has low-noise construction. There are no loose parts to resonate when used with SCR dimmers.

With all these advantages, the DSF is more than a replacement.

It's a major improvement.

*Sylvania Electric Products Inc.,  
100 Endicott St., Danvers, Massachusetts 01923*

**SYLVANIA**  
GENERAL TELEPHONE & ELECTRONICS

Circle Number 22 on Reader Reply Card

interpreting the DC beta reading a tester might give us. So many transistor types have been manufactured that a transistor testing manual giving the control settings of the tester to permit the use of a good/bad scale is not always practical. In addition, the beta reading varies with the collector current used during the test. We must decide the limits that are acceptable in beta readings, often without sufficient information on which to base this judgment.

A transistor with a DC beta of 150 does not automatically produce twice the AC gain of another transistor of the same type which reads a beta of 75. There are several reasons why this is true. The same circuits that stabilize against undesired changes because of heat variations also partially stabilize against

variations in average emitter current. Therefore the more effective the heat stabilization of the circuit, the less AC gain variation when transistors of different DC beta are used.

A transistor with a low DC beta might produce normal gain if the circuit can supply the added base current. However, the input resistance of the transistor will be lower and this could have a noticeable effect on AC gain because of the change in impedance matching.

### Ohmmeter Tests

Ohmmeter tests of germanium type transistors and diodes are quite useful, but are of questionable value when checking silicon devices whose normal readings are nearly an open circuit.

Table 1 compares the ohmmeter

readings of three different output transistors. Readings are actually those of individual transistors and do not represent average conditions. Notice that only the forward bias readings of base-emitter and base-collector of the silicon transistor are low enough to have any significance in an ohmmeter test.

Some of these ohmmeter readings will change as the heat near the transistor changes. Also, the table does not show the completely different readings obtained when another ohmmeter battery is substituted.

Despite all these limitations, nearly all germanium and many silicon transistor defects can be found with ohmmeter tests, because borderline or questionable results are seldom obtained.

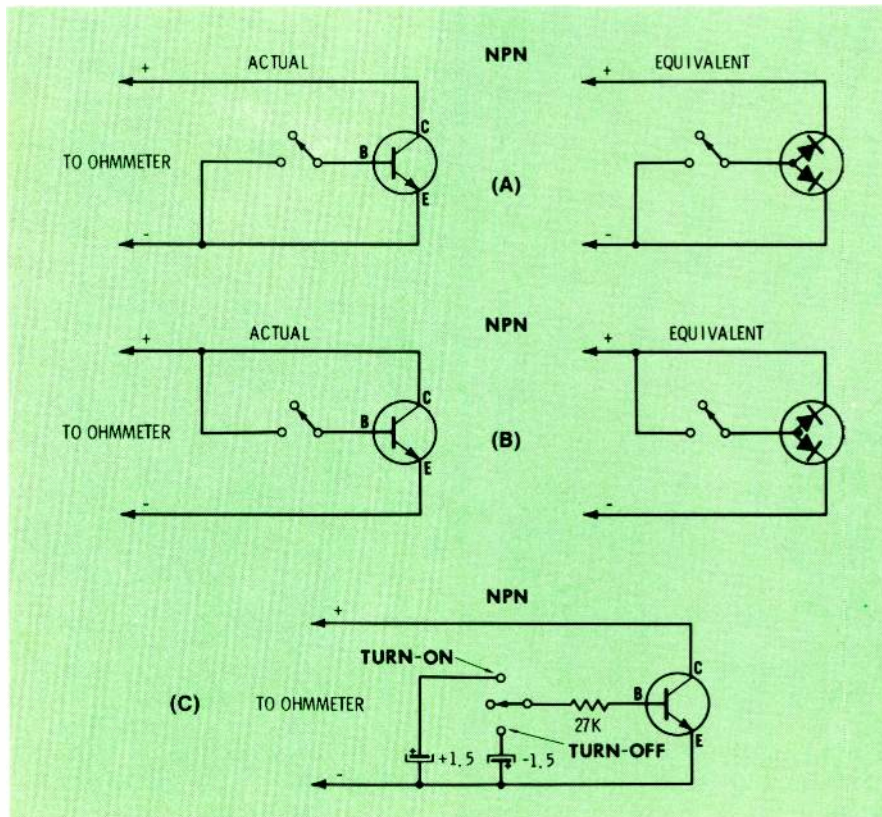
### Turn-Off and Turn-On Tests

Ohmmeter readings combined with simple turn-off and turn-on tests provide an easy method of determining leakage and the ability of the base to control collector-emitter current.

The collector-emitter resistance (in the forward bias polarity) increases when the base is connected to the emitter, as shown in Figure 1a. This is true (but not complete) transistor action, because a small amount of voltage is developed between base and emitter when the base is floating, and this voltage acts as forward bias on the base to reduce the collector-emitter resistance. Connecting the base to the emitter is a simple turn-off test.

The circuit of Figure 1b should be a simple but good turn-on test. A low reading on the ohmmeter results when the base is connected to the collector. But examine the diode equivalent schematic. The positive ohmmeter lead is now connected to the base, which is forward biased relative to the emitter, and will measure as a low resistance. This is a false turn-on test and has no value.

True transistor action can be tested by the circuit shown in Figure 1c, which keeps the collector isolated from the base as the base



**Fig. 1** Simple turn-off and turn-on tests of transistors. (A) The collector-emitter resistance increases when the base is connected to the emitter. A fairly good test. (B) The collector-emitter resistance decreases when the base is connected to the collector. A false test of no value. (C) A switch, resistor and two batteries permit turn-off, turn-on and ohmmeter tests. Accurate judgement of the transistor can be obtained, but leads must be changed during the tests.



is supplied with forward-bias, no external bias, or reversed bias. Experience shows the test results to be very good, but the operational drawback of changing leads brings the possibility of poor connection and loss of time.

A complete adapter that provides all connections for ohmmeter, turn-off and turn-on tests is shown in Figure 2. Neither the transistor nor the ohmmeter leads require reversing or changing, and a transistor can be identified as a PNP or a NPN by the readings obtained by switching the position of S1.

The 2N408 used to obtain the readings in Table 1 measured 200 ohms on the turn-on position of S2, 6K-ohms on the C-E position, and about 100M-ohms on the turn-off position. No hair-splitting decisions are necessary to judge that transistor to be normal! ▲

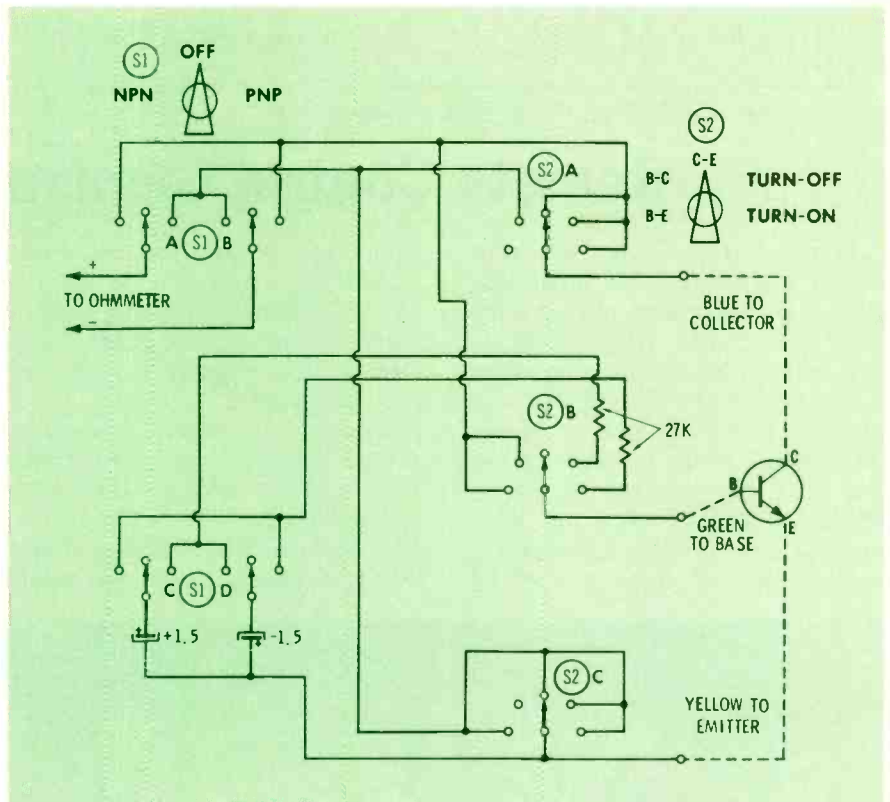


Fig. 2 Complete schematic of an adapter you can build that permits turn-off, turn-on and ohmmeter tests without moving ohmmeter or transistor clip leads.

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Circle Number 23 on Reader Reply Card

# NEW PRODUCTS

(Use circle number on reader service card for further information)

## Remote Control Camera System

In the past few years the technology associated with broadcasting has gradually been pulling away from the technical staff. Engineers and technicians must keep their track shoes on if they are to stay within shooting distance of recent innovations. It is for this reason that over the past several issues, **Broadcast Engineering** has been running more product development articles and far more pieces of

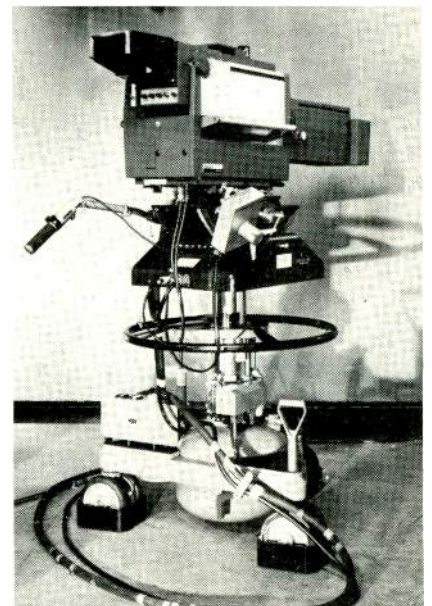
equipment in the New Products section.

This month we're going to start things off with a look at the **Power Optics, Inc.**, remotely controlled camera system.

Designed for hands off operation at the camera itself, this unique system allows remote control of pedestal height, pan, tilt, zoom, focus, and iris. Power Optics' intent was to design a system that would

enhance operating conditions for news and weather presentations, workshops and demonstrations, interview and panel shows, as well as commercial video taping and special effects. There are other possibilities, because of the "missing cameraman" effect. Perhaps it is a step toward more extensive coverage of government in action.

The remote system includes a shot setting panel and a control



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1" Helical Scan Video Tape Recorder with inst. manual, head & cord. **\$399.95**. Shipping Wt. 150 lbs. FOB Rockville.

**NEW!**

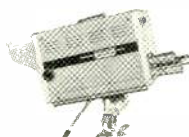
**#3800—48mm fl. 9 Lens "C" mount  
adj. iris & focus \$21.95 plus post.**



**#4080—3 in 1 Lens  
25mm fl. 9 "C" mount  
with wide angle &  
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**FAIRCHILD TV-600 CAMERA  
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Circle Number 24 on Reader Reply Card



panel. The shot panel provides for up to 10 shots, each of which may be pre-set during rehearsal. Each shot is recalled on the air by pressing the appropriate buttons. However, on-air adjustments can be made on the control panel.

The picture, taken at WUTR, shows that the shot setting panel uses a series of color coded function potentiometers allowing maximum presetting of controls. To meet the specifications in the type of control required for each function, the pots use different turn ratios.

Circle Number 55 on Reader Reply Card

### Equalizer-Amp Input Modules

The new Model 711L is the first of a new series of low-noise audio equalizer-amplifier input modules for microphone and/or line level inputs developed by the **Electrodyne Corporation**, an MCA Tech Company, Los Angeles, California. It consists of a microphone pre-amplifier, a straight line attenuator, input selector switch, Eq. amplifier and a program amplifier.

Front panel controls allow 12 dB boost and attenuation and reciprocal equalization curves for each of 8 frequencies which permits equalization of the low, mid range and high frequencies. Four high frequency and two of the low frequency curves can be selected as shelving or peaking curves. A phase reversal push button switch is provided to give 180° phase shift to the incoming signal. One echo send pot and selector switch gives the operator the choice of echo send from ahead of attenuator, ahead of attenuator but after equalization, or after attenuator and equalization.

Equivalent input noise is -127 dBm, with gain rated at 70 dB. Two microphone input impedances, 50 and 200 ohms, are provided. Line input impedance is 10K ohm bridging. All output impedances are designed for 600 ohm lines. Actual output impedance is less than 50 ohms.

Even greater flexibility is offered through the input selector lever—a dual concentric switch—which allows selection between microphone and line. There are two positions for the line with a 20 dB pad to

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by  
*Crown*

## D40



compact

delivers 40w RMS/channel at 4Ω  
takes 1¾" rack space, weighs 8½ lbs.  
IM distortion less than 0.3% from  
1/10w to 30w at 8Ω  
S/N 100dB below 30w output  
price - \$229 rack mount

## D150



value

delivers 150w RMS both channels 8Ω  
IM distortion less than 0.1% from  
1/10w to 75w at 8Ω  
S/N 100dB below 75w output  
takes 5¼" rack space, weighs 16 lbs.  
price - \$439 rack mount

## DC300



power

delivers 300w RMS/channel at 4Ω  
IM distortion less than 0.1% from  
1/10w to 150w at 8Ω  
S/N 100dB below 150w output at 8Ω  
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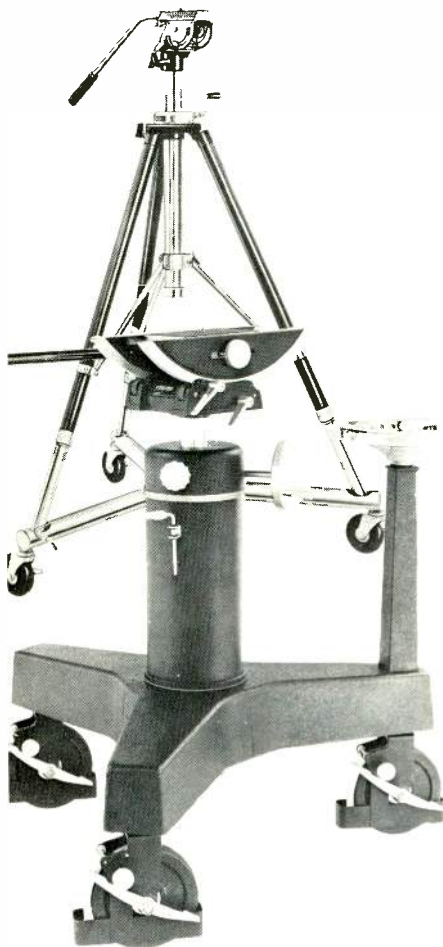

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8121 Central Park Avenue SKOKIE, ILL.

Circle Number 26 on Reader Reply Card

## New Products

(Continued from page 49)

compensate for high level input signals.

A microphone pre-amp gain control is provided, allowing up to 50 dB gain in the microphone position. Other positions provide 10, 20, 30 and 50 dB attenuation. The latter (-50 dB) position is desirable for handling the high signal levels of modern condenser microphones. This position will allow signal levels as high as +18 dBm. The size of the module is 14" x 1½" x 4¼".

Circle Number 56 on Reader Reply Card

### Variable Speed Turntable

A continuously variable speed turntable, introduced a decade ago for the monaural era, has been redesigned to meet today's stereo needs.

Manufactured by **Rek-O-Kut**, a division of **CCA Electronics Corporation**, the CVS-12 turntable is available independently or can be furnished with a custom base, professional tonearm and stereo cartridge. The system is identified as CVS-12S.

The turntable can be used by

both professional broadcasters and by schools, sports arenas, amusement parks and wherever there is need for continuously variable speed effects.

Typical applications range from producing sound effects in the radio broadcasting studio to furnishing musical backgrounds in schools, skating rinks, amusement and sports arenas. It is ideally suited for square dance music and dance instruction.

Circle Number 58 on Reader Reply Card

### Low Power FM Transmitter

We've been running behind on low power transmitters, but here's one from **Ampex**, the TD-7020. The TD-7020 is just one of a series of Ampex low power rigs. The series was designed for educational FM broadcasting and for STL (studio to transmitter link) service. Four models using direct crystal-controlled cascade modulation are available.

The TD-7020 model offers full stereo with one SCA channel. The TD-7120 is monaural only, 7220 is stereo only, and the TD-7320 is monaural with one SCA channel.

(Continued on page 52)

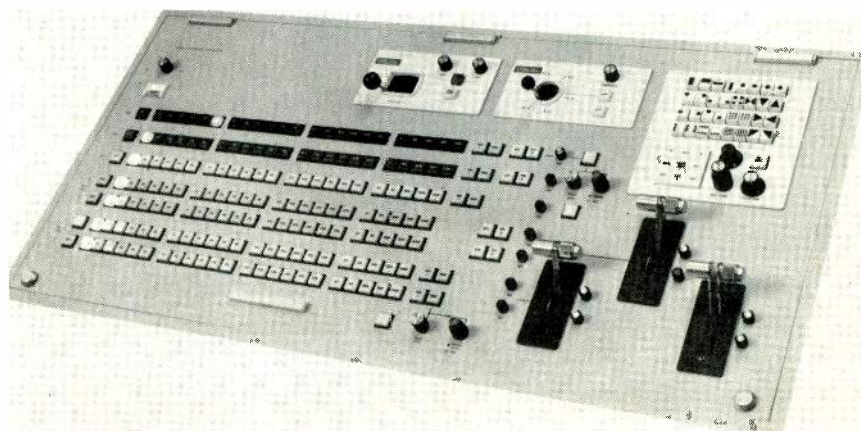
## Vertical Interval Switcher

**Visual Electronic Corporation** announces the introduction of its new Model 24-10 Vertical Interval Production Switcher. Shown here is first production model sold to KBTB, Denver, Colorado.

The production switcher accepts comp or non-comp signals on any input, automatically adding sync to the non-comp signals. Automatic synchronous-non-synchronous detection with mix-effects lockout is built-in. Easily adjustable delays

eliminate coiled coax cable delay and cable cutting for delay matching. As an additional feature for use with character generators, the non-additive mix module includes remote color saturation and here controls mounted on the switcher panel plus black border insertion for high contrast characters on light backgrounds. Yes, Visual is still in the thick of it.

Circle Number 57 on Reader Reply Card





# NO. 400

**"Scotch" Brand  
Color Video Tape guards  
itself against damage.**

**Guards against cinching.** "Scotch" Brand No. 400 now solves your video tape handling and shipping problems. A new, matte-finish back treatment virtually eliminates cinching, windowing and creasing. Capstan slippage is a thing of the past.

**Guards against scratching.** The exclusive treatment on "Scotch" Brand No. 400 resists scratching, eliminates polyester redeposits on the oxide surface. Prevents the increase of dropouts and effectively extends tape life.

**Guards against dust damage.** This highly conductive treatment reduces static attraction of contaminants that can damage tape and VTR heads. New No. 400 gives you built-in protection, plus performance — the finest value in color video tape.



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300	5½ min. (207')		2.90
300	8½ min. (320')		3.70
300	10½ min. (394')		3.90
300	empty cart.		1.60
600	16 min. (600')		6.25
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1200	31 min. (1163')		10.45

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A Filmways Company

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(Continued from page 50)

Metering consists of an audio level meter to indicate correct modulation level and individual meters for RF power output, final amp current, and final amp voltage.

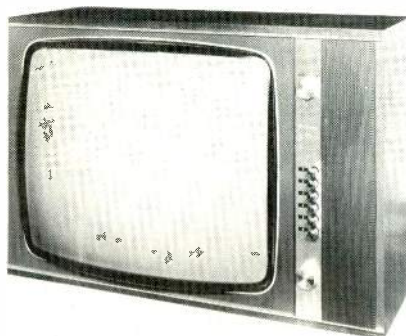
No external accessories are needed. The compact self-contained unit is designed for table top operation.

Circle Number 59 on Reader Reply Card

### TV Monitor

Rank Precision Industries, Inc. has introduced two new Monochrome TV Monitors in the North American Market.

Housed in a contemporary teak-wood cabinet, the Monitors, which offer quality monitor performance, are available with either a 20-inch or 24-inch screen. The cabinets



make the units ideal for use in executive offices or for educational and industrial or other TV uses where exposed cabinets are required.

The Monitors are equipped with 4 x 3 aspect ratio tubes which make possible reduced scan viewing, utilizing maximum screen area. A black-level clamp assures a high degree of stability and, Rank explains, clarity for the high resolution pictures produced on both Monitors.

Six channel capacity is available for both audio and video input on both units, and ease of installation is enhanced by a choice of either 110V or 220V power input.

Circle Number 60 on Reader Reply Card

### Dynamic Microphone

A new Ultra-Cardioid dynamic microphone featuring a 25 dB front-to-back rejection ratio that minimizes reverberation and microphone placement problems is now available from **The Astatic Corporation**, Conneaut, Ohio. Designated Astatic Model 811, the new microphone

utilizes an exclusive sintered phosphor bronze (SIBROPHASE) acoustic filter to assure positive phase shift and directional characteristics that result in good control of feedback.



The effects of "pop," "blast", and wind are substantially reduced by a grille assembly consisting of a stainless steel mesh that encloses a foam filter and a fine magnetic screen which effectively prevents dust and magnetic particles from reaching the diaphragm.

The 811 has a unidirectional (cardioid) polar pattern and a frequency response of 40-15,000 Hz. Simple adjustment of a solderless connection permits the selection of either high impedance (EIA 40,000 ohm) or low impedance (EIA 150 ohm). Sensitivity at high impedance is -50 dB re: 1V/microbar. At low impedance, the sensitivity is -54 dB re: 1 mw/10 microbars.

Special shielding reduces hum to a negligible level in environments where electrostatic or magnetic pick-up may be a problem. Hum pick-up is attenuated to -121 dBm re: .001 Gauss, 60 Hz.

Circle Number 61 on Reader Reply Card

### Photo Conductive Color Telecine

Rank Precision Industries, Broadcast Division will introduce their first 3-tube Photoconductive Colour Film Telecine at the International Broadcast Convention. This will be a 16 mm Uniplex equipment capable of extension to a full Multiplex format by adding a further 16 mm or 35 mm film projector and a 60 slide projector. A revolutionary feature is the departure from the normal "island" philosophy and the adoption of an "in-line" format.

Both the camera head and control unit have been specially de-

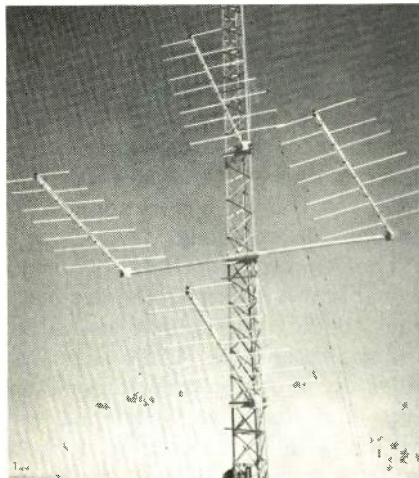


signed and built for the new telecine, all film loading operations can be carried out from one side, there are only two fixed angle moving mirrors on the multiplexer and two lamps ensure a continuous light source in each projector.

Circle Number 62 on Reader Reply Card

### CATV Antennas

**Hy-Gain Electronics Corporation**, Lincoln, Nebraska, announces a new line of head end antennas for use with CATV Systems. The antennas are super rugged yet light



weight to allow installation on minimum size towers. Log periodics cover the VHF TV channels in 3 ranges; channels 2, 3, & 4, 4, 5, & 6 and 7 thru 10. The antennas are available in single bay, dual stack and quad arrays. Dual and quad arrays include a unique new beam phasing technique that provides sharper patterns and eliminates phase distortion.

Circle Number 63 on Reader Reply Card

### VU Meter

A newly styled VU meter, featuring a three-way choice of panel mounting options, is now available from **API Instruments Co.**, Chesterland, Ohio. Model 7045 meets all specifications of ASA Standard C16.5-1954. The new design permits mounting on the panel front, or behind the panel with either an optional bezel or lens kit.

The meter has a rugged phenolic case and front, with a glass window which is scratch-proof and free of static electricity. Size is 4½". Model 7045 is available with either "A" type scale for recording, or "B" type scale which emphasizes percentage modulation for broadcast use.

Circle Number 64 on Reader Reply Card

(Continued on page 54)



## Yes, YOU can reduce your risks of heart attack

While scientists are searching for cures, *everyone* can take these simple precautions: see your doctor periodically; reduce if overweight; eat foods low in saturated fat and cholesterol; stop smoking cigarettes; control high blood pressure, and exercise regularly.

You also reduce your risk when you give to the Heart Fund to support your Heart Association's program of research, education and community service.

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## CUSTOM MODEL TURNTABLE

Single lever controls 33 & 45 speeds. Plays 45's without adapter. Illuminated speed indicators. Has detachable tone arm mounting plate. Comes with syn. motor only.

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MONAURAL MODEL 1-M

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**RUSSCO Electronics Mfg.**  
6879 N. SUNNYSIDE, CLOVIS, CALIF.  
PH. 299-4692

Circle Number 30 on Reader Reply Card

(Continued from page 53)

### Educational CCTV System

A closed circuit television system including everything needed to equip a quality low-cost studio has been placed on the market by **Ampex Corporation**, it was announced by Richard J. Elkus, Jr., general manager, Ampex educational and industrial products division.

The "mini-studio," designated Originate II, is a one-inch videotape package available for under \$10,000. In addition, it includes a "bonus" all-expense-paid trip and course at the Ampex Video Institute. The course covers all basics of closed circuit television production.

Heart of the 28 category, 37 major piece system is a complete single-cabinet portable television control center, the Ampex AC-125. Flexibility is provided by the addition of an Ampex VR-5100E one-inch electronic editing videotape recorder and two Ampex CC-450 electronic viewfinder cameras.

The AC-125 provides complete video monitoring and control, waveform monitoring and audio mixing, all the tools needed to control multi-picture, multi-camera source and production in one compact cabinet. The user can combine three cameras, microphones, a videotape recorder and a film chain electronically to produce profes-

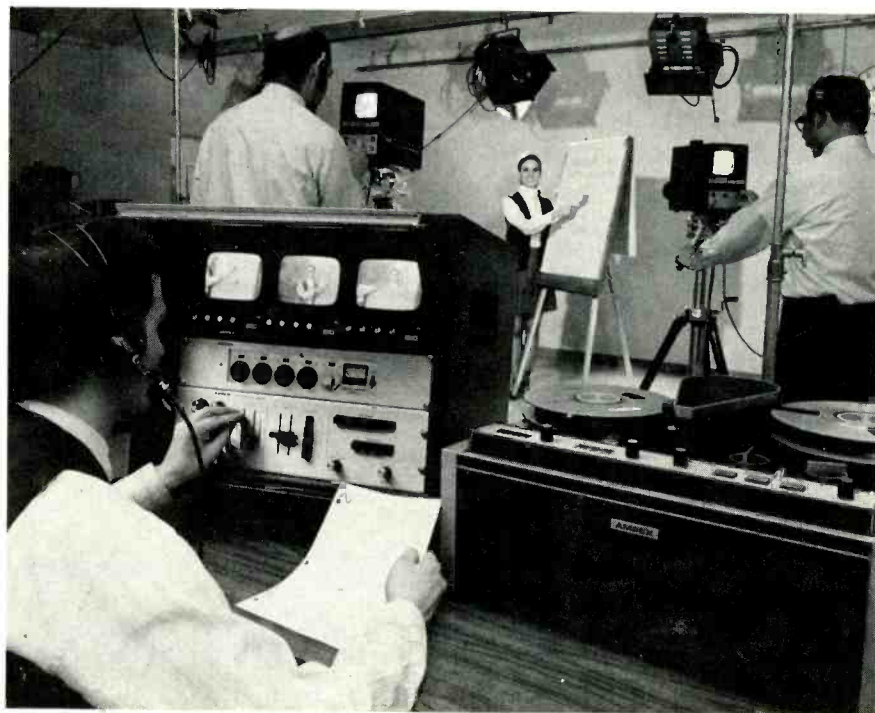
sional quality videotapes or live closed circuit productions. The 90-pound unit can easily be transported for on-site productions.

The AC-125's built-in vertical interval switch/fader special effects generator can create a variety of effects in videotape productions. The control center includes three small monitors. In addition, the system includes a separate 20-inch monitor/receiver.

The package also contains a complete lighting kit, zoom and general purpose lenses (one each), two hand or desk microphones, three headset microphones, two desk microphone stands, two tripods, two dollies, two function heads, two offset camera handle adaptors and 125 feet of necessary cable for coaxial connection, camera hook-up and audio.

The Ampex VR-5100E one-inch helical scan videotape recorder provides audio and video assemble editing capability. Audio can be added to any prerecorder segment. Any tape made or assembled on the VR-5100E can be played back on any other Ampex one-inch videotape recorder.

The compact Ampex CC-450 viewfinder cameras meet all the major needs for closed circuit use. The high resolution 15-pound unit automatically compensates for varying light levels. The viewfinder doubles as a monitor in playback.



Circle Number 65 on Reader Reply Card



### Portable Lighting Kit

The demand for a lightweight, yet rugged, professional quality lighting kit has been challenged by **ColorTran** in their new Mini-Pro Go Kit. This kit has already proven its versatility and dependability with network news crews, cinematographers, and photographers around the world. Designed for use with 30 volt battery power or 120, or 220 volts, the Go Kit includes three sturdy Mini-Pro heads, which are fast focusing and produce a smooth field of light without hot spots.



These Mini-Pro heads are coupled with ColorTran's new Pro Stand, whose unique design allows the legs to expand from a conventional 31 inch base to an ultra-stable 46 inch base. The Mini-Pro Go Kit, complete with 3 Mini-Pro heads, 3 Pro Stands, and a host of accessories, weighs only 29 lbs., and is briefcase size.

Circle Number 66 on Reader Reply Card

### Stereo/Monaural Console

**Wilkinson Electronics, Inc.** announces the availability of a new stereo or monaural console, Model TSC-4 for use in AM or FM studios or where applicable, in recording service. The TSC-4 incorporates six (6) low level inputs into two (2) attenuators switchable to the left or right channel. Nine high-level dual inputs are provided into five dual attenuators with one attenuator serving five switchable inputs.

Inputs to the five level attenuators can be switched to left, right, or stereo channel for maximum versatility. The TSC-4 comes complete

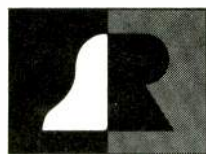
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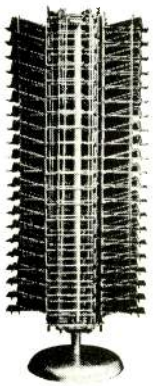


# BELAR

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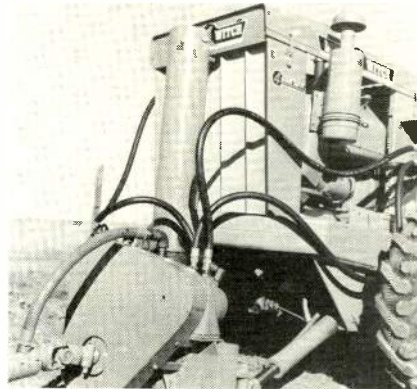
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with power supply incorporated and is immediately ready for service. The entire front panel swings forward to expose all components for instant access and quick service.

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### Boring Attachment

The Roto Witch boring attachment for Ditch Witch trenching units allows trenching operation to go under surface obstructions without breaking paved surfaces or marring landscaping.



Roto Witch units are available for all Ditch Witch trenchers except the C series, a handlebar model.

Roto Witch will produce, on the first bore, a horizontal hole of up to four inches in diameter with wet bit and reamer, or 2¾-inch hole with a dry bit. Holes can be enlarged by back reaming. In most cases, only four-in-wide approach trench is required.

The Roto Witch is available as a mechanically-powered attachment for M series trenchers. It is hydraulically powered on all larger units.

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### Cassette Duplicator

A new cassette duplicator capable of copying either reel-to-reel or cassette masters in one compact unit has been announced by Infonics, Inc., originator of in-cassette duplicating equipment.

In making the announcement, Peter H. Stanton, president, stated that while the majority of cassettes used in schools, colleges and industry are duplicated from reel-to-reel tapes, there are increasing requirements for cassette-to-cassette duplication as well. He said that the new Infonics Dualmaster Duplicator



fulfills both requirements for the low price of \$2,995. The new Dualmaster produces three half-hour cassettes every two minutes, duplicating all tracks at the same time. It is available in either a 2-track monaural or a 4-track stereo version.

Performance characteristics and specifications are equal to those of the Infonics reel-to-cassette and cassette-to-cassette duplicators in operation all over the world.

Circle Number 69 on Reader Reply Card

### Digital Clock System

Chrono-log is now offering a TV Studio Digital Clock System that provides a precise central digital time source with the capability of displaying the time in the corner of TV monitors throughout the station.

The TV studio digital clock system consists of one central digital clock and timing inserters for each monitor chain on which time is to be displayed. The inputs to each timing inserter are the output of the central digital clock and the normal video input to the monitor chain. By using existing monitors, the cost of remote displays is eliminated. Among the advantages of the digital clock system are: 1) Parallax errors and other mistakes in reading the time are eliminated; 2) All clock displays are in absolute synchronism at all times; 3) The clock reading is automatically mixed with the video to each monitor chain at one point; extra wires to each monitor are not required; 4) Setting and resetting of the clock is done at a central location; all remote displays change instantly when the central clock is changed; 5) Displays of time are white numerals on a black background so that the digits are clearly readable regardless of the video background.

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**The Analysis, Design, And Synthesis of Electrical Filters** is a new book on the market that bridges the gap between the study of network synthesis and its practical application—the design of various kinds of filters. The author, DeVerl S. Humphreys, gives specific information on designing filters (including crystal filters, LC filters primarily for telephone applications, and RC filters for control system applications. He outlines the basic concepts needed for the synthesis of a filter system and for the prediction of the system's performance when subjected to various excitations.

The author gives special emphasis to fundamental analysis tools by which the time- and frequency-domain characteristic of a passive filter may be found; establishes ideal reference filters and correlates the performance of lumped RLCX models to these references; and, treats coupled network approximations by means of the constant reactance impedance inverter.

The book is available through Prentice-Hall, Inc., Englewood Cliffs, New Jersey.

**Introduction To Computer Engineering** has been written to answer questions about computers: What are they? What do they do? How do they do it? The author, B. S. Walker, primarily intended this book for undergraduate engineers and technologists. The book will have appeal to the scientifically inclined reader who would like to know just what the new computers are about, what powers they have, and how they operate.

The author's approach embodies a systems logic which first examines the task to be done by computers and then evolves the most logic way to accomplish it.

The fundamental principles and philosophies underlying the whole concept of computers and their applications are carefully dissected to make the logic of technical advances easier to follow.

The book is available through Hart Publishing Company, Inc., New York City, N.Y.

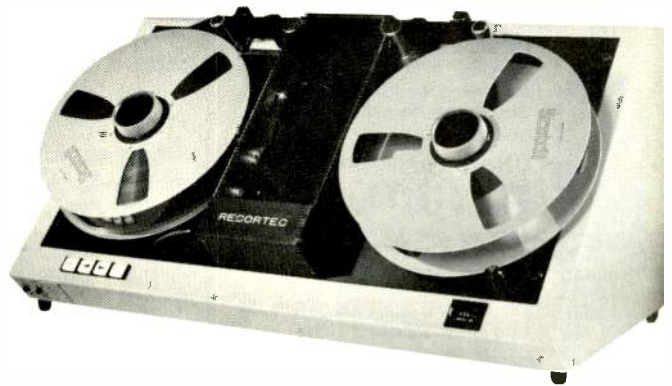
The newly-published volume, **Solid-State Circuit Design & Operation** is a unique and informative guide to semiconductor circuit analysis and design. The author, Stanton Rust Prentiss, has made this a practical guide to the design and operation of solid-state circuits from diodes to integrated circuits—from FETs and MOSFETs to opamps.

He takes semiconductors—diodes, transistors, FETs, MOSFETs, thyristors, SCRs, triacs, diacs, etc. and explains how they are constructed and how they work. Chapter 3 provides an in-depth analysis of amplifier circuit design, with guideline for analyzing AC circuit characteristics. Pulse and switching circuits are discussed in Chapter 4, along with an array of useful multivibrator data.

The book is available through TAB Books, Blue Ridge Summit, Pa. 17214.

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## TECHNICAL DATA

For further information, circle data  
identification number on reader service card

### 100. AMERICAN ELECTRONIC LABORATORIES, INC.

—A new Colorvue(TM) folder filled with the latest data and price lists on their line of CATV equipment —including technical articles of interest to the CATV industry is now available. The feature of the AEL file folder is the Model CT2-1C, SUPER-BAND(TM) Tunerless CONVERTER. The folder also includes data on the CVT-1 series of SUPER-BAND(TM) Amplifiers (50-220 MHz), the series CT-2 Amplifiers (50-270 MHz) and the series CVT-3, SUPER-BAND(TM) 27 Amplifier line (50-270 MHz). Pilot carrier generators and power supply technical data sheets are also included. Also described are the CATV Turnkey Services available from AEL Communications Corp. Articles on Solving Temperature Problems Using Dual Carrier Automatic Slope And Gain (ASG) Controls, Stabilizing Cable TV Systems For Level Fluctuations Due To Temperature, Diat(R) A Current-Controlled Solid-State Attenuator, The 270 MHz Super-Band (TM) Concept and Constructing CATV Transmission Lines are included.

**101. AMPEX CORP.**—An information sheet describing the new Ampex Model ADR-150 high-speed broadcast color videotape duplicator for television program distribution by networks, stations and production companies is now available. The sheet explains how the ADR-150 is used for multiple copy production of videotaped programs and commercials.

**102. APM-HEXSEAL CORP.**—A data sheet listing specifications, color and application information on their Silikromes is now available. Silikromes are silicone rubber colored filters that instantly change the color of clear miniature lamps. Capable of operating in extremely difficult environmental conditions, Silikromes serve, for example, at 500° for 1000 hours or more without color fade or degradation of

the elastomer properties. Interchangeable and reusable, the filters come in any color, meets MIL-S-22885 and other applicable Mil-Specs, and are ideally suited for switch indicators, lighting panels, instrument lighting, automotive radios and dash panel and many other military and commercial applications.

**103. APPLIED RESEARCH INC.**—A new catalog, "Broadband Varactor Frequency Multipliers", describing a wide range of active and passive devices for operation from 30 MHz through 16 GHz is now available. The document reflects the growing need within the communications industry for a source of state-of-the-art frequency multiplier designs, which are available with off-the-shelf delivery schedules. The frequency multipliers described in the catalog are a representative listing of the large number of proven designs produced by Applied Research. The frequencies, passbands, power outputs and performance options presented are diverse enough to fill most anticipated customer needs. However, special modifications, based on these proven designs can be developed by ARI engineers to meet the most stringent requirements.

**104. ATLEE CORPORATION**—A new catalog listing specifications of the complete line of standard Atlee products is now available. Their product line includes component holders, clips, circuit board holders and other electronic hardware. If special sizes and shapes are required for unusual applications, Atlee will be pleased to design and quote on the hardware you need.

**105. BECKMAN INSTRUMENTS** — Electronic Instruments Division. The Model 613 Heterodyne Plug-in Converter's capability of providing rapid and accurate measurement of CW signals through X-band with better than 100 millivolt input sensitivity is highlighted



in a new 2-page publication now available. Bulletin 2266 describes the new Heterodyne Converter as extending the frequency capability of the 25-, 50-, and 100 MHz Beckman 6100 Series Counters to cover the range of 3.0 GHz to 12.4 GHz. The publication outlines how the Model 613 also serves as a prescaler and sensitive amplifier for signals to 200 MHz. By use of a toggle switch, direct measurements to as high as 136 MHz can be made with the basic counter without unplugging the 613 or disconnecting its microwave input. Complete specifications and price information are also provided.

**106. C. P. CLARE & CO—** Small, low cost, 10 amp plug-in switching with less wiring expense than octal base types is featured by new Clare general purpose GP2 and GP3 relays described in Data Sheet No. 1302. Complete specifications include coil tables listing voltages from 6 to 240 vac and 6 to 110 vdc. Drawings illustrate seven case and mounting styles, including cased and uncased types and relays with solder or plug-in terminals. Drawings for printed circuit board types include a suggested pcb layout.

**107. COHU ELECTRONICS, INC.—**A rack-mounted video multiplexer that expands the capabilities of existing waveform oscilloscopes and video monitors is described in a new technical data sheet (6-539). Details on Model 2486-004 include photographs, specifications and applications.

**108. COLUMBIA ELECTRONIC CABLES—**An illustrated data sheet on Dura-Color® 82-channel coaxial cable for UHF/VHF home color television reception is now available. This sheet describes the advanced design of Columbia Dura-Color RG-59/U type cable, part No. 5750. Dura-Color is 100 percent shielded, the shield consisting of a mylar film coated on both sides with aluminum foil and four standard tinned copper drain wires for conductive continuity. This type of shield is electrically more stable and is highly resistant to moisture. Dura-Color accepts standard F type 59/U connectors. The low loss capability and other outstanding characteristics are described in illustrated form. Also included are descriptions of two 75-ohm Dura-Color kits, one for UHF and VHF  
(Continued on page 60)

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(Continued from page 59)

reception and the other for UHF or VHF reception.

**109. ECKEL INDUSTRIES, INC.**—A 4-page illustrated brochure "Portable An-Eck-Oic® Chambers" details the use of these anechoic enclosures in noise studies of small electronic, electrical, and mechanical equipment; calibration of microphones; free field response testing of loudspeakers; determination of hearing aid characteristics; and behavior studies of small animals. Nine standard models are described that are available with free-field volumes ranging from a 19¼" cube to a 69" cube, and with low frequency cutoffs from 150 Hz. Among the features discussed are the outstanding acoustical performance obtained with the chambers, the versatility in use, the long-term economy, and the quick and easy installation. Another feature is the flexibility of the enclosures that is enhanced by the various options and accessories available. These include: vibration isolators, ventilation, microphone calibration

rigs, instrumentation supports and hangers, observation windows, and animal cage linings. Also provided are construction details and model architects' specifications. In addition, a chart on noise reduction is given as well as a partial listing of portable An-Eck-Oic Chamber users.

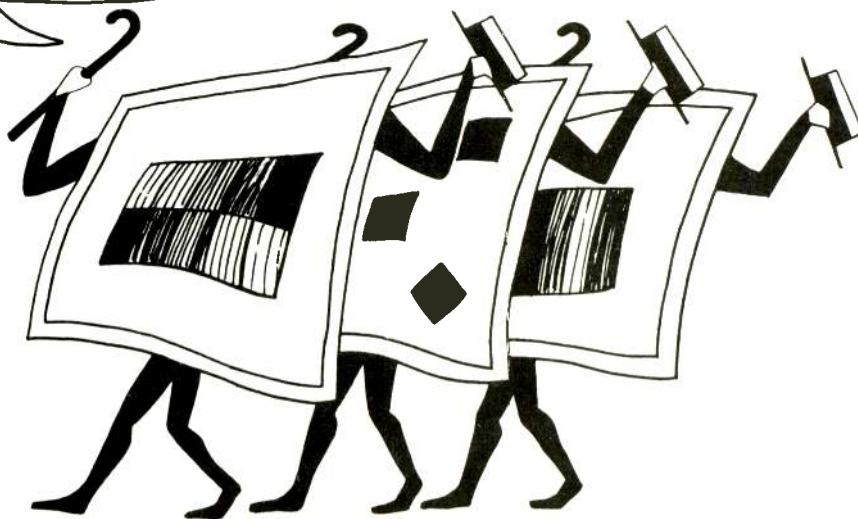
**110. ENGINEERED DATA PRODUCTS INC.**—A new 56-page data processing accessories catalog containing valuable basic information on utilization, handling, installation and systems applications as well as product prices and descriptions is now available. Several innovative products, new to the EDP field, have been introduced through this catalog. Among them is the "Swinger"—a cabinet-free, fresh approach to side pack storage that offers maximum disk access. Another is their One Piece Canister, a highly inventive, highly flexible unit that offers outstanding ease of tape reel handling and identification, yet provides maximum protection and storage density—only a fraction short of bare tape reel density itself. Still another time and


space saving unit is the MAXI-TRAY, especially designed for use with the new System/3 computers.

**111. FAIRCHILD SEMICONDUCTOR**—An updated edition of the 54/75 brochure which reflects almost a threefold expansion in the company's line of 5400 and 7400 TTL integrated circuits is now available. The new publication, contains 52-pages and describes 63 off-the-shelf products in the 54/74 series. Description of the circuits include information about electrical characteristics, switching characteristics, logic diagrams, and pin configurations. Recommended operating conditions are also indicated. The brochure is abundantly illustrated, with 20 pages of diagrams and schematic drawings showing test circuits and voltage waveforms. One section of the brochure is devoted to packaging dimensions and illustrations.

**112. HEWLETT PACKARD**—Increases greater than 20 dB in the sensitivity of RF and microwave instruments can be obtained by signal averaging techniques described in a new 20-page Application Note.

We're a great team  
It's a shame we never  
get on the air



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The Note, "Signal Averaging Enhancement of RF and Pulse Measurements," contains detailed diagrams of the interconnections between the signal averager and several other instruments, including spectrum analyzers, network analyzers, sampling oscilloscopes, and time-domain reflectometers. The theory of signal averaging is explained, and the concepts of calibrated and weighted averaging are introduced. Also explained is the use of the variance display—a feature unique to HP signal averagers—as an indication of the validity of a measurement.

**113. ELECTRONIC RESEARCH LABORATORIES**—The 48-page Bulletin 93 contains one of the largest, most diversified presentations of electronic test equipment and sophisticated components. Special sections are included on: test equipment, power supplies, bridges, decodes, delay lines, 400 Hz power sources, high voltage power supplies and hipot testers, portable instruments, pulse networks and transformers, synchros and tachometer generators, servo motors and many others.

**114. METEX CORPORATION**—A new, 28-page short form catalog covering EMI shielding materials, gaskets and components is now available. Covered are the company's Polastrip and Pola-H composite EMI and pressure gasketing, EMI Mesh Strips, Metalex, EMI gasketing, Xecon conducting elastomer, connector gaskets, Shield Vu EMI shielded windows, Shield Cell EMI shielded ventilating panels, Shield-screen EMI shielded air filters, ZIPEX-2 EMI cable shielding and other products manufactured by Metex. The catalog is fully illustrated and unusually complete, containing all necessary ordering information, full specifications and extensive part number tabulations.

**115. PHELPS DODGE COMMUNICATIONS CO.**—A new 68-page catalog completely covering the company's full line of antenna systems is now available. In addition to the illustration of each type of antenna, along with specifications and performance data, the new catalog also includes descriptive material on antenna mounting hardware, duplexers and cavity res-

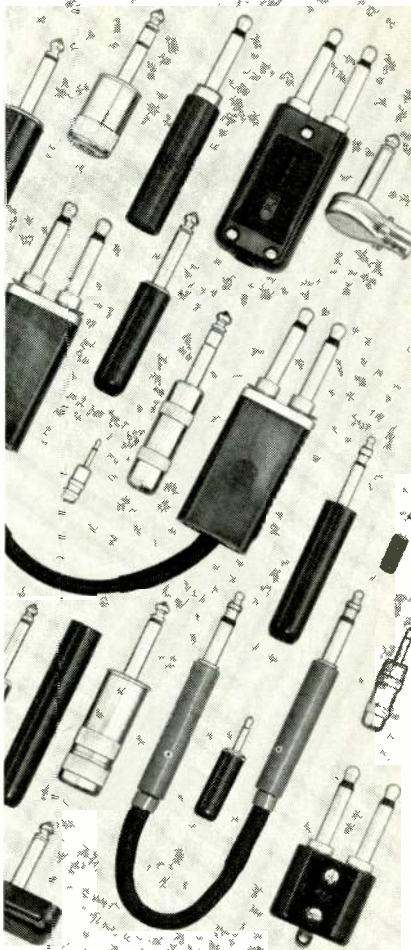
onators, coaxial cable systems and antenna mounting accessories. A special technical data section is incorporated offering information designed to be of assistance to the communications specialist.

**116. MICROWAVE SEMI-CONDUCTOR DIVISION**—A new brochure entitled "Noise Engineering Data" is now available. Ideal for reference and specification, the 6-page brochure describes Desirable Noise in terms which permit the engineer to analyze his needs and make best use of the data presented. The brochure indicates several applications in the electronics industry in which noise is desirable rather than an enemy, i.e., as the carrier for secure communications, as a jamming signal, as a reference signal level for built-in test equipment and as an amplitude reference for determining receiver noise figure. In addition, the brochure explains how to purchase noise, as raw diodes, in modules or in systems. Each package has its own set of specifications, benefits and requirements. For example, the raw diode must be packaged into a compatible structure by the design engineer, the module need only be coupled to and the system has an output jack and an ON-OFF switch. Examples of each are illustrated.

**117. RCA ELECTRONIC COMPONENTS**—A new booklet, "RCA Silicon Rectifiers, Assemblies, and Bridges" Publication No. SRS-300A is now available. The booklet contains characteristics charts for the entire rectifier product line, a brief introduction, and a statement of RCA's custom-design capability in the field of "stacks" and bridges. The RCA line of diffused-junction silicon rectifiers includes more than 150 devices, ranging from 1 mA, 200 V units for consumer and low-voltage industrial applications to high-voltage rectifier assemblies. The booklet also features a "Designers' Guide for Rectifier Circuits." This double-page chart which includes a sample calculation, enables the engineer to determine voltage ratings for high-voltage assemblies required for a particular circuit configuration.

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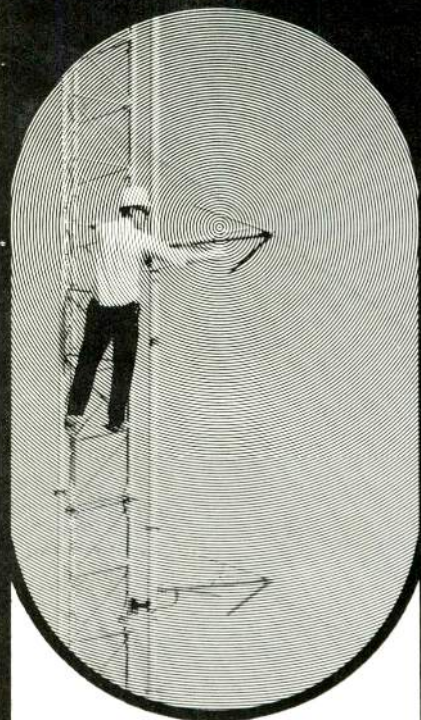
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## Second Series FCC Reports Now Available

Volume 16 of the Second Series of FCC Reports, covering the period of February 7, 1969 to April 4, 1969, is now available to the public. The 1,140 page book (catalogue number 1970 O-LT-351-460) is available from the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402, for \$6.

In addition to decisions, reports, memorandum opinions, orders, and other selected material the volume contains a digest of statutory and rule provisions and a digest by subject. It also permits reference by call letters and localities, as well as through documents reported.

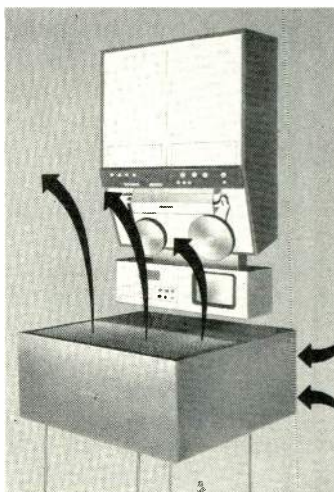
The complete FCC Reports now consist of a First Series of 40 bound volumes, dating from July 17, 1934 to July 9, 1965, and the Second Series of 16 volumes covering the period July 9, 1965 to April 4, 1969. Volume 41 (Television Matters) of the First Series, including Commission documents and actions up to July 1, 1965, is currently under preparation by the Government Printing Office.

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### New ISOLAIR Unit by Liberty



This unit provides a laminar downflow of the cleanest possible air at the critical video head area. Excessive wear and damage by airborne contaminants are virtually eliminated, extending head life by 100% or more and insuring better overall VTR performance. The elimination of this dust problem by use of the Isolair results in great savings of time and money.

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Chief engineers who have used the Isolair unit have attested to the multiple advantages provided by this low-cost VTR accessory.

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- Requires no additional floor space.
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BROADCAST ENGINEERING



## FCC Equipment List Interconnect Data Ready

The latest listing of Radio Equipment Acceptable for Licensing, dated July 31, 1970, has been issued by the Federal Communications Commission.

The list includes equipment for the Domestic Public Radio Services other than Maritime Mobile; Radio Broadcast Services; Experimental, Auxiliary and Special Broadcast Services; Stations on Land in Maritime Services; Stations on Shipboard in Maritime Services; Public Fixed Stations and Stations in the Maritime Services in Alaska; Aviation Services; Public Safety Radio Services; Industrial Radio Services; Land Transportation Radio Services; and Citizens Radio Service.

The transmitters listed are considered acceptable for licensing in the various services provided that their operation is in accordance with Commission rules and the specifications for this equipment are not exceeded. The list also includes frequency and modulation monitors that are type approved for use in the radio broadcast service. Equipment is listed alphabetically by manufacturer and numerically by type number.

Inquiries about equipment listing may be addressed to Technical Division, Technical Standards Branch, Federal Communications Commission, Washington, D.C. 20554 (Telephone 632-7093, area code 202).

The report entitled "Interconnection Action Recommendations" prepared by Dittberner Associates relating to attachment of consumer-provided equipment to the Nation's telephone networks, announced by the Commission on September 1, 1970, will be available for sale to the public through the United States Department of Commerce.

The report will be sold for \$3 per copy; microfiche copies of the report will also be available at \$.65 per copy. Orders should be addressed to the United States Department of Commerce, National Technical Information Service (formerly Clearinghouse for Federal Scientific and Technical Information), Springfield, Virginia 22151. The accession number for the report is PB 193 636 and should be included with all orders.

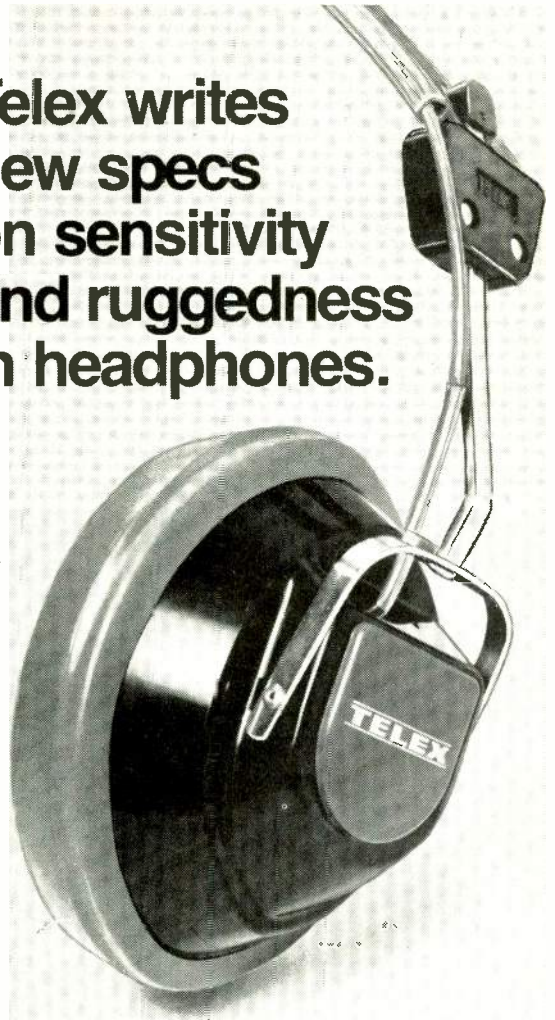
Irwin S. Elyn, an attorney-adviser in the Broadcast Bureau's Renewal and Transfer Division, has been appointed Chief of the Transfer Branch.

## New Transfer Div. Chief

A native of Seattle, Washington, Elyn received his law degree from the University of Washington and was in private practice in Seattle before joining the Commission in 1963. He served as a trial attorney with the Hearing Division and as an attorney-adviser in the Renewal and Transfer Division from 1963 to 1967 before moving to the Office of the General Counsel for an assignment with the Administrative Law and Treaties Division. He returned to the Renewal and Transfer Division at the end of 1968.

The Transfer Branch is responsible for processing all applications for assignments of licenses.

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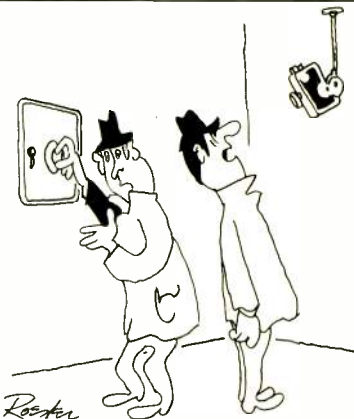
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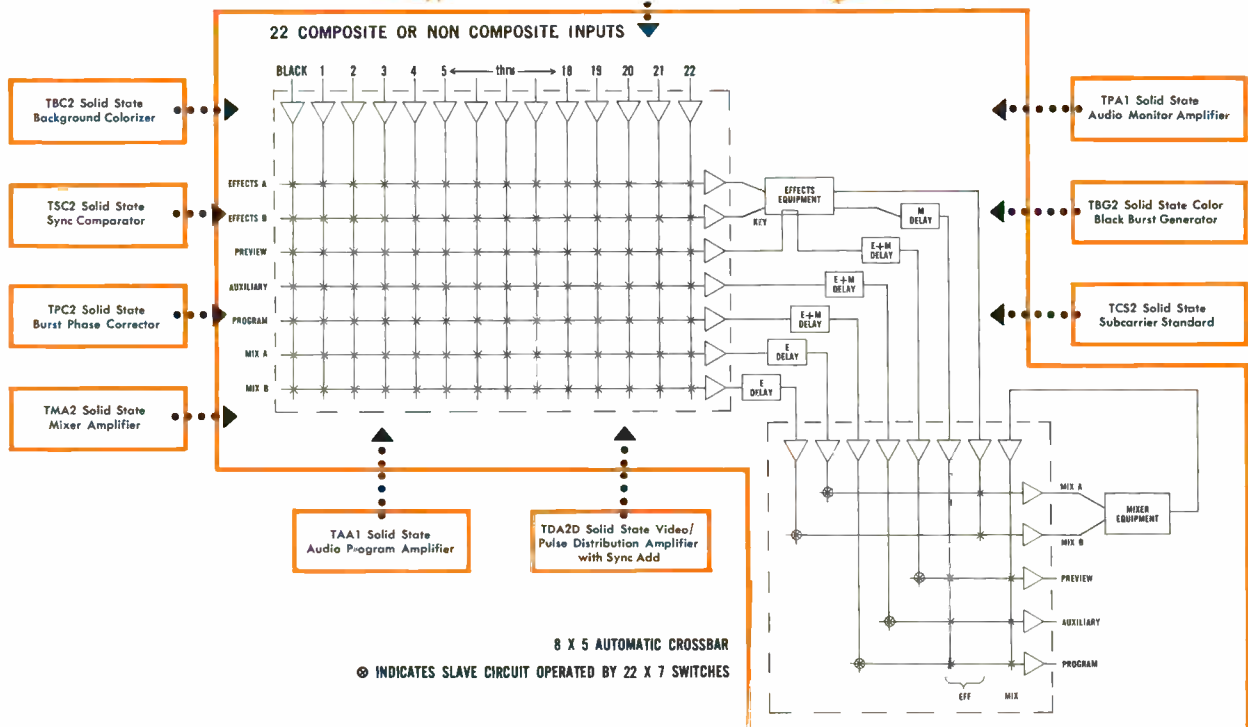


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