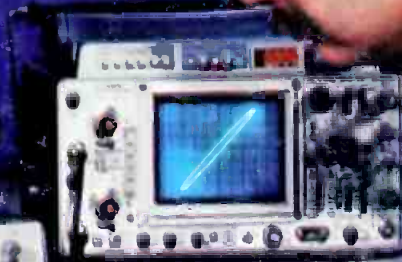


# BROADCAST ENGINEERING

August, 1978/\$2.00

## Selecting audio test equipment



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NRBA convention guide

Maximizing  
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Automatic frequency nulling and auto set level features of the 339A speed your total harmonic distortion measurements (THD). And true-rms detection means accurate measurements as low as 0.0018% (-95 dB) from 10 Hz to 110 kHz. Just select the frequency of the built-in oscillator and the 339A's "turn signal" indicators show you how to make the proper range settings. Whether you're testing transceivers, sophisticated audio equipment or broadcast performance, here's how the 339A, priced at \$1900\*, can help you make quick and accurate measurements.

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**For a separate low-distortion oscillator,** investigate HP's new 239A, priced at \$575:



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\* Domestic U.S.A. price only.

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# BROADCAST engineering

The journal of the broadcast-communications industry



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## About the cover

The right test equipment can save hours during routine maintenance or troubleshooting. Here, Bob Moore, assistant chief engineer, WKBW, Buffalo, New York, performs a series of tests on a cartridge machine. (Photo by Peter Burk)

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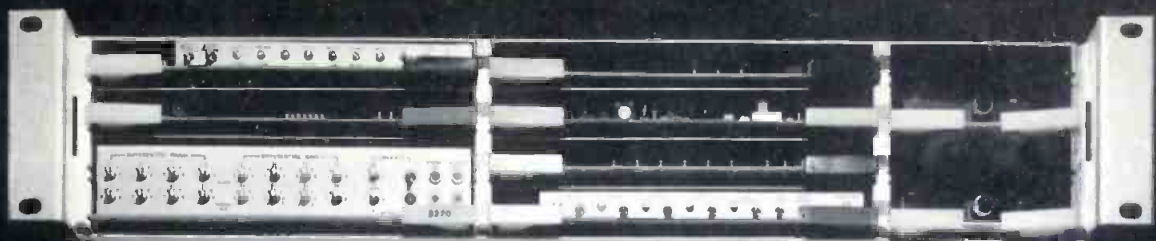
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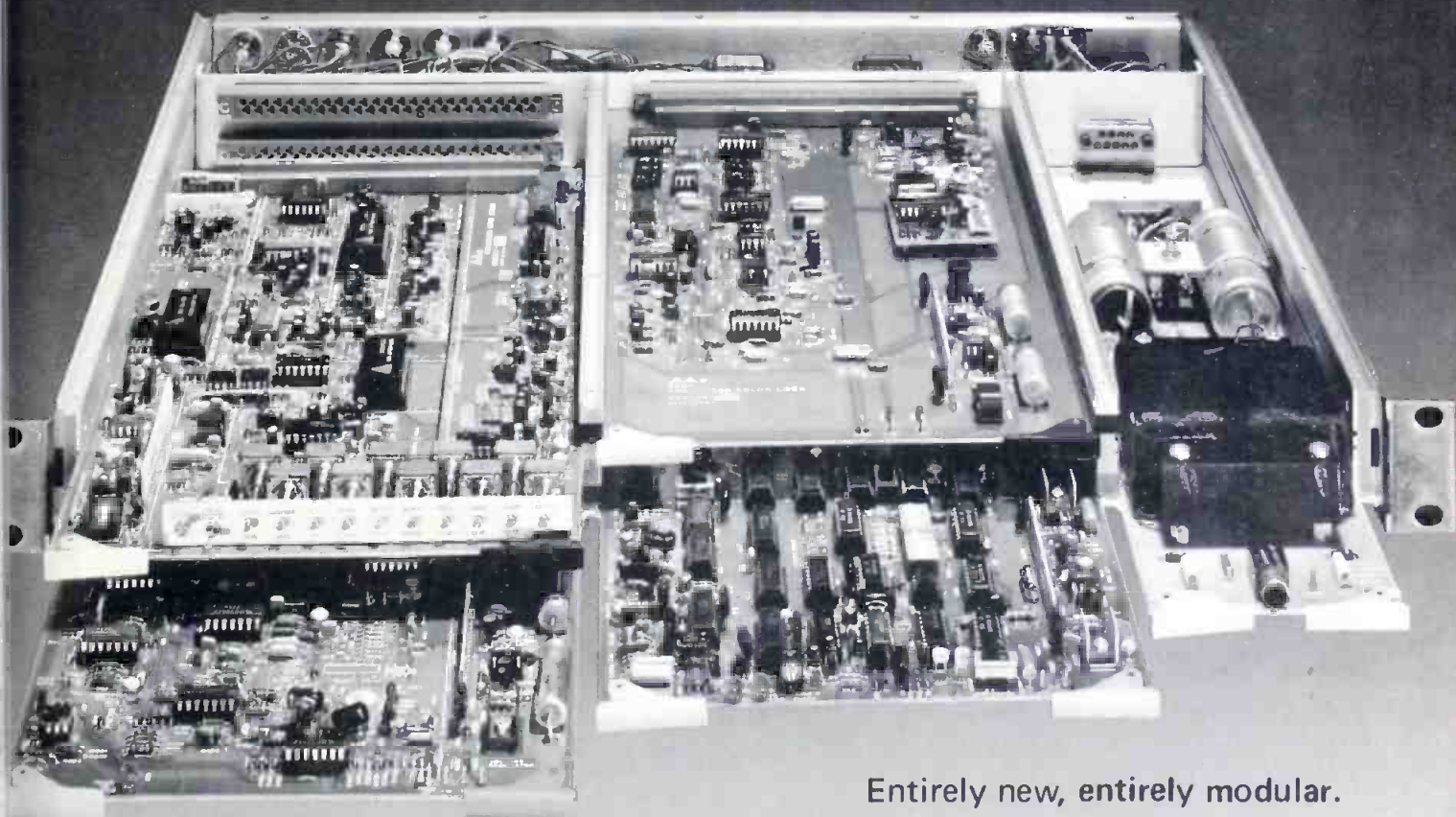


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Entirely new, entirely modular.

A system of remarkable flexibility designed for requirements of network, remote, studio, transmitter or other broadcast applications.

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# DIRECT CURRENT FROM D.C.



August, 1978/By Howard T. Head and Harold L. Kassens

## WARC Committee Appointed

The U.S. Department of State has appointed an advisory committee to assist the U.S. delegation under Glen Robinson, the chairman of the delegation, to the 1979 World Administrative Radio Conference.

On the committee are six persons representing land mobile interests, thirteen for public interest and minority groups, three for educational interests and one representing commercial broadcasters. The U.S. must submit its proposals for the conference to ITU headquarters by next January. The meetings begin in Geneva, Switzerland in September, 1979 and last for 10 weeks.

## FCC Renews NIAC

The FCC has renewed the charter of the National Industry Advisory Committee for an additional two year period. The President requires the FCC to prepare national emergency plans, develop preparedness programs and attain an appropriate state of readiness.

The development of these plans includes common carrier, broadcasting and the safety and special radio services. NIAC was established in 1958 and is a voluntary advisory committee that makes recommendations for emergency communications policies, plans systems and procedures for all FCC licensed and regulated communications.

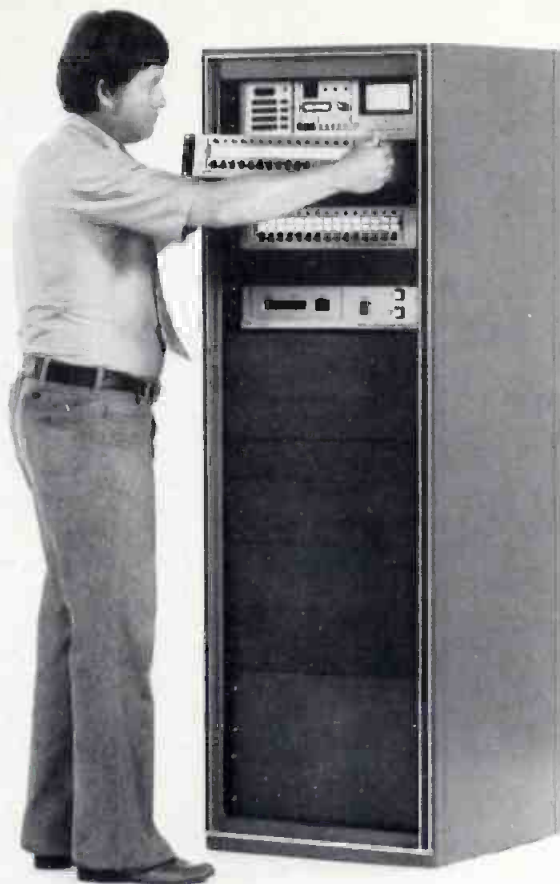
One of its contributions is the Emergency Broadcast System (EBS) developed in the early 1960s with more than 8500 broadcast stations, most networks, wire services and the communications common carriers to provide warnings and other needed information to the public during emergencies.

## FCC Denies Petition

The American Petroleum Institute filed with the commission a petition for rule-making to prohibit future Closed Circuit Educational Television (CCETV) stations from using the 6575-6875 MHz private operational fixed microwave band.

*continued on page 6*

# TFT MODEL 7600 PIONEERS...



## THE NEW ERA

### IN FULLY EXPANDABLE DIGITAL REMOTE CONTROL

Now TFT builds on a generation of remote control technology to provide a system that lets *you* build remote capability as your requirements grow. The fully modular, field-expandable design of TFT Model 7600 makes expansion plug-in-simple.

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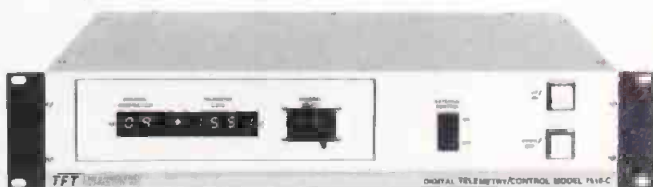
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# DIRECT CURRENT FROM D. C.

*continued from page 4*

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It was suggested that a good place for this service is in the 6875-7125 MHz TV auxiliary band. The FCC noted that all new private operational fixed systems, such as CCETV, which use 20 MHz bandwidth must now be located in bands above 12 GHz. For this reason, as well as the present crowding of the TV auxiliary band, the petition was denied.

## FCC Application Processing Revisited

As reported in the June issue, the FCC moved a task force into the AM processing area which worked up the engineering portion of all AM applications filed before the June 30, 1976 freeze - except for those applications with problems (mutually exclusive, requests for waiver, petitions to deny, etc.).

But the broadcast bureau still has 160 applications (110 daytime only and 50 unlimited time) which were filed since January 1, 1977 plus 106 pre-freeze applications which are on the current cut-off list plus 182 other applications which are floating around somewhere in the bureau (awaiting acceptance, awaiting amendment, awaiting grant, etc.) for a grand total of 448 applications for new stations or major changes.

Now, in response to congressional pressure, a new task force is being formed to attack the 160 applications which have not yet been cut-off. No attempt is being made at this time to expedite the legal processing or to shake loose those applications which involve more difficult decisions. At the end of May, 1978 there were also pending: 530 applications for "minor" AM changes; 610 FM major and minor applications; 200 UHF-TV applications and 98 VHF-TV applications.

## New Educational FM Rules

Last month, we reported the adoption by the FCC of new rules and policies relating to educational FM broadcast stations. One item reported was the new requirement that all 110-watt "educational sandboxes" would be required to increase power to a minimum of 100 watts or move to the commercial portion of the FM band (92-108 MHz). Also adopted was a temporary freeze on the filing of 10 watt applications. We are now informed that the protection rules under which 10 watt stations will be permitted on commercial channels are about to be published and that the freeze will be lifted 30 days after the date of publication of the rules in the Federal Register.

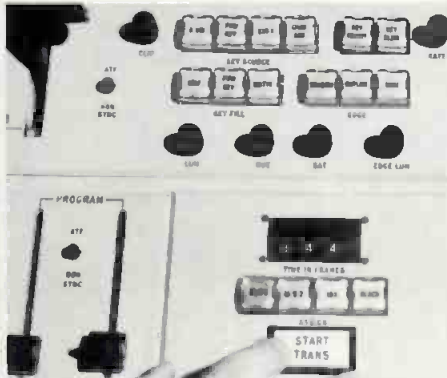
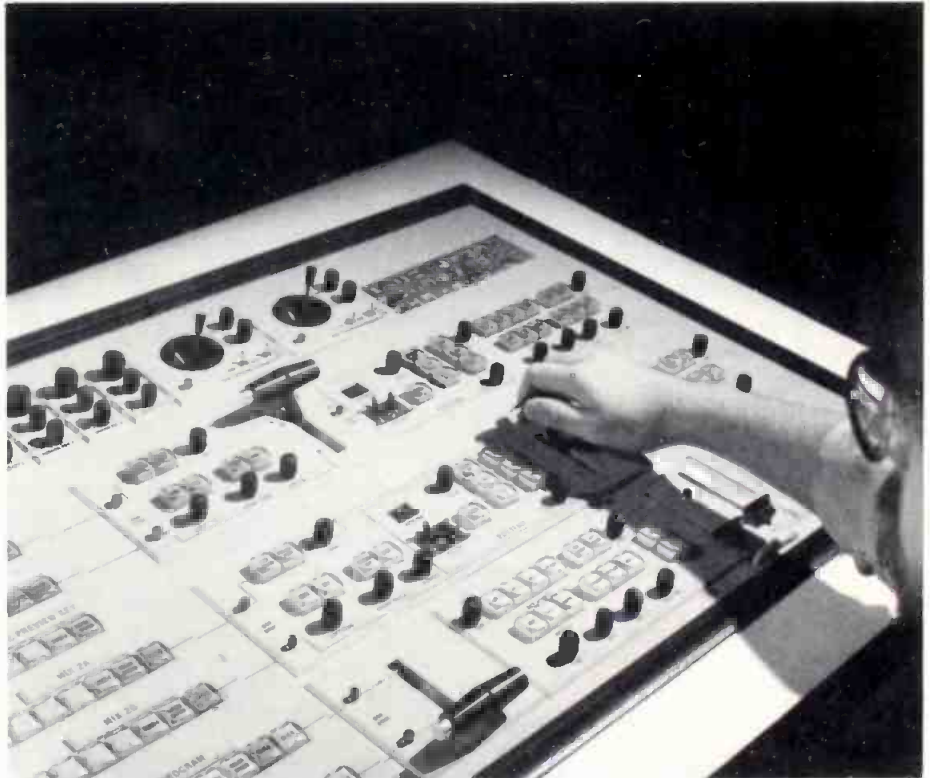




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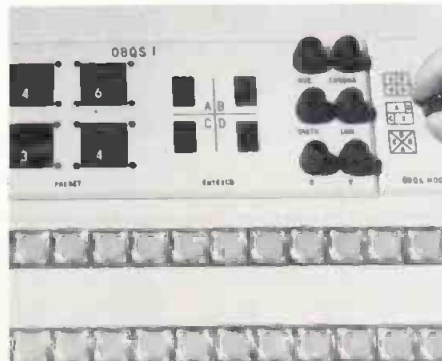
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# industry NEWS

## New telecommunications agency to advise President

A new federal agency to advise the President on issues relating to communications and information has been formed within the Commerce Department.

The National Telecommunications and Information Administration (NTIA) will play a vital role in the national effort to formulate comprehensive policies for an "information society," according to Secretary of Commerce Juanita M. Kreps.

NTIA is a Commerce Department response to President Carter's Reorganization Plan No. 1 of 1977, announced last July. The plan added substantially to the department's responsibilities in the area of telecommunications, especially with respect to policy development. It also stipulated that the department create a position of assistant secretary for communications and infor-

mation. Henry Geller, former general counsel of the FCC, was recently named to that post by President Carter.

As Assistant Secretary of Commerce for Telecommunications and Information Policy, Geller will be the principal advisor to the President on telecommunications policies and to the regulation of the telecommunications industry.

NTIA's program will be divided into four major elements: policy analysis and development; federal systems and spectrum management; telecommunications applications; and telecommunications sciences.

This program will comprise a number of varied activities. In addition to contributing in a major way to the development of domestic communications and information policy, NTIA will coordinate govern-

ment preparations for international telecommunications conferences and negotiations, and will advise the State Department on international communications policy.

NTIA also will assign frequencies to federal radio stations and establish policies involving the use of the government's share of the radio frequency spectrum. It will perform applied scientific and engineering research and analysis principally on radio wave behavior and performance of communications systems. It will coordinate federal telecommunications assistance to state and local governments. And, together with the Office of Management and Budget, it will evaluate the procurement and management of government telecommunications systems.

*continued on page 10*

## log entries

**August 17-20**—North Shore, Coeur d'Alene was chosen as the site for this year's *Idaho State Broadcasters Association* summer convention. The convention chairman is Gerry Cornwell.

**August 20-23**—Attendees at the NAB's *Radio Programming Conference*, scheduled for Chicago's Hyatt Regency Hotel, will be able to discuss problems and trends in programming with program directors from across the country. Included are a discussion of formats with program directors from nine stations, and a meeting with the presidents of six record companies.

**September 6-10**—The 19th annual conference and trade show of the *Information Film Producers of America (IFPA)* will feature a variety of seminars and workshops accenting the latest film, video and audio-visual systems. In addition, the show includes the Cindy Awards Banquet and Cindy Awards presentations for excellence in film, video and filmstrip production. Additional information on the Vall, Colorado, conference is available from IFPA National Headquarters, 3518 Cahuenga Boulevard West, Suite 313, Hollywood, CA 90068.

**September 10-12**—The *Nebraska Broadcasters Association* will hold its annual convention at the Holiday Inn in Kearney. Convention chairman is James Johnson of the Nebraska Television Network.

**September 17-20**—The 18th annual conference of the *Broadcast Financial Management Association* is scheduled for the Dunes Hotel and Country Club in Las Vegas.

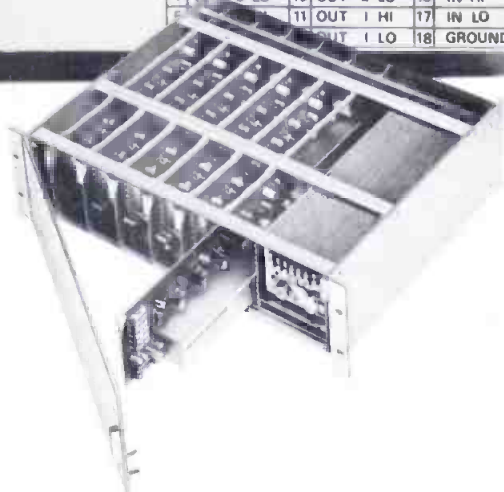
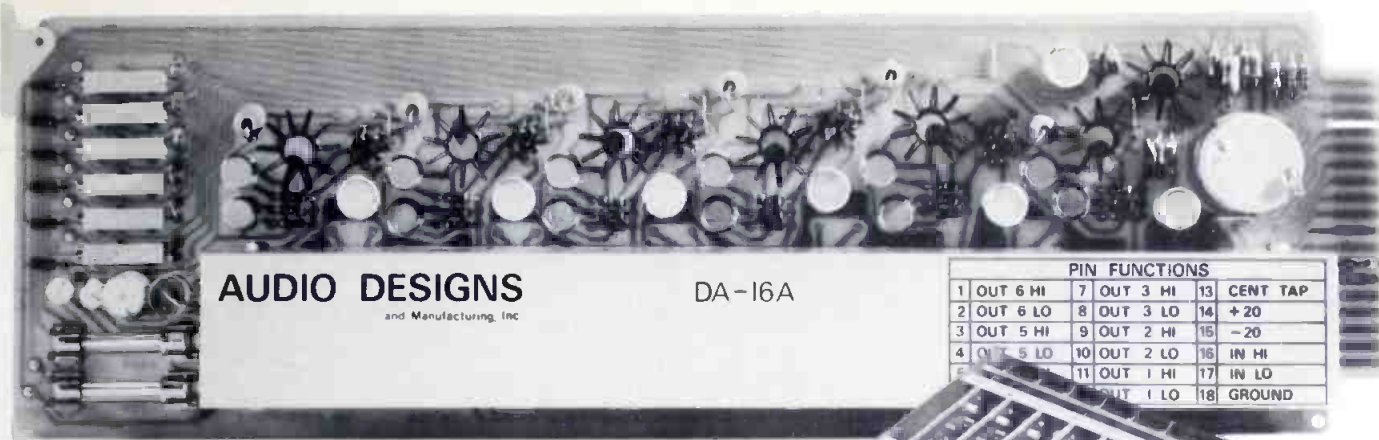
**September 17-20**—The *National Radio Broadcasters Association's* 11th annual convention will be held at the Hyatt Regency Embarcadero Hotel in San Francisco. An expanded exhibit floor of 150 is expected.

**September 20-22**—The Atlanta Hilton is the site of the *Radio Television News Directors Association* international conference.

**September 24-27**—Papers presented at the *IEEE's Eascon '78* conference at the Sheraton International Hotel in Arlington, Va., will address the theme "Electronics—Key to the Information Age." Technical areas to be covered include radar/sensor systems; satellite communications; electro-optical systems; and information systems.

**September 25-29**—London's new Wembley Conference Centre is the site for the seventh annual *International Broadcasting Convention*. In addition to numerous exhibitors and social events, the conference will feature a technical program focusing on such topics as microprocessors and mini-computers in broadcasting; satellite broadcasting; studio lighting; sound systems; and new broadcasting systems (e.g., teletext and traffic information).

**September 1979**—*TELCOM '79*, the world's largest telecommunications congress and exposition, will be held in Geneva, Switzerland. More than 100,000 representatives of Electronics Industries Association's worldwide communications market are expected to attend the event. The communications division is sponsoring the American pavilion. Countries will display telephone, telex, radio and electronic data communication, and audio and video broadcasting equipment. Further information and space requests may be directed to The Show Company International, 8687 Melrose Avenue, Suite M38, Los Angeles, CA 90069.



# The ultimate audio distribution system.

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- The input is transformer coupled and each of the six outputs is individually transformer-isolated.
- Amplifiers have individual front panel gain

adjustments and individual test points for both power and audio.

- The CH20 rack frame has redundant power supplies with automatic changeover.
- The DA16/CH20 system is designed and built to demanding Audio Designs and Manufacturing quality standards.

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continued from page 8

## FCC not EEO enforcer, NAB says

The NAB has asked the FCC to study carefully the legal and factual showings submitted by licensees, networks and associations before requiring additional employment information from broadcasters on FCC Form 395.

The Office of Communication of the United Church of Christ, Citizens

Communications Center and others have urged the FCC to require licensees to submit information—employee salaries, hires, promotions, terminations, training programs, organizational charts—not even routinely gathered by the Equal Employment Opportunity Commission. Such information would be unnecessary and invade the privacy of employees, NAB said.

The NAB maintains that industry-wide employment statistics and information are already submitted pursuant to the FCC's Ten Point Model EEO Program and Form 395. According to the association, the

FCC has no mandate to act as an equal employment opportunity enforcer, but must limit its activities to ensuring that broadcasters are acting in the public interest by providing programming that reflects the tastes and viewpoints of minority groups.

## COMSAT reduces rates

Communications Satellite Corporation (COMSAT) has filed with the FCC substantial rate reductions for international communications satellite channels.

The lower rates, which become effective this month, apply to satellite channels leased to COMSAT's U.S. international common carrier customers for voice data and video services through satellites of the INTELSAT global system.

COMSAT's new tariffs provide for a single rate of \$1,575 per month for all voice grade channels leased for service between the United States and foreign points. Currently, the rates for such service range from \$2,500 to \$4,900 per month. The rate for satellite channels between the U.S. mainland and Puerto Rico will be reduced to \$970 per month from \$1,500.

Television rates, which currently range from \$414 to \$725 for the first 10 minutes of video and accompanying audio, will be reduced to \$275 to all points. Additional per minute charges will be \$10, which under existing tariffs range from \$11.40 to \$20.50.

COMSAT has reduced its rates for satellite channels several times since commercial service was first introduced via the Early Bird satellite in 1965. However, the current across-the-board rate decrease represents the largest overall reduction in the history of international satellite communications.

The FCC has instituted a proceeding to assure that the benefits of COMSAT's lower rates will be passed through to the public by COMSAT's carrier customers.

## Canadians insulted by advertising

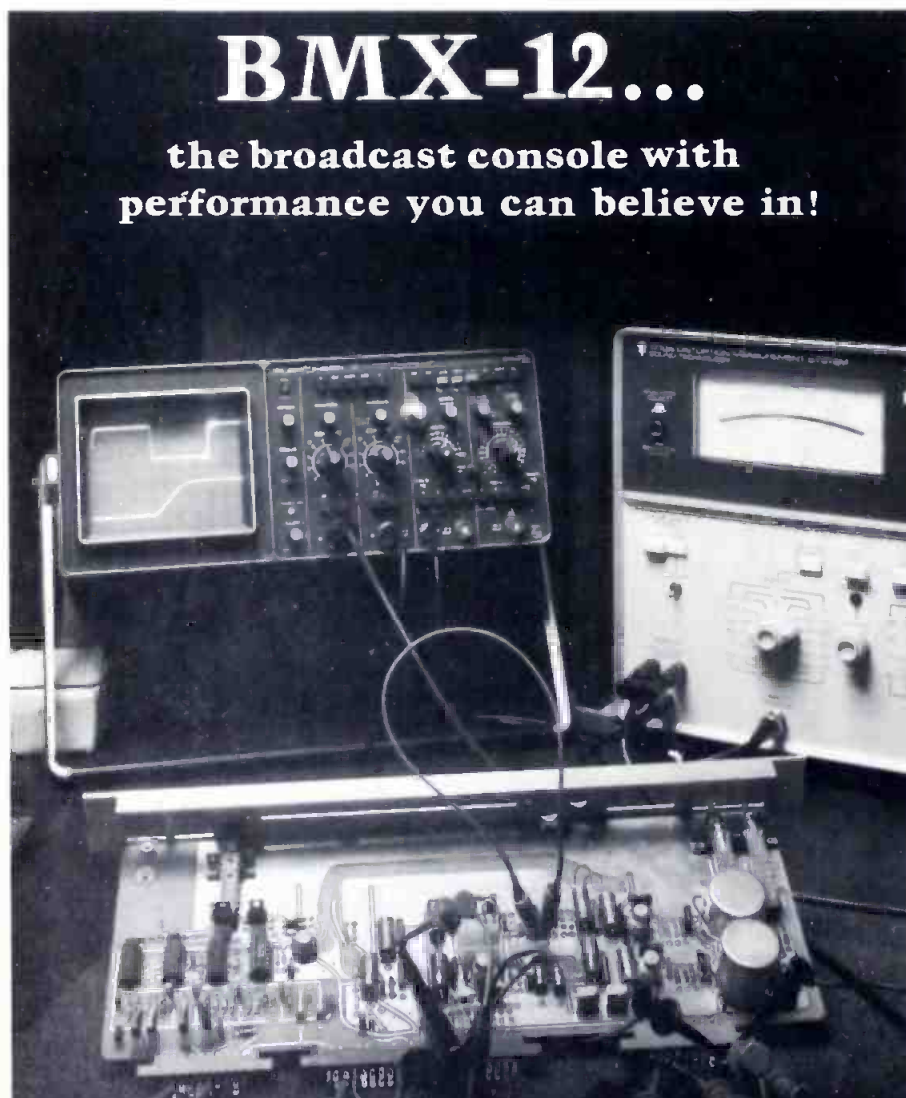
Most Canadian television viewers regard advertising messages as an insult to their intelligence, according to a national study conducted by the Canadian Radio-television and Telecommunications Commission.

The study found that Canadians hold negative attitudes toward the form, content, and manner of pre-

continued on page 12

# BMX-12...

## the broadcast console with performance you can believe in!



Transient response is the forgotten spec that makes our consoles stand out from the rest—because we didn't forget it...

See it at the NRBA

Call, write or telex:



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Scotch® 479 Master Broadcast

## SCOTCH IS FIRST IN BROADCAST. GIVE OR TAKE AN INCH.

Scotch® has been state of the art in broadcast videotape for more than twenty years. It's an industry-wide fact that nobody knows tape like 3M.

So when the industry looks at a new format, the industry looks to Scotch.



In broadcast quality one-inch, it's Scotch Master Broadcast 479. 479 has all of the qualities you've come to expect from a tape named Scotch.

Like superior color noise and signal-to-noise. And nobody gives you better RF output.

### Scotch Master Broadcast 479.

When you come to that new format, you'll have an old friend.

"Scotch" is a registered trademark of 3M Company, St. Paul, MN 55101 © 1977, 3M CO.

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continued from page 10

sentation of television advertising. Many are annoyed by the frequency, repetitiveness, and interruptive effects of commercials. Also cited as irritating are the insulting tone of commercials and the use of celebrities in selling products.

The study, conducted for CRTC by Market Facts of Canada, was conducted in two phases. In the first phase, qualitative measurements were used to determine the ways in

which these attitudes were expressed. In phase two, a survey was conducted to obtain a quantitative measurement of how widely these attitudes were shared. The survey sample was composed of 3,060 respondents, selected to represent a cross section of the Canadian population. Responses to a variety of carefully selected statements were obtained through personal interviews.

The project investigated three primary areas: attitudes toward advertising as an economic and commercial activity; attitudes to-

ward television as a medium; and attitudes toward advertising on television specifically.

The study concludes that Canadians' attitudes toward advertising in general are mixed. While the majority believe advertising to be necessary to the economy, many believe that there are unattractive financial consequences such as increased prices of products and increased spending on useless commodities.

Although most Canadians believe advertising is necessary to pay for the provision of programming, opinion is split as to whether the quality of general programming is improved where advertising is present: 38% of the population feel there should be no advertising at all; 50% indicate willingness to pay for good advertisement-free programs; and almost 75% agree there should be at least one commercial-free channel.

Canadians prefer advertising to be factual and presented in an entertaining way. Moreover, viewers favor longer messages on related topics grouped at the beginning or end of programs.

Finally, the study found that Canadian viewers are concerned about truth in advertising, and the majority want the government to insure truthfulness of commercials.

**Fairness Doctrine unfair**

The Fairness Doctrine and equal time law "remove from the broadcast press the ultimate responsibility for editorial decision-making and place that responsibility in the hands of a government agency. This gives the government the right to tell the broadcast press what it may or may not publish."

This was the view expressed by Bill Leonard, NAB television board and First Amendment committee member, before the U.S. Senate Communications Subcommittee.

Leonard, a former newsman, also said, "The purported justification for placing restrictions on broadcasters—a 'technological scarcity' of frequencies—is an argument which has little basis in fact, and will, as time goes by and technology develops, have less. There are in excess of 8,000 broadcast stations in the United States—more than four times the number of daily newspapers. Indeed, I suggest that the multiplicity of voices heard over broadcast stations far exceeds that provided by any other mass medium at any time in our history."

continued on page 14

**TRI-DEK<sup>®</sup>...the low cost, compact triple deck cartridge reproducer from AMPRO.**



It works harder for you with 4 exclusive features:

1. **SELF ALIGNING PINCH ROLLERS** automatically adjust for mechanical misalignment. Prevents tape slew, poor stereo phasing and excessive tape wear common to all other cartridge equipment.
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You get maximum reliability with a completely independent operating system for each deck...audio playback, cue detection, logic control and power supply regulation. Record option available.

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# System 21

No gambles! DYNAIR's System 21, carefully developed through 21 years of distribution switching experience, is a sure thing.

The video cards are stacked with such numbers as 0.15% differential gain, 0.15° differential phase and  $\pm 0.1$  dB frequency response to 5 MHz. Check the audio card's harmonic distortion of less than 0.2% at full 30 dBm output with hum and noise riding 105 dB below.

Matrix switching cards — audio, video, time code, data, machine control — are all instantly replaceable with power on. They're controlled by a micro-processor with battery-backed memory so loss of

power doesn't lose the setup. Control troubleshooting is straightforward since self-diagnostics are built in.

Yes, the deck has been stacked to give you the best combination of performance and features available in a distribution switcher today. We've been in the game for 21 years and know how to do it!

Give us a chance to deal you a specification sheet describing System 21's other features — like expandability to 1000 x 1000, constant vertical-rate refresh of the entire matrix, RS-232 interface, single-line switcher control, full salvo capability, and more.



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Security is having every word automatically recorded 24 hours a day. And being able to retrieve that information... with the time of record... whenever it's needed. That's the kind of *failsafe* protection the 400 Logger provides to major radio and television networks worldwide. Find out about our many standard features:

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Audio/Electronics Division

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## news

.....  
continued from page 12

### IBC '78 to convene in September

Engineers from around the world are expected to gather to keep current on the latest developments in radio and television technology at the International Broadcasting Convention, IBC '78. The convention has moved to London's Wembley Conference Center, and will convene from September 25-29. The convention has two major parts, an exhibition and a technical program.

Careful scheduling of IBC '78 places the event six months away from NAB '78 and on alternate years with the International Television Symposium in Montreux, Switzerland, the other major international industry event (also biennial). These international events make it possible for U.S. broadcast engineers to keep tabs annually on technical developments abroad as well as at home.

The exhibits—83 in all, from over 50 different countries—are expected to draw keen attention. Among the smaller companies exhibiting this year are AEG Telefunken, Aston, Digivision, Dynamic Technology, EMI, Electroimpex, NTP Elektronik A/S, System Video Ltd., and others. Of course, the giant firms well known to U.S. broadcasters, such as Ampex, Bosch Fernseh, Marconi, Pye/Philips, and Thomson CSF, will be represented.

The technical program will concentrate on new techniques, systems, and developments in audio and television broadcasting, both analog and digital. Included will be reports on microprocessors and mini-computers in broadcasting; low-budget broadcasting systems; studio lighting technology; transmitters/antennas; lightweight program equipment; stereo and quadraphonic sound systems; TV cameras, electronic graphics, visual effects and other studio equipment; video and audio recording and storage; new broadcasting systems (e.g., teletext and traffic information); audio and video measurement technology; and future possibilities in receiver design.

In addition to the exhibits and the technical program, plans include a reception and a special ladies' program. For information on registration, contact The Secretariat, International Broadcasting Convention, IEE, Savoy Place, London, United Kingdom WC2R OBL. □

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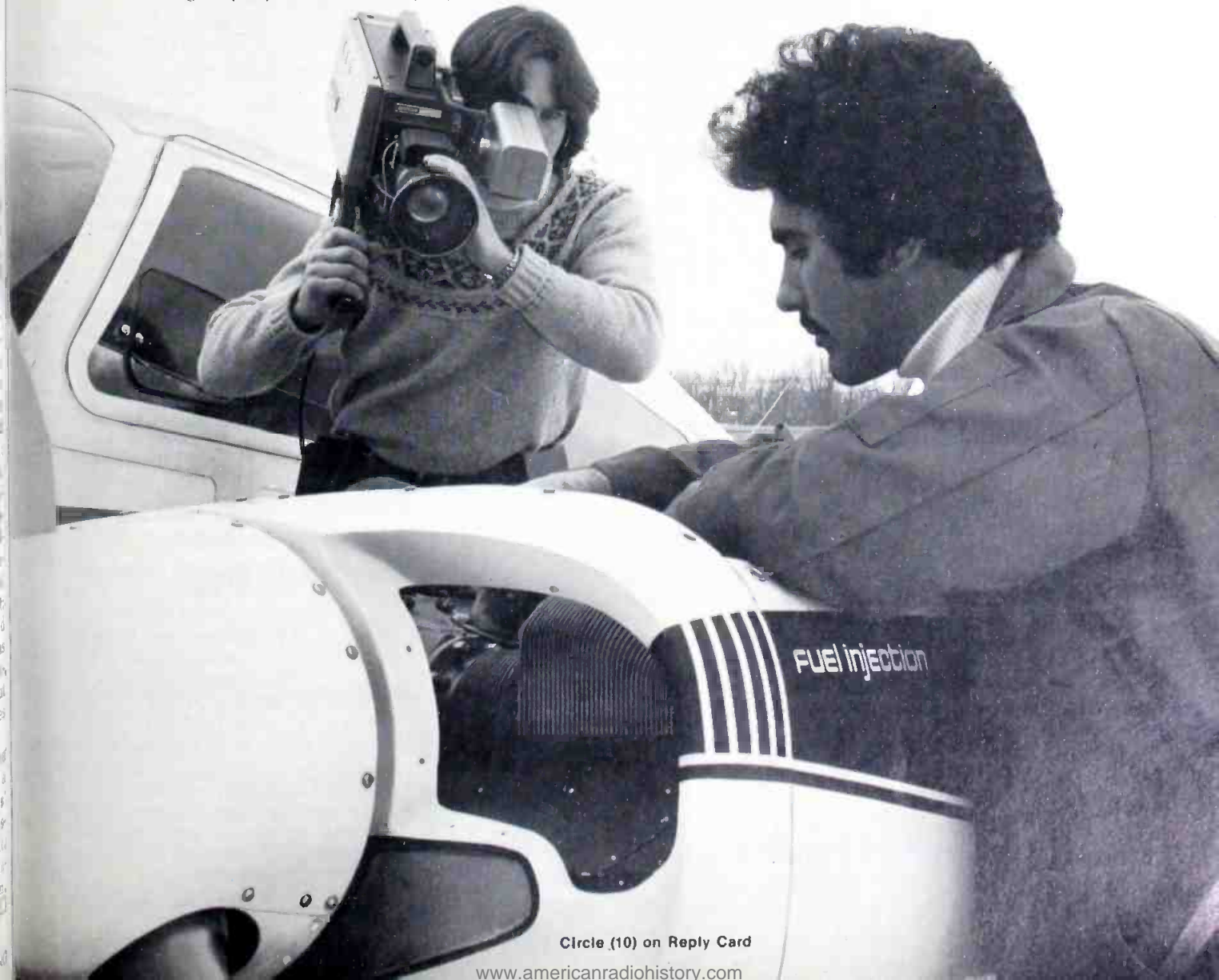
No matter what the assignment, the FP1020's three  $\frac{2}{3}$ " Saticon® tubes deliver broadcast-worthy resolution and colorimetry. And like all Hitachi portables, the FP1020 combines lightweight handling with heavyweight performance features such as: auto white and black balance controlled by an 8-bit digital memory...three-way power via 2-hour battery belt, AC, or 12V DC...built-in color bar generator...vertical enhancer...and a 5-position color temperature filter disc.

Two key options extend the versatility of the FP1020: built-in Gen-Lock for multi-camera system use and a remote Operation Panel which controls camera functions from up to 150 feet away.

For documentaries, for training programs, for any field production applications, see the Hitachi FP1020 first. At your Hitachi dealer.



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# Solid State at Tube Prices.

And when we say solid state, we mean 100% solid state. So you get all the energy savings and improved reliability that solid state technology implies. But price isn't the only thing that's exciting and important about the new Sintronic SI-A-1S 1 kW AM transmitter. It's also loaded with features that save downtime and reduce maintenance.

Most of the circuitry is on 26 computer-type plug-in cards, even the power amplifier. Circuit monitoring and maintenance is a cinch. Panel indicators and a direct reading digital multimeter monitor all critical circuitry. Card extenders allow easy access to components for in-service maintenance. The operating frequency is precisely maintained by a synthesizer referenced to a high stability crystal requiring no oven. It has 125% positive peak modulation capability, but does not use a modulation transformer which can cause phase shift distortion.

Multiple muffin fans move a column of air *slowly* and *evenly* through the transmitter, reducing filter cleaning and eliminating the worry of catastrophic failure as when a single, high-speed blower suddenly quits. The output power is monitored and automatically adjusted to maintain the correct output power... precisely and continuously. The RF drive and modulation are constantly compared and the drive is automatically regulated for the optimum level *throughout each audio cycle*.

A strappable 7.5 khz low pass filter is standard so you can use your audio energy where it will do the most good. We have added a switchable peak-riding audio clipper too, removing those sharp, low energy peaks causing the modulation meter to flash prematurely.

Remote control facilities are standard.

Of course Sintronic makes transmitters other than the SI-A-1S. They can provide you with the transmitter you need from 10 Watts to 55kW FM, or to 50kW AM.

There are many more impressive facts about this transmitter we would like to tell you about. Contact Tom Humphrey at Sintronic Corporation, 212 Welsh Pool Road, Lionville, PA 19353. Telephone: (215) 363-0444.



Sintronic Model SI-A-1S  
1kW AM Transmitter

**Sintronic** CORPORATION  
Sintronic is a subsidiary of Singer Products Co., Inc.

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## people in the news

### Manufacturers/Distributors

**John Francke** moved from Marconi Electronics to A.F. Associates, where he assumed the position of corporate controller. Francke was with Marconi for six years.

**Lanny Myers** was promoted from assistant controller to controller at California Microwave. Myers came to the company in 1977 from Intersil Inc., where he held the position of corporate accounting manager.

Two promotions were announced at the Conrac Division of Conrac Corporation. **Frank Heyer**, who has been with Conrac for 10 years, is the new engineering manager, television products. In his new position, Heyer will be responsible for all engineering functions related to Conrac's line of professional television monitors. As manager of technical support engineering, **Gene Ornstead** will be responsible for interfacing with customers on all technical matters. Ornstead was previously field service engineer for Conrac.

At NEC America's Broadcast Equipment Division, **Robert Curwin** was appointed eastern regional sales manager, **Ray Koerner** as sales engineer, and **Lewis Wigal** as customer service engineer. Curwin is developing a network of dealers to complement the direct selling of NEC terminal television equipment and telephone video systems. Koerner conducts research of the transmitter market and assists in the planning of market strategy for NEC transmitters. And, Wigal provides training and technical assistance to customers, including servicing of their equipment.

Succeeding **John Larkworthy** as general manager at Microtime is **David Acker**. Acker, who has been instrumental in the design and production of Microtime's analog and digital products, will continue as a vice president of Andersen Laboratories Inc., Microtime's parent company, and the Microtime division.

All company advertising, sales promotion, and trade shows will be the responsibility of **Robert Davis**, recently appointed manager of advertising and promotion at Broadcast Electronics. Davis moved to BE from Harris Corporation, Broadcast Products Division.

RCA's board of directors elected **Richard Sonnenfeldt** as vice president, RCA "SelectaVision" VideoDisc Project. **Sonnenfeldt** was formerly manager of engineering and production of RCA's industrial computer systems department.

**Gerry Brill** joined Ampex as senior product manager of professional cameras. He was formerly product manager for all broadcast products at Philips.

The Grass Valley Group named **Peter Hughes** to the position of routing systems manager. Hughes joined Grass Valley in 1977 after years of experience with Richmond Hill Laboratories and Image Video. His TV engineering career began with the BBC.

continued on page 20

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Through engineering improvements like these:**

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- + 18 dBm audio output (optional).
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- Improved head mounting blocks provide better stability.
- Improved air-damped solenoid with Teflon® coated plunger for quieter operation.
- Self-aligning top capstan bearing
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August, 1978

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# INNOVATION 78



...the finest most complete line of cameras and broadcast equipment ever offered by one company — Philips.

Philips, with over 3 decades of leadership in cameras, transmitters, turn-key studios, mobile vans, systems, around the world.

Philips, the company that revolutionized color broadcasting in 1965 with the development of Plumbicon™ tube technology and the legendary Philips Norelco PC-60 camera.

Now, presenting the highlights of Philips latest line of innovative equipment as demonstrated to SRO audiences in our NAB "Innovation '78" exhibit:

**LDK-25 Camera Family with New Diode-Gun Plumbicons.** Our new 1-inch 73XQ Plumbicon tubes and camera circuitry give you *higher resolution and lower lag than 30mm cameras.* Better than

65% depth of modulation at 400 lines! With new



**Dynamic Beam Control (DBC)** to control hot highlights, as much as 4 f-stops over peak white. The finest, state-of-the-art multicore studio and field camera system ever produced is now better than ever. Plus, *only* Philips rear-loading design, as in the advanced LDK-25 camera family, can deliver the *maximum* out of this new diode-gun tube technology.

NAB '78 also saw the addition of a new production portable to the LDK-25 family. The compact and lightweight LDK-15L matches the picture quality of either the LDK-25 multicore or LDK-5 digitally controlled triax cameras, enabling it to be used either as a compact studio camera or in the field as part of a multiple camera system. Totally compatible, the LDK-15L can be used with the base station of the LDK-5 or the CCU of the LDK-25.

**Philips UHF/VHF Transmitters, famous around the world for high reliability and low operating cost, are now the most rapidly growing transmitters in North America.** Over 37 already installed since introduction to the U.S. and Canada... and over 1000 worldwide.



Transmitter output power range up to 110 kW. Equally suited for single or parallel operation. Designed for unattended operation with automatic or remote control.

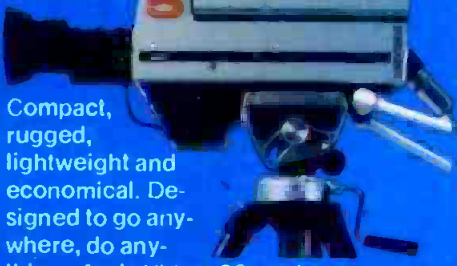
Features include: I.F. modulation, solid state design except for power stages. High stability. Ease of installation and maintenance. SAW filter, re-

ducing the number of controls to achieve proper group-delay. Small size and minimum floor space are made possible by the advanced design and a unique common exciter which can also be retrofitted into earlier competitive systems. UHF offers a choice of internal or external vapor cooled Klystrons.

**VIDEO 80...the Incredible Convertible Camera and Complete Production System** for multi-use applications.

Converts to ENG, Field Production, Studio, or Special Applications (telecine, microscope, operating room lamps) with just a change of slide-on viewfinder and plug-in electronics.

Simple to set up and operate because the test features are built-in, with "no compromise" performance. With automatic features for total mobility.



Compact, rugged, lightweight and economical. Designed to go anywhere, do anything. And, Video 80 systems are expandable and compatible with existing equipment for additional cost savings.

**LDK-14—New, 2/3-inch ENG/EFP/ Studio Systems Camera** has the look and feel of a film camera with the picture quality and performance features of Philips studio cameras.

Features include: Outstanding broadcast picture quality for ENG, EFP, or full studio use. Lightweight, rugged, one piece. Low power consumption. Remote control option. High sensitivity. Dynamic Beam Control (DBC) for hot high-light handling. Fully automatic operation, including auto-centering, and switchable black stretch. 1½-inch and 5-inch view finders for hand-held or tripod use. Full bandwidth chroma key and triax facilities.

**One Inch Video Recorders** in both "C" and "B" formats to satisfy your requirements. Philips has always offered the widest selection of portable and studio camera systems to best meet your specific applications.

Now Philips expands this same "meet-your-needs" policy to include 1-inch VTR's and time base correctors, with both "C" format (PVR series) and "B" format (BCN series) VTR's in both portable and studio configurations.



Philips wide selection and systems experience provide the greatest objectivity and cost effectiveness in packaging systems to match your requirements.

Also presented at NAB: The studio performance LDK-11, Field Production Portable and Compact Studio Camera. Full production control either remotely or at backpack. Up to 300' of ½" cable between camera head and backpack.

The LDH-20S, Economy Broadcast-Quality Studio Camera.

A new, versatile Sync Pulse Generator, LDK-4210.

A full line of Test and Measuring Equipment.

Altogether Philips displayed and introduced the widest range of cameras and broadcast equipment at NAB or anywhere else. For complete information write on your company letterhead (indicating product interest) today to:



Philips Broadcast Equipment Corp., 91 McKee Drive, Mahwah, N.J. 07430 (201) 529-3800. (Canada: Philips Broadcast Equipment, 601 Millar Ave., Scarborough, Ontario M1B 1M8).

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## Lighting Control System of the Future

The ILS (Intelligent Lighting System), is a unique, fresh approach to lighting control for theatre and television. It represents a harmonious blending of the demanding requirements of production lighting control, with the latest technology available from the computer industry.

The operation of ILS was purposely kept simple, because it had to perform complex functions according to the requirements of the production. ILS is designed to communicate in ordinary production language.

We created a system which will not only perform the required functions of a show, but it will also handle many of the bookkeeping functions which used to take lighting directors, their assistants and the board operators hours to write out. Since ILS is truly an "Intelligent Lighting System," it will never belittle the operator.

You won't see a large console filled with levers, switches and lights. That's not needed with ILS. Instead, you sit in front of a terminal. In addition to the usual alpha and numeric keys found on these keyboards, we have added our own special function keys.

The CRT displays information you need to know during the show and often you respond to questions asked by the computer. It's a self-reaching system and will not let you enter an incorrect command.

It's an exciting concept in lighting control and we are sure you'll see why when you take command of an ILS Control System.

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## people in the news

.....  
continued from page 16

**David Clark** and **Tony Digirolamo** of Imero Fiorentino Associates Inc. were recently presented Emmy Awards for their outstanding achievement in lighting direction. Clark received an Emmy for his lighting design of the New York remotes of "The Mike Douglas Show"; Digirolamo was awarded for his lighting design of the children's special "Henry Winkler Meets William Shakespeare."

Two years after joining Berkey Colortran as director of finance, **Paul Friedman** was named vice president, finance and administration. In his new position, Friedman will be responsible for accounting, credit, data processing, billing, and office management.

### Radio/Television

**Jonathan Frank** joined WJIB-FM, Boston, as assistant to **Jim Howard**, engineering manager. Frank, formerly maintenance engineer at WVBF/WKMX (Framingham, Mass.), will be involved in all phases of technical operations.

**Ivan Miles** was appointed director of engineering for Broadcast Enterprises Network Inc., which owns stations in Atlanta, Ga; Charlotte, N.C.; Clearwater, Fla.; and Cincinnati. Miles had been chief engineer at WAOK, Atlanta.

**Randy McCallister**, formerly radio product manager at RCA Broadcast Systems Division, has been named telecommunications director of engineering at Radford College, Radford, Virginia.

**Stephen C. Trivers**, president and general manager of WQLR in Kalamazoo, Mich., announced the appointment of **Leroy Green** to the position of news director. Green has been with the station for more than a year as an announcer/newsperson.

**Jorge Infante**, new program director at WOJO-FM, Evanston, Ill., brings a vast background in Spanish broadcasting to this Spanish-language radio station.

The new station manager of KATU-TV is **Sherwood "Skip" Hinman**, according to general manager Tom Dargan. Hinman joined the station in 1969 as a sales manager, and has been assistant general manager since June 1976. **Tom McCall** has left his post as KEX and KATU-TV political commentator, as a result of his candidacy for the Republican nomination for governor of Oregon. Also, **Bob Clark** and **Melinda Coats** have left KEX to work for an FM station in Agana, Guam. Clark is replaced by **Steve O'Shea**.

The principle staff of KBDF in Eugene, Oregon, recently purchased by Jaymar Communications, includes **Rob Skinner** and **Peter Townsend**.

**Richard A. Browne** has been named program director at WFEA Radio, Manchester, New Hampshire. Browne previously was with WAEB, Allentown, Pennsylvania.

An **AUDIO-VIDEO** routing switcher for today—tomorrow—or 10 years from now

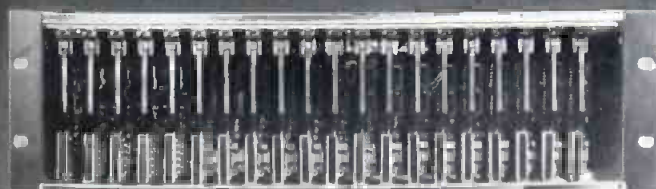
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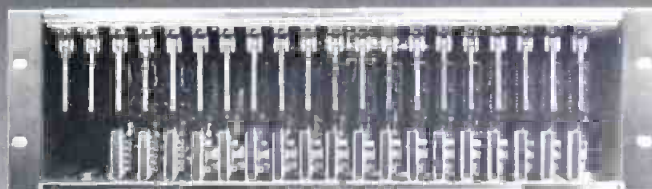
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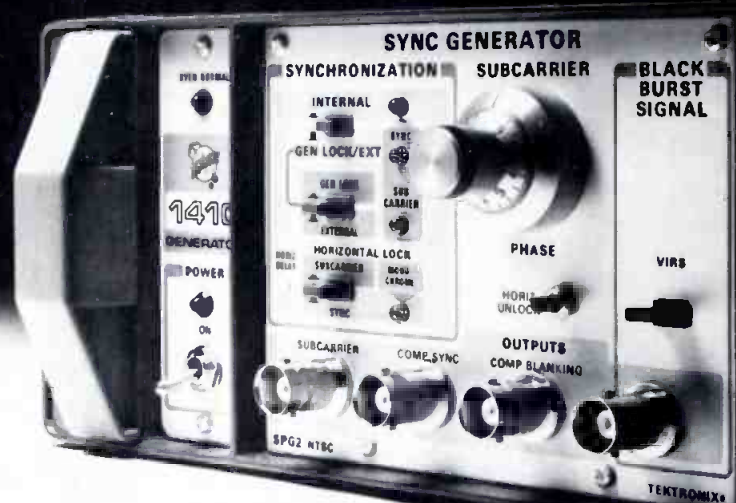


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  - Black burst output
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  - Precise subcarrier to horizontal sync phasing is maintained at all times, including when genlocked. Color field identification is provided by a field identification pulse output.
- Greater sync system stability
  - Optional  $\pm 1$  Hz color subcarrier stability performance ( $\pm 10$  Hz is standard)
- Sync system status easily determined
  - LEDs indicate internal or external reference source, monochrome signal incoming, loss of sync or external subcarrier lock
- 1410 Mainframe easily accommodates additional test signal generators.

- Put your total sync system together with TEKTRONIX
  - Automatic Changeover Unit provides switching to back up sync generator
  - Systems available for NTSC, PAL and PAL-M



Typical NTSC sync generator system comprised of two 1410R Option 01 mainframes with SPG2 sync generator modules, and one GVG 3257A Automatic Changeover Unit.

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For Demonstration Only Circle (17) On Reply Card

BROADCAST ENGINEERING



# Unique remote production unit joins Boston's July 4th celebration

A new remote telecast unit offering three-camera production capability in a small, compact vehicle was initiated recently by WCVB-TV, Boston, during that city's July 4th celebration.

The new mobile unit, the first of its type in New England, was used in a remote shoot that included portions of the Boston Pops Orchestra's performance on the banks of the Charles River.

## Enter the "Hippo"

Less than 20 feet in overall length, the WCVB-TV remote unit, nicknamed the "Hippo," boasts the smallness and maneuverability of an ENG-type van with production features normally restricted to much larger vehicles in the 30- to 40-foot range.

"It makes multi-camera remote productions much faster and simpler, and delivers improved picture quality to WCVB-TV's viewers," said Peter Cohen, manager of press relations.

The end result of more than 12 months' planning and construction, the Hippo was conceived, designed and constructed entirely by the WCVB-TV engineering staff, headed by Ross Kauffman, director of engineering. The actual construction of the vehicle was under the supervision of Ira Goldstone and Dave Underhill, engineering supervisors. The custom interior portion of the \$400,000 vehicle was crafted by Wolfcoach of Northboro, Mass., a top constructor of remote video units.

## Three-camera capability

The Hippo carries two Ikegami HL-51 cameras and an RCA TK-76 camera. The high-quality Ikegami HL-51's have an extended field range of 900 feet, while the RCA TK-76 can remain tethered to the main production unit at distances up to 300 feet. All three cameras also have total remote capability with operator-carried power sources. Motorized camera cable take-up reels for the Ikegami's are one of the factors in the vehicle's quick set-up and tear-down ability.

The TK-76 has distinguished itself as the standard unit for ENG work, being slightly smaller and lighter than the Ikegami's. The TK-76 is also used on the three other WCVB-TV remote units: the "Bumblebee" (ENG), the "Zebra" (ENG), and the "Winnie" (ENG-production). Unlike the Hippo, however, the three other units only have single-camera capability.

## 1-inch goes remote

According to Cohen, the use of the RCA TH-100 1-inch VTR on the Hippo marks the first remote use of

the new standard Type C 1-inch videotape in New England.

"WCVB-TV is the first station in New England to employ the new 1-inch tape format," Cohen said, "and the station will be taking a hard look at the reliability and performance of the smaller equipment during the next year. However, WCVB-TV engineers feel that a total switch from 2-inch to 1-inch videotape hardware is still three to five years away, if at all."

Another TH-100 will soon be installed in the station's tape room to blend with 2-inch equipment currently in use. In addition, RCA's new TH-50, a field portable version in the 1-inch format, is being added to the Hippo's equipment inventory when it becomes available (early 1979). Unlike the TH-100, which is mounted permanently to the vehicle, the smaller unit will be used for remote shoots that require leaving the vehicle.

*continued on page 26*



WCVB-TV engineers are pictured manning the three cameras of "The Hippo," a new, compact remote production unit. The roof-mounted RCA TK-76 joins two Ikegami HL-51s for unique production capabilities in a small, maneuverable vehicle.



# The Sony BVE-500A. It's the best editing decision you'll ever make.

Announcing the professional automatic editing control unit professional editors have been waiting for. The Sony Broadcast BVE-500A.

Already, the earlier BVE-500 has been accepted as the state of the art in control track editing by broadcasters around the world. In the new BVE-500A, we've made substantial improvements that increase the speed, versatility, and convenience of the editing process.

Compare these editing advantages with existing equipment, and consider the added creative capabilities you get with the Sony Broadcast BVE-500A.

**1. BIDIREX control.** The big news in the BVE-500A is BIDIREX: two self-return search dials that take the place of ordinary pushbutton search controls. Many control instructions have been built into these BIDIREX dials to allow an operator to shuttle tape in forward and reverse direction at various speeds.

BIDIREX eliminates mode selection error. And it gives Sony U-matic editing a true "film" feeling ordinary editing systems can't match.

**2. Decision Prompter.** The new BVE-500A uses lamps to prompt the operator to the mode and progress of all editing decisions.

Function lamps blink until the edit commands are made, then go automatically to "steady on." Even in a busy newsroom, with many interruptions, an operator can tell at a

glance the status of his last instruction as the BVE-500A prompts him for the next command.

**3. Automatic Entry.** The BVE-500A saves valuable time with a feature that automatically enters the "IN" point when the preview button is engaged.

If the operator has already selected an "IN" point, this auto mode has no effect; the editor may preview without disturbing his pre-selected "IN" point.

**4. New Full Time Counter.** The BVE-500A counts control track pulses from -79 minutes through 0 to +79 minutes. An operator need not concern himself with the count when he initiates an editing sequence.

**5. Short Pre-Roll.** When used with external sync, pre-roll is reduced from five seconds to three seconds, a further time-saving advantage.

**6. Cue Control.** The BVE-500A features built-in cue record and erase. This 1kHz tone is recorded on Audio 1, and is useful for both auto control systems and pre-cueing the tape to air.

These are just a few of the new BVE-500A features.

Others include auto shut-off, external interface of control logic, manual edit capability, and more. You can see them all in action when you ask for a demonstration of this versatile new editing control unit. To do that, just contact your nearest Sony Broadcast office.

## Sony Broadcast

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- \* 50 db separation ..... 10 KHz 15 KHz
- \* FM Noise — 75 db ..... Cross Talk — 60 db



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## News feature

continued from page 23

### Live via microwave

For feeding live reports from the Hippo to the station via microwave, the tape can be fed and recorded through a frame synchronizer. The remote unit also can be equipped with a time base corrector to mix playbacks with other remote material (e.g., live cameras).

With the TBC, the TH-100 can provide moviola-type viewing, still-frame viewing, frame-by-frame joggings, and picture viewing at up to 40x shuttle speed. The VTR has two program audio channels plus a cue track/time code channel. Time code record and read ability is included in the machine.

### Equipment complement

Simple miking can be inputted directly to the mixer located at the switcher control panel. For use of more than three mikes, however, an outboard console must be used. In this case, the audio man works outside the van and feeds his composite audio directly to the Hippo. The console has eight inputs, and will handle any routine mixing required for the talk-show and simple music-show remotes the Hippo is designed to handle.

The van includes two 15-inch color monitors (line and preview) positioned in front of the switcher. There also are three black and white monitors.

Truck power is available for minimal lighting from one of the two truck generators. The HL-51's and TK-76 provide good video in the 100-200 footcandle range.

A microwave dish and tripod are stored on the truck, and mounting brackets are provided on the roof. The roof is accessed by a ladder, located on the truck's rear door. The microwave transmitter rides inside the truck, and is removable.

A new RTS system forms the heart of Hippo communications. Included in this system are full headsets, which may be strung to any area in the remote. There are four separate channels of IFB. The program side of this IFB system may be fed with truck audio, air audio, WCVB subcarrier, or the new cueing system. Split feeds to give interrupt to one ear and constant program to the other are possible.

The cueing system is a dedicated 75-watt cueing transmitter located in downtown Boston and controllable from the station. It can carry studio mix-minus, air, or studio output as desired, including director interrupt from A-control or any other control room at the station. Thus, the director at the station can cue the Hippo talent directly via this channel and Hippo IFB system. For more portable uses, the talent can even be supplied with cue-channel receivers.

The truck also is equipped with a mobile telephone, and with a transceiver on the news and engineering two-way channels.

### Key word: flexibility

With its full complement of equipment, compacted into a 20-foot remote vehicle, the Hippo adds tremendous flexibility to WCVB-TV's on-location shooting. And, flexibility and image quality were the key words used by Cohen to describe the Hippo.

"The small size of the vehicle allows it to travel where larger units have not been able to, making full-scale remote productions feasible," Cohen said. "Remote inserts will no longer be limited to basic, one-camera shoots." □

# IF YOU CAN TYPE, YOU CAN TITLE.



Our D-3016 and D-2000 Character Generators put broadcast quality graphics at your fingertips.

Inside the D-3016 we've packed a 16-page memory for often-used titles and a dual-channel display to let you preview and program simultaneously. Choose two fonts from the three available styles.

Our lower-priced D-2000's built-in, 4-page memory is supplemented by an audio interface that turns an ordinary tape recorder into an additional memory unit. An optional

random access memory unit compatible with both generators is also available.

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# Studio construction

# Increasing efficiency with modern test equipment

Part 2/By Peter Burk



A well organized test bench helps improve efficiency, as demonstrated by Michael Moore in the "back room" at KRVR. (Photo by Peter Burk)

This month, the **Radio Workshop** is really going to stay in the workshop! We'll try to help you plan your dream test bench so that you can spend less time on routine maintenance and troubleshooting and have some time for the really important things (like putting an 8-track in the boss' car).

Everyone's idea of perfection is a little different, so we won't try to recommend any one complement of equipment. We'll just point out some of the things to look for when you go shopping.

## Signal generators

At the top of our shopping list is a good audio sine wave generator. We emphasize good, because it's really the limiting factor in the entire test chain. If you can't put a good clean signal into the device under test, it's next to impossible to measure the quality of the signal coming out of the device. As a general rule, your test equipment should be ten times better than the performance of your best piece of broadcast equipment. If you want to read distortion at less than one percent, the generator will have to be capable of less than a tenth of a percent.

In addition to low distortion, the test oscillator should have a sufficiently wide frequency range, a calibrated output attenuator, and sufficient output level. This last detail is sometimes overlooked. If your transmitter requires a +10 dBm signal for 100% modulation at 1 kHz, a generator only capable of +10 isn't adequate, since the sensitivity at 10 or 15 kHz is probably somewhat lower.

Most generators have sufficient frequency range for audio tests, but an even wider range can provide a few "freebies." An oscillator that happens to go up to one megacycle or better can be used for AM rf and if

alignment and even as a signal source for AM antenna resistance measurements.

## Function generators

While we're talking about signal sources, let's talk about one of the most versatile generators of all—the function generator. For some reason, this piece of gear doesn't find its way into every station's workshop. It should. A good function generator can produce an appropriate test signal for almost any conceivable audio test. Even an inexpensive unit can create a tough obstacle course for any transmitter.

The basic purpose of a function generator is to produce non-sinusoidal waveforms. Don't be concerned about the distortion on sine waves. Even a \$1,200 function generator produces a pretty mediocre sine. Concentrate instead on the square, triangle and ramp capabilities. Square waves are super for quick amplifier performance tests, and vividly reveal ugly problems like transformer ringing, group delay, and transmitter tilt. A ramp test can be used to observe 125% modulation capability on AM.

The more elaborate function generators come equipped with some very useful adjustments. DC offset, rise time, and symmetry should all be adjustable to derive maximum use from this instrument. AM and FM inputs, phase lock and trigger capability also enhance the unit. With an AM input, the generator can be used as a test transmitter for evaluating audio processing equipment or measuring receiver performance. (Caution: Don't measure the audio response of a typical consumer radio—it'll leave you with a helpless feeling and create severe mental depression.)

## The oscilloscope

Scopes have really blossomed with features in the past few years. It's still the most basic tool for seeing what you're hearing, but there's nothing basic about some of today's choices. Storage, dual trace, dual time base, wide bandwidth, and fancy trigger circuits have helped make the scope one of the most powerful pieces of equipment that you'll ever own. Look for the features that you need, plus operating ease. If at all possible, try before you buy. Some scopes have all the features you need, but are awkward to use.

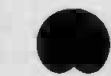
Good X-Y capability is a must, especially for stereo. For some reason, many otherwise excellent scopes lack this feature. Some units provide the capability, but require that you plug the "X" signal into the back of the unit, and provide only a ten to one horizontal adjustment range. This is inconvenient, to say the least. Most of the less expensive scopes (and even many of the two to three thousand dollar units) use the sweep circuit for the "X" amplifier in the X-Y mode. A much more satisfactory arrangement is available on several models that convert one of the vertical amplifiers into an X-axis amp. This way, the

*continued on page 30*

# Audio-Technica introduces five new microphones... and a pleasant surprise.



**AT813**  
Electret  
Condenser  
Cardioid



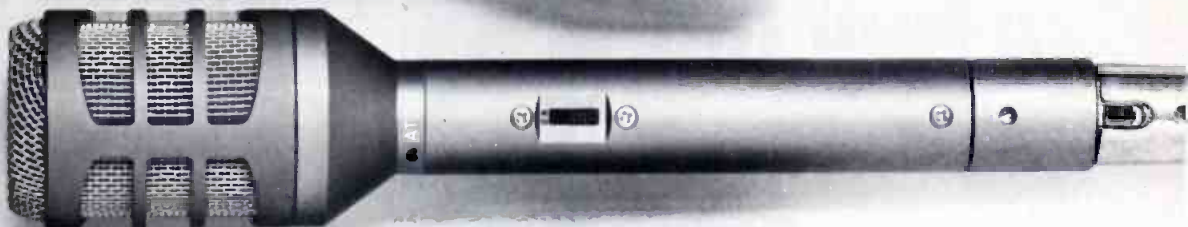
**AT811**  
Electret  
Condenser  
Cardioid



**AT801**  
Electret  
Condenser  
Omnidirectional



**AT812**  
Moving Coil  
Dynamic  
Cardioid



**AT802**  
Moving Coil  
Dynamic  
Omnidirectional



Take a close look at these new Audio-Technica microphones. Three electret condensers and two dynamics. Plus two clip-on miniature electrets (not shown). All are superbly finished. Carefully thought out in every detail. With the right "heft" and feel. Professional A3M Switchcraft output connectors, of course.

Then listen in your studio. Full-range, peak-free, clean and crisp. With

no distortion even when used close-up to high-level performers. And the balanced, phased Lo-Z (600 Ohm) output matches pro and semi-pro mixers alike.

Now for the surprise. The price. Both omnis are nationally advertised at just \$60, for either dynamic or electret condenser element. The two basic cardioids are just \$80, while the AT813

electret condenser with integral wind-screen is pegged at \$95. All complete with full one-year warranty.

Once you've seen and tried these new Audio-Technica microphones we think you'll welcome them. Not just because they cost so little...but because they do so much. Available now from your Audio-Technica Professional Products dealer.



**audio-technica** *Great sound. right from the start!*

# In the market for FM broadcast antennas?

## There are over 300 reasons to buy ours.

We have over 300 circularly and horizontally polarized FM broadcast antennas radiating signals daily in the U.S. alone. And, they're operating without difficulty or downtime. Still, you actually pay less for these remarkable antennas. Choose from 24 different types. Use an element as a single bay antenna. Use multi-element arrays. Your antenna ships complete, ready for installation with a tunable input transformer to match the antenna to the location.

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dodge**  
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## Studio construction

*continued from page 28*

phase accuracy is terrific, and the horizontal amplitude is adjustable exactly the same as the vertical is, over the complete amplitude range of the instrument.

### Distortion analyzers

Recent advances in distortion analyzers have really taken the pain out of THD measurements. Two options in particular reduce the time per reading by a large factor: Automatic null and automatic level set. If you haven't used a unit with these features, you're in for a treat. With automatic nulling, you can record the results of one measurement while the unit is nulling out the fundamental on the next. Automatic set level eliminates the need to adjust the sensitivity before each measurement.

For maximum convenience, the distortion analyzer should have high and low-pass filters on the input to identify noise that might be interfering with the distortion reading. Also an output of the distortion product is useful to identify the type of distortion on the scope.

Some units are built as a combination analyzer and oscillator. For studio measurements, this is nice, especially if the oscillator and analyzer are locked together in frequency. Unfortunately, split measurements such as studio to transmitter require an additional generator. If your budget will withstand two good generators, fine. Otherwise pick a pair that can be split.

### Intermodulation distortion

This country has been slow to recognize intermodulation distortion as a superior method of correlating a measurable parameter to audible distortion. The Europeans have led the way here, substantiating by listening tests that IM is more important in actual sonic quality than THD. More and more broadcasters are jumping on the bandwagon and are using an IM analyzer to keep tabs on equipment performance. An IM analyzer can also be used nicely for tape recorder bias adjustment. While there is still some debate the most valid, there's no question that an IM analyzer of some type should be a part of any dream test bench.

### Spectrum analyzers

An RF spectrum analyzer is a little out of reach for most radio stations, but a low frequency unit makes a good second choice. The spectrum analyzer can be considered a universal test instrument, since it is capable of making almost every type of distortion measurement. Some engineers feel that an audio spectrum analyzer can take the place of all other distortion measuring sets. Others find the conventional approach more satisfactory for routine measurements, and rely on the spectrum analyzer for more in-depth evaluation and troubleshooting. Either way, it's a powerful tool.

One advantage of spectrum analysis for THD measurements is that it is immediately obvious which harmonic is contributing to the distortion. An asymmetrical clipper, for instance, can be analyzed very effectively. Odd harmonics are a function of the amount of asymmetry. Measuring THD with a spectrum analyzer also eliminates the noise contribution which exists with a conventional distortion analyzer.

*continued on page 32*





## “Shooting a 2-hour network special with CEI-310 cameras was a real experience.”

Says the well-known director Vincent Scarza: “I’d heard about CEI-310 cameras, but I’d never worked with them.”

Scarza had the opportunity to work with them at ‘The World’s Largest Indoor Country Music Show,’ a 2-hour NBC prime time special edited from 4½ hours of videotape, shot at the Silverdome in Pontiac, Michigan in front of a live audience of 65,000.

Besides directing, Scarza co-produced with executive producer Jim Fitzgerald of Rudy Callicutt Productions. Complete video production facilities and crew were provided by Northwest Teleproductions.

The production involved seven cameras. Four were versions of the CEI-310—two hand-held portables, one portable in a mobile cart, and one studio version.

“I was amazed,” says Scarza, “at the absolutely marvelous pictures



produced by the CEI cameras—even under difficult lighting conditions.

“Maneuverability of the portable units was incredible. My cameramen were able to get fantastic hand-held shots. Since they had 4½ hours of non-stop shooting, light weight was really important.

“All in all, it was a dynamite performance. Anybody who hasn’t worked with the CEI-310 really doesn’t know what they’re missing.”

Isn’t it time you looked at the CEI-310? Call your local CEI dealer now. Or get in touch with Commercial Electronics, Inc., 880 Maude Avenue, Mountain View, California 94043, (415) 969-1910.

Changing the look of field production.

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# STL PRECISION TEST TAPES

## WIDEST VARIETY—HIGHEST QUALITY

Do not accept lesser quality—Insist that the STANDARD TAPE LABORATORY name is on the label.

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CATALOG #			DESCRIPTION	PRICE (EACH) (FOB HAYWARD, CA)
Mono	Stereo	Compatible		
34-1	34-2	34	<b>Reproduce Alignment</b> — NAB 1976 $\infty/50\mu\text{sec}$ 160nW/m level, voice an- nounced frequencies from 50-16000 Hz, 12.5 kHz azimuth, 1 kHz level set.	\$40.00
P-34-1	P-34-2	P-34	<b>Pink Noise</b> —20-20000Hz, $\infty/50\mu\text{sec}$ . For stereo phase check, and fre- quency alignment when used with a $1/3$ octave analyzer.	35.00
F-34-1	F-34-2	F-34	<b>Sweep</b> —700 to 15000 Hz, 100 ms log sweep re- peated for 4 minutes with a dead section between sweeps to facilitate scope synchronization—Useful for fast response checks	35.00
—	—	L-34	<b>Level Set</b> —1kHz, 160 nW/m, 1 1/2 min.	25.00
—	—	A-34	<b>Azimuth</b> —12.5 kHz, 1 1/2 min.	25.00
—	—	35	<b>Flutter &amp; Speed</b> —1 1/2 min. 3150 Hz, tape accuracy —.03% RMS Flutter— 0.1% Speed at 74°F.	25.00
—	—	36	<b>Flutter &amp; Speed</b> —1 1/2 min. 3000 Hz, tape accuracy .03% RMS Flutter— 0.1% Speed at 74°F.	25.00
—	—	Q-34	<b>Q Track Test</b> —Upper and lower limit frequencies, upper and lower limit levels, long and short duration, on and off at zero crossings. Voice announced.	35.00

### STANDARD TAPE MANUAL

Recently announced, this data book is a must for the audio tape recordist, engineer, and designer—priced at \$45.00.

### FREE CATALOG

For a full description of the manual and a complete listing of all cassette and reel to reel test tapes please send for our latest catalog.

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## Studio construction

continued from page 30

The spectrum analyzer can be used for a host of other distortion measurements, some rather esoteric. IM is a snap, with the display showing not only how much, but which harmonic of the low-frequency tone is the offender. Also, with a spectrum analyzer, you can use any tone pairs or ratios you want, so you can pick your favorite kind of IM.

Another type of distortion useful for transistor equipment is transient intermodulation distortion. TIM is visible on a scope, but is best observed on a spectrum analyzer. The technique involves combining a low frequency square wave with a high frequency sine wave and watching for discontinuity of the sine wave at the transition points of the square wave.

### Real time analyzer

The real-time analyzer is another form of spectrum analysis made popular by the sound reinforcement people. Although perhaps not as powerful on the test bench, it is a very useful tool for evaluating dynamic devices such as multi-band limiters. It is also probably the most satisfactory method for observing the spectral distribution of program material.

The primary difference between the RTA and a spectrum analyzer is that the spectrum analyzer sweeps from one end of the frequency range to the other, while the real time analyzer simultaneously displays the entire spectrum, but in discrete bands. The sweep method would be fine if it were fast enough, but the high-Q filter requires substantial time to respond as the frequency is swept. The RTA uses a separate filter for each band, allowing it to operate in real time. The trade-off is frequency resolution. RTA's are usually produced with either one-octave or (for more money) third-octave bands.

### X-Y plotters

An X-Y plotter may seem like a bit of a frill for a radio station, but from the standpoint of time savings it'll pay for itself in a few years. There are other advantages, too...better documentation for your maintenance records, and a more meaningful response representation than is possible with spot frequency checks. Particularly at the higher audio frequencies, it isn't uncommon to see a severe dip on a cartridge reproducer that happens to fall right between the two "spot" frequencies.

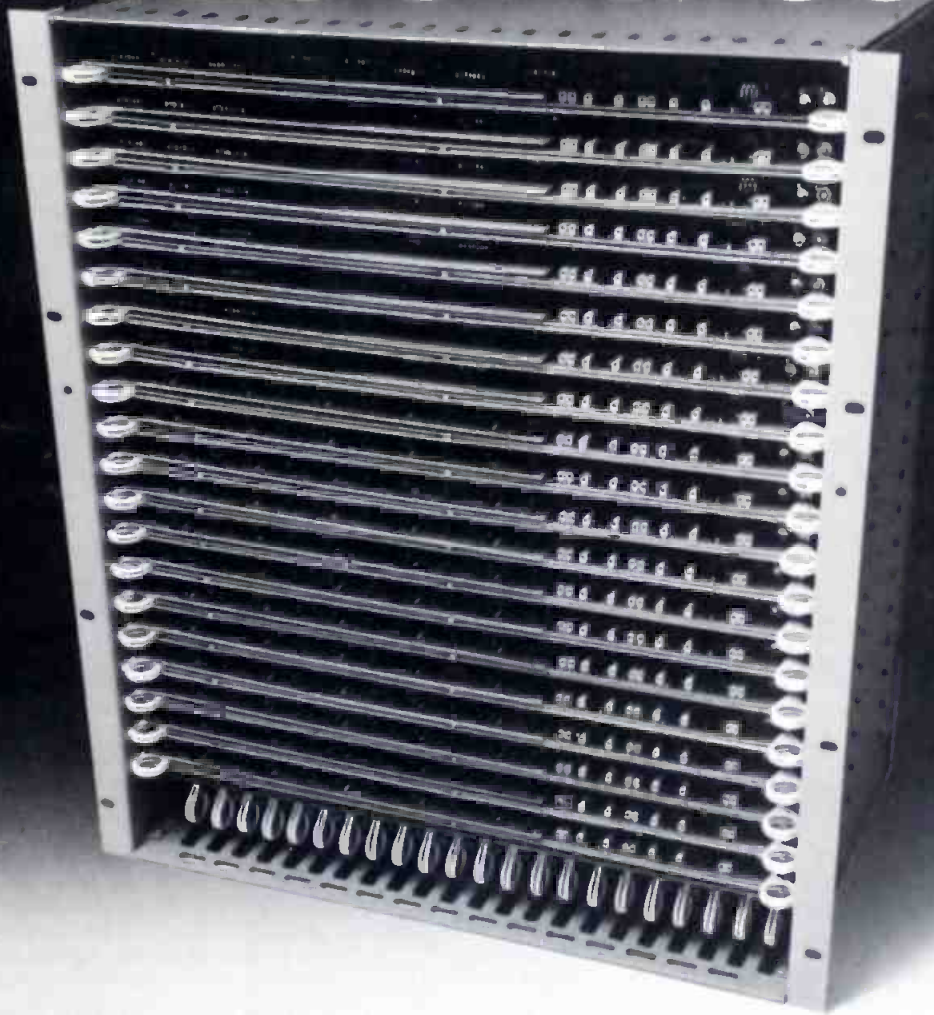
A basic X-Y plotter needs a DC voltage to drive both the vertical and horizontal axis. This requires some interface electronics to convert the audio amplitude to vertical voltage and the frequency to horizontal voltage. The unit shown on the cover has several plug-ins available to make the unit useful for audio.

A straight X-Y plug-in is useful for producing a permanent record of spectrum analysis plots if the analyzer has X-Y outputs.

Another module contains a built-in sweep oscillator which is locked to the pen so that the plot automatically tracks with the sweep. This module is primarily intended for amplifier testing, since there is no convenient way to sync a tape machine output or a remote output such as the end of a phone line with the tracking oscillator.

A third module contains a receiver for tracking the input frequency. With this unit, the output from a tape recorder or phone line can be directly plotted without any sync signal.

# GET YOUR SIGNALS UNCROSSED.



No matter how complicated your studio operation is, we can unsnarl your signals and send them on their way, with one of our nine off-the-shelf Switcher series.

For example, many broadcasters use our lower cost 15X or RX Series Switchers to switch input signals to their VTR machines. By providing instant access to signals at the touch of a button, difficult editing jobs are accomplished on the spot and, during the Vertical Interval.

And to minimize system downtime we've designed our Series 20X and 40X Switchers for optimum reliability and capability. Most units have a microprocessor in every channel to eliminate total system failure if the logic system malfunctions. And you can replace a channel

module without shutting down the entire system.

For audio use, our solid-state Series AX Switchers make the old fashioned patch panel a thing of the past.

All 3M Routing Switchers can be built to nearly any input/output capability, with vertical interval switching and can be operated by many types of controls.

Studio operation is getting more complex every day. You can't fight it, so why not switch? Switch to 3M Routing Systems.

Circle the reader service card number at the back of the book for more information or call 205-883-7370 for system design assistance. 3M Video Systems. Watch us in action.

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# NRBA: Sold out again!

"The 1978 convention promises to be the biggest and most comprehensive in the history of the NRBA," according to John L. Richer, executive vp/administration. Exhibit space and the 56 hospitality suites for the 5th Annual NRBA Conference and Exposition have been sold out.

The show, scheduled for September 17-20 at the Hyatt Regency Embarcadero in San Francisco, will have 147 booths compared to 125 in 1977. A total of 74 equipment

manufacturers will be represented. This will be the first NRBA convention for 17 of the exhibitors.

The four-day conference will feature survival courses in the real world of radio. On the agenda you'll find sessions designed to update you on the latest AM stereo developments, the future of satellites in radio and what FCC monitors look for when they check your station.

For one session on Tuesday, representatives of all major divi-

sions of the FCC and other key people on the Washington FCC/legal scene will be on hand to answer your questions.

Probably the highlight of any NRBA convention is the true engineering give and take that starts in the meetings, continues in the exhibit area and even permeates the halls. The NRBA calls it "just straight engineer-to-engineer talk about survival and success in a tough competitive business."

## Agenda

### SUNDAY, SEPT. 17

9 am-5 pm: Registration; 10 am: NRBA board meeting; 2-5 pm: Exhibit area open; 5:30 pm: Gala welcome cocktail reception.

### MONDAY, SEPTEMBER 18

8 am: Registration; 9 am: Welcome and kickoff; 9:15 am: (Four concurrent sessions):

"NEW WAYS TO GET MORE PROFIT AND PRODUCTIVITY FROM YOUR PEOPLE"—Presented by Jim Hooker & Co. John Gorby, Moderator.

"EFFECTIVE PROMOTION IN SMALLER MARKETS"—Paul Lange, KDLR, Devils Lake, ND, Moderator. Reg Streeter, Concerned Communications, KOBO, Yuba City, CA; Gordon Zlot, KZST—Santa Rosa, CA; Tom Burns, WMCB—Michigan City, IN.

"HOW TO CHOOSE A FORMAT, PART I" (to 10:30 am)—Bill Moyes, The Research Group, Moderator. C. T. Robinson, Sunbelt Communications; Michael Hesser, Sunbelt Communications. "HOW TO CHOOSE A FORMAT, PART II" (10:45 am)—Ralph Guild, McGavern-Guild, Moderator.

"ENGINEERING YOUR WAY TO NUMBER 1-FM" (to 10:15 am)—Jim Howard, WJIB—Boston, Moderator. Irv Joel, Schulke Radio Productions; John Higdon, Consultant; John McCarthy, KFOG—San Francisco; Bob Van Buhler, KDKB—Phoenix; Randy Stover, Consultant. "ENGINEERING YOUR WAY TO NUMBER 1-AM" (10:30 am)—Robert Beamish, KABL—San Francisco, Moderator. Robert Kammer, KHJ—Los Angeles; Greg Ogonowski, KEZY—Anaheim, CA; Bruce Earl, XEROK—Ciudad Juarez, Mexico; Ed Edison, Consulting Engineer.

11 am-5 pm: Exhibit area open

12:30 pm: Luncheon—Guest speaker: Rep. Lionel Van Deerlin, Chairman of the House Subcommittee on Communications.

1:45 pm (Four concurrent sessions):

"BUYING AND SELLING A STATION; FINANCING AND BANK RELATIONSHIPS"—Ted Hepburn, Moderator. John Bayliss, Combined Communications Corp.; Thomas Schattensfield, Arent, Fox, Kintner, Plotkin & Kahn; Alan Griffith, The Bank of New York; Bill Exline, William A. Exline, Inc.; Keith Horton, The Keith W. Horton Co., Inc.; Bill Egan, T.A. Associates.

"BIG SALES IN SMALL MARKETS"—Ray Livesay, WLBH—Mattoon, IL, Moderator. Jerrell Shepherd, KRES/KWIX—Moberly, MO; Larry Keene, WWOC—Avalon, NJ; John DeGroot, WWRM—Gaylord, MI.

"FORMAT FOCUS-TOP 40"—Ted Smith, KSLQ—St. Louis, Moderator. John Tobin, KSLY—San Luis Obispo, CA; Ron Gilbert, WICC—Bridgeport, CT; Les Garland, KFRC—San Francisco.

"FUTURE IN THE STARS—SATELLITE TECHNOLOGY TODAY AND TOMORROW"—Gary Worth, Mutual Broadcasting, Moderator.

3:15 pm (Three concurrent sessions):

"HOW TO READ THE RATINGS AND MAKE THEM PAY OFF"—Bob Duffy, The Cristal Company, Moderator. Bill Engel, Arbitron; Bill Clark, KABL—Oakland-San Francisco; Fred Walker, Covenant Broadcasting Co.; Avery Gibson, Audits & Surveys.

"FORMAT FOCUS-COUNTRY"—Don Nelson, WIRE—Indianapolis, Moderator. Jim Stone, KCUB—Tucson, AZ; Dan McKinnon, KSON—San Diego.

"THE PROPOSED COMMUNICATIONS ACT OF 1978: ASK THE PEOPLE WHO WROTE IT"—Staff members of the House Communications Subcommittee: Harry (Chip) Shooshan, Ron Coleman, Edwina Dowell and Chuck Jackson.

### TUESDAY, SEPTEMBER 19

8:30 am: Membership meeting 9:30 am (Five concurrent sessions):

"SMALL MARKET IDEA EXCHANGE: For Markets Under 50,000"—Dutch Doelitzsch, WDDD—Marion, IL, Moderator.

"THE RATINGS: WHERE DO WE GO FROM HERE?" (to 10:30 am)—Ellen Hulleberg, McGavern-Guild, Moderator. Avery Gibson, Audits & Surveys; Jack McCoy, RAM Research; Jim Seiler, Media-stat; Bill Engel, Arbitron; Harry Bolger, Burke Marketing Research. "HOW AND HOW MUCH TO PAY YOUR SALES PEOPLE" (11 am)—Judy Currier, KLOK—San Jose, CA, Moderator. Jim Williams, The Welsh Co.

"THE BIG MARKET PROMOTION BATTLE"—Lynn Christian, Century Broadcasting, Moderator. Dorothy Brunson, WBLS—New York; William Bosse, KULF—Houston; Bob Prangle, KLAQ/KPPL—Denver.

"TALK, NEWS, PUBLIC AFFAIRS AND SPORTS" (to 10:30 am)—Gary Worth, Mutual Broadcasting, Moderator. Norm Woodruff, The Woodruff Organization; Lee Morris, WSOB—Charlotte, NC; Richard K. Penn, WWVE—Cleveland. "FORMAT FOCUS: ALBUM-ORIENTED ROCK" (10:45 am)—Lee Abrams, Burkhart-Abrams, Moderator. Steve Marx, WAAP—Worcester, MA; John Parikh, Joint Communications; Jack Popejoy, KPOL—Los Angeles.

"AM STEREO: THE QUESTION OR THE ANSWER?" (to 10:30 am)—Harold Kassens, Chairman of the National AM Stereophonic  
*continued on page 38*

## Cetec Schafer System 7000: Post-graduate technology, elementary operation

Put your hands on  
the 7000 keyboard  
at the NRBA Show!

System 7000 is the leading-edge in radio automation: Multiprocessor architecture, plug-in firmware boards, super-clean audio circuitry, almost limitless expandability.

### Keeping it simple to operate

System 7000 also includes another design breakthrough: human engineering. This marvelous machine is people-oriented. The sophisticated and versatile solid-state electronics are programmed for simple, step-by-step direction in plain English language.

### Powerful and expandable

Most of all, System 7000 is a powerful broadcasting tool for any radio operation. It guarantees consistently superior audio quality, precise timing, silky smooth transitions, and enhancement of any program format.

When you're ready, the 7000 helps you grow without growing pains. Add memory, 1000 events at a time, with plug-in boards. Ditto with additional audio sources, up to 64. Add video

terminals — at any time, for any remote location. Add Verified English Logging. Plug-in a "debug card" for system self-diagnosis.

### A goof-proof keyboard

You talk to the 7000 in English on a color-coded, mode-clustered keyboard that won't accept mis-programming errors. Your instructions are displayed on a video screen (or several video screens, if you wish). The system answers politely, in English, on the same screen(s). At any time, you can look forward or backward to verify program sequence, or real-time sequence, or to review editing-in-process.

The bottom-most line is that Cetec Schafer System 7000 can handle the toughest and most complex radio broadcast tasks easily and cost-effectively, and with built-in capability to take on tomorrow's added jobs.

All the details are in our new, full-color 7000 product book. Write to Andy McClure at Cetec Broadcast Group, or telephone him at (805) 684-7686.



**Cetec Broadcast Group**

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# NRBA

continued from page 34

Radio Committee, Moderator. "HERE COMES THE TRUCK: THE FCC MONITORS ARE IN TOWN!" (10:45 am)

11 am-6 pm: Exhibit area open; 12:30 pm: Luncheon.

2 pm: ANNUAL FCC/LEGAL AFTER-NOON—Thomas Schattenfield of Arent, Fox, Kintner, Plotkin & Kahn, Moderator.

4:30 pm: Cocktail reception

## WEDNESDAY, SEPTEMBER 20

9:30 am (Five concurrent sessions):

"THE REGULATORS" (to 10:45 am)—Thomas Schattenfield, Arent, Fox, Kintner, Plotkin & Kahn, Moderator, Issie L. Jenkins, Equal Employment Opportunity Commission; plus FCC and FTC representatives.

"SELLING THE RETAILER; CASHING IN ON CO-OP" (to 10:45 am)—Jack Adamson, KBIG/KBRT—Los Angeles, Moderator, Bill McGee, Broadcast Marketing Corporation; Bill Weaver, KLOK—San Jose, CA; Bert Levine, Bert Levine & Associates.

"MAXIMUM PROMOTION IN MEDIUM

MARKETS"—Dave Raven, WSAU—Wausau, WI, Moderator, Sis Kaplan, WAYS/WROQ—Charlotte, NC; Harold Greenberg, KTAC/KBRD—Tacoma, WA; Lynn Higbee, WREN—Topeka, KS.

"FORMAT FOCUS: BEAUTIFUL MUSIC"—Darrell Peters, WLOO—Chicago, Moderator, Jim Schulke, Schulke Radio Productions; Marlin Taylor, Bonneville Broadcast Consultants; Jim Schlichting, Starborne Productions; Harvey Wittenberg, WLOO—Chicago.

ENGINEERING TOUR—On-site inspection of five leading San Francisco area radio station facilities and the Mt. Sutro tower installation.

11 am (Three concurrent sessions):

"INTERDEPARTMENTAL RELATIONS AND COMMUNICATIONS AND THE BUDGET BATTLE"—Chester Coleman, KGAB—Ventura, CA, Moderator, Ney Landry, FCC Western Regional Manager; Howard Imekus, KCBS—San Francisco; Don Ethen, KSRO—Santa Rosa, CA.

"GETTING THOSE NATIONAL DOLLARS"—Sis Kaplan, WAYS/WROQ, Charlotte, NC, Moderator, Sal Agovino, Katz Radio.

"FORMAT FOCUS: MOR"—Ron Garner, Pacific Northwest Broadcasting, Moderator, Mark Blinoff, KMPC—Los Angeles; Jan Claire, KPAY—Chico, CA.

11 am-3 pm: Exhibit area open. 12:15 pm: Breakaway buffet

## Exhibitors

Accurate Sound Corporation: 264, 265, 266  
Ampro Broadcasting: 124, 125, 126  
Andrew Corporation: 119  
Auditronics: 205  
Automated Broadcast Controls: 223, 224  
Automated Processes: 108, 109

Belar Electronics Laboratory: 104  
Bloomington Broadcasting Corporation: 163, 164  
Bonneville Broadcasting: 159, 160, 161, 162  
Broadcast Cartridge Service: 216  
Broadcast Consultants Corporation: 148  
Broadcast Electronics: 127, 128, 143, 144  
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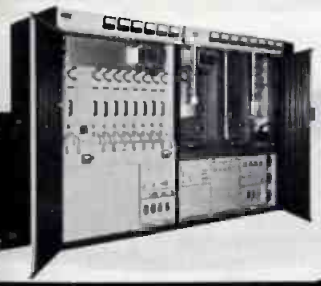
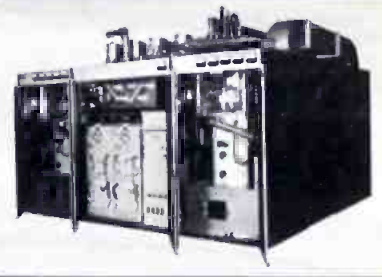
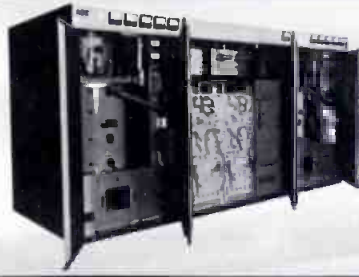
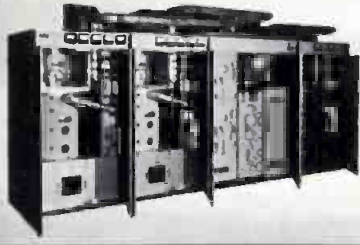
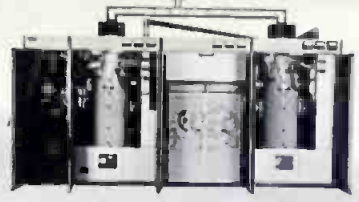
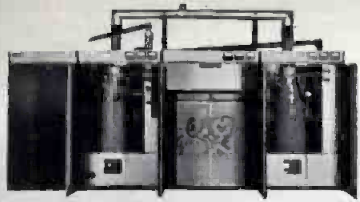
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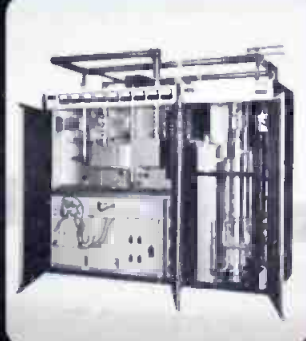
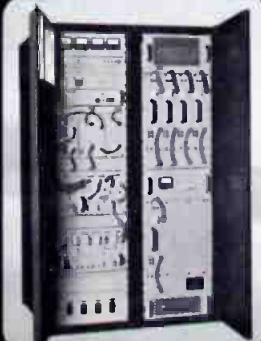
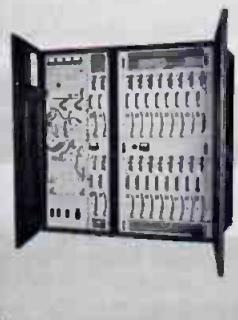
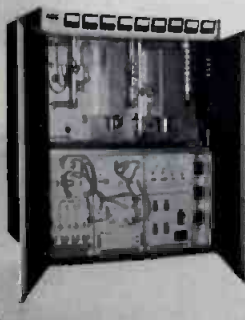
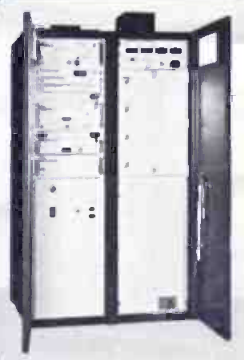
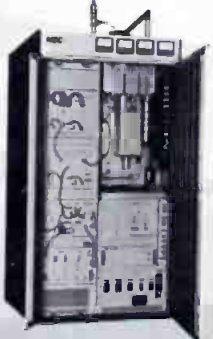
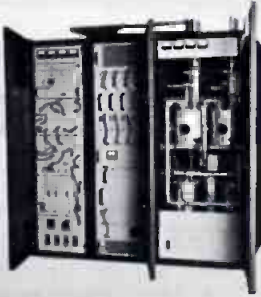
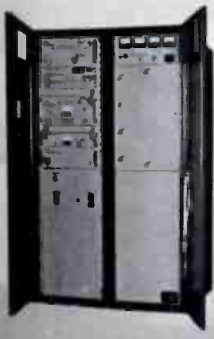
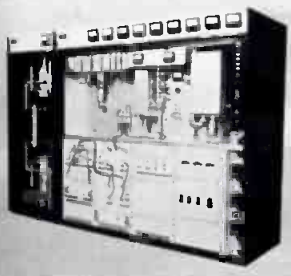
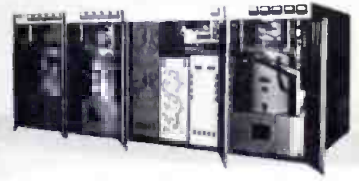
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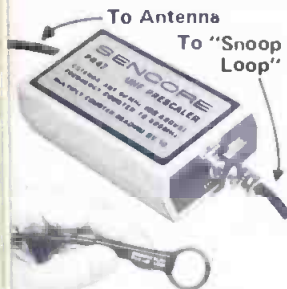
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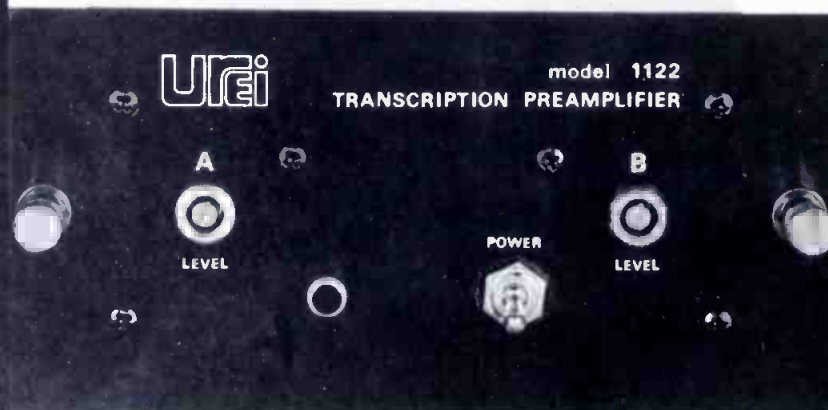
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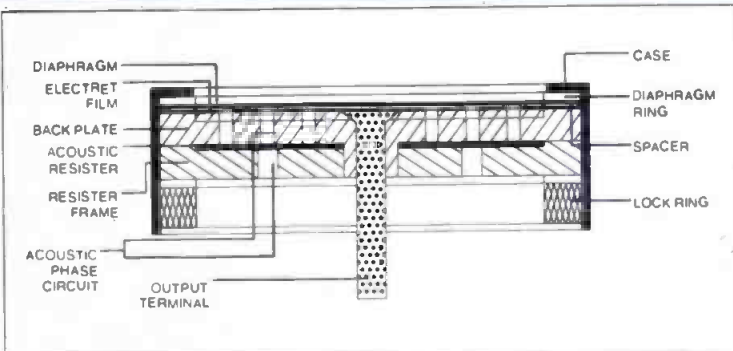
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# Maximizing subcarrier deviation during simultaneous stereo transmission

Part 1/By James Tonne

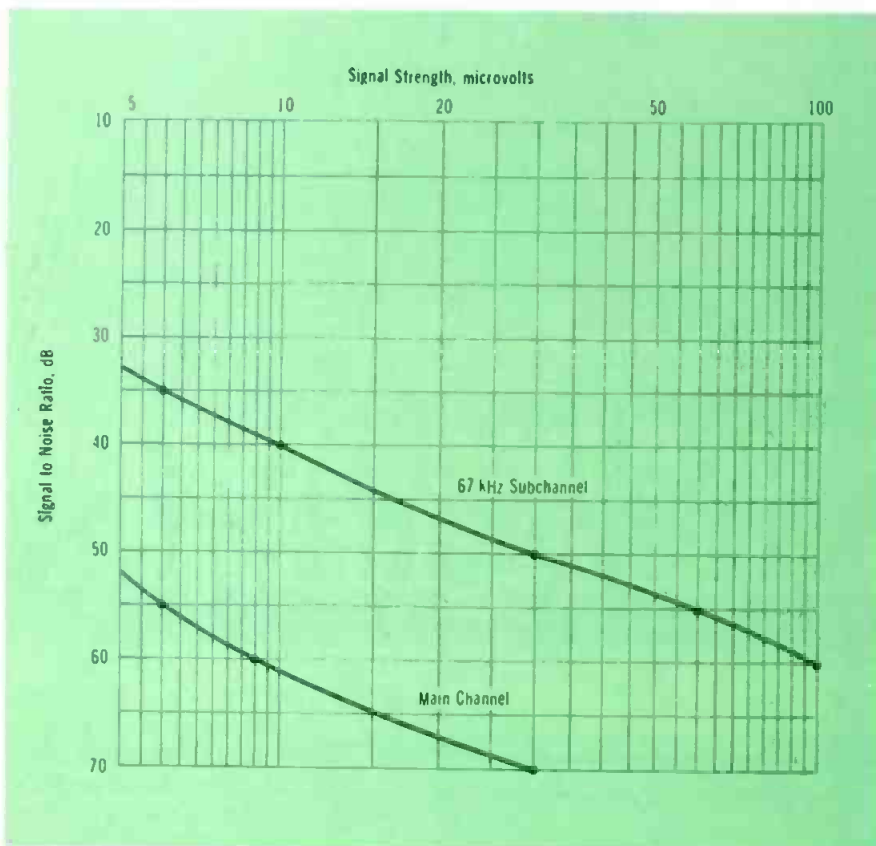


Figure 1 Typical quieting of SCA receiver.

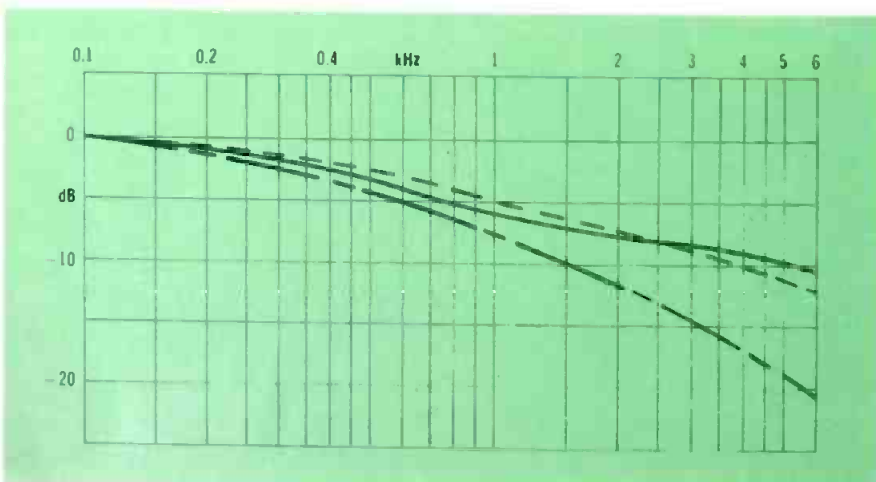


Figure 2 Frequency responses of available SCA receivers. SCA generator used precision 150-microsecond pre-emphasis.

The SCA subcarrier is a valuable source of income for many FM broadcasters. Provided that transmission is accomplished properly and the subcarrier receivers are installed correctly, the only problem for some broadcasters is what to do with all those profits.

Unfortunately not all broadcasters have that kind of problem. Both transmission and reception are capable of causing grief. Sometimes the broadcaster or SCA operator is expecting, or has been promised, something that simply cannot be delivered.

The SCA system in practice should be likened to a communications-grade channel with the singular exception that it is generally capable of audio response down to 30 Hz or even lower. Due primarily to the selectivity used in the subcarrier extraction portion of current receivers, intermodulation and harmonic distortion of significance are common in the audio delivered from the SCA receiver.

White noise ("hissing") appearing in the SCA receiver output is generally caused by a poor receiving installation. Adequate signal strength should be available to quiet the receiver. A typical curve of subcarrier receiver quieting is shown in Figure 1. For this plot, a test tone of 200 Hz was used, deviating a 67 kHz subcarrier to 4 kHz peak deviation; injection was set at 10%.

Subcarrier receivers need considerably more signal strength for a given degree of subchannel quieting than do monaural receivers. Attention paid to the receiving antenna and receiving feedline will normally enable a quiet receiver, if that receiver is of a modern design.

Another aspect of SCA operation which is altogether too common is crosstalk from the main transmission.

*continued from page 44*

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## Subcarrier deviation

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channel (or from the stereo sub-channel) into the SCA subchannel. This can be caused by any non-linear device in the entire system, such as a defective or misadjusted modulator in the FM exciter or a mistuned discriminator in the sub-carrier receiver. The exciter can easily degrade the quality of the signals in the baseband applied to it.

A quick test of the exciter is to measure its harmonic distortion

when it is modulated 100% with a clean low-frequency audio tone, as for example 400 Hz. If the harmonic distortion under these conditions approaches 1%, crosstalk from the main transmission channel into the SCA subchannel is nearly assured. A reading of 0.3% should result in acceptable crosstalk, while 0.1% distortion will commonly result in no crosstalk in the system due to the exciter.

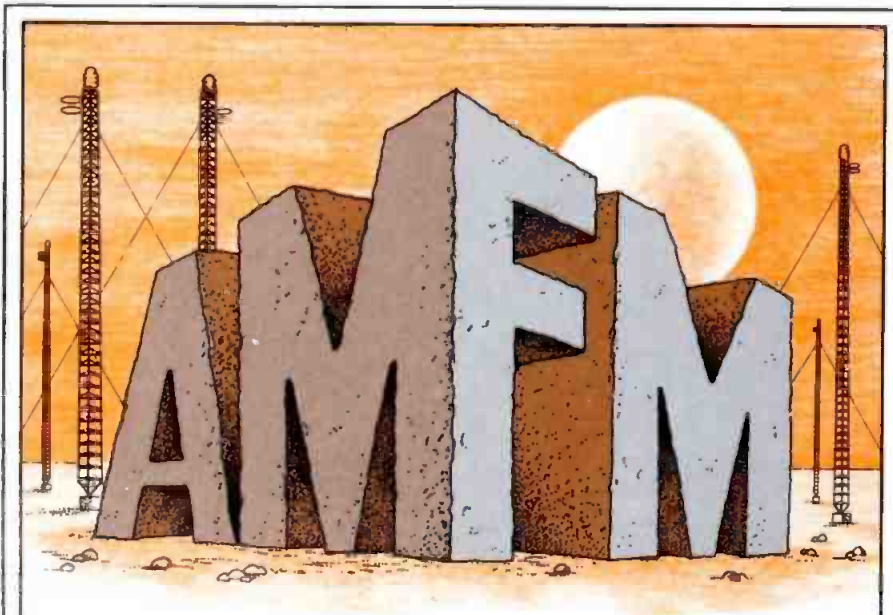
An even simpler harmonic distortion test, requiring no distortion meter, is to modulate the exciter with a clean 12 kHz tone. Switch the stereo monitor to read the amplitude of the stereophonic sub-channel, sometimes called "L-R." In this position the monitor is, by using a 23 to 53 kHz bandpass filter, responding only to the second, third, and fourth harmonics of the 12 kHz tone. Ideally during this test there will be no signals appearing in the subchannel. If any do appear, it is due to harmonic distortion. As with the earlier test, a reading of 0.3% (-50 dB) should result in a clean SCA subcarrier transmission.

Crosstalk also can be caused by any system item containing radio-frequency selectivity. Examples of such items are the various amplifier (or multiplier, if used) stages in the FM transmitter, the transmitting antenna system, the receiving antenna, and especially the IF selectivity-determining portion of the SCA receiver. Often overlooked is the potentially disastrous amount of crosstalk that can be caused by a high-gain transmitting antenna. It has been found over the years that a four-bay transmitting antenna is usually transparent, causing no noticeable crosstalk.

At the other end of the scale is the very-high-gain antenna with perhaps 12 bays. Such an antenna is often a troublemaker in multiplex operation. In any event, for a given element design, a large (as for example 12-bay) antenna is always worse in this respect than a small (4-bay or less) antenna. The best method for a station to obtain a high, effective radiated power is to use a high-powered transmitter and a low-gain antenna. Because of the higher initial equipment cost, the decision of whether or not to use a high-powered transmitter requires careful consideration.

A signal-to-noise/crosstalk ratio of 45 dB on a subchannel system, including the receiving installation, should be considered acceptable; 50 dB should be considered good, while 40 dB will be cause for alarm. These numbers should be slightly better if the SCA monitor is used for measurement. Be aware, however, that some SCA monitors have signal-to-noise ratio measurement systems which measure the noise not de-emphasized. If your monitor is of this type, use an external noise meter connected to the SCA monitor

continued on page 46



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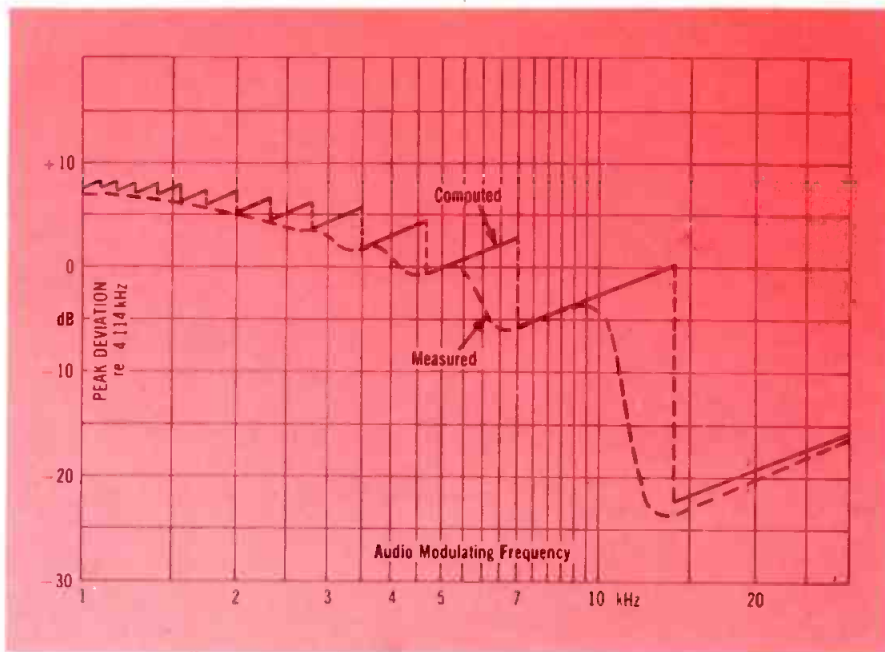


Figure 3 Maximum allowable deviation of 67 kHz SCA subcarrier during stereo transmission.

To reduce both noise and crosstalk, the treble frequency response of the typical subcarrier receiver has been heavily de-emphasized, most commonly using a 150-microsecond curve. In addition, it has been rolled off even further by additional lowpass filtering. Figure 2 illustrates the measured frequency response of several stock SCA receivers on the market today.

These plots were run using a laboratory-standard SCA generator with 150-microsecond pre-emphasis. The system response will be even poorer if only a 75-microsecond or a "droopy" pre-emphasis (or none at all) is used. In a gross understatement, this is not high fidelity. The severe treble rolloff can be corrected only partially with excess pre-emphasis during transmission. Remember that for positive subcarrier deviation control the pre-emphasis must effectively be located electrically prior to or included within the studio limiter.

The signal-to-noise ratio of the audio recovered from the subcarrier receiver may be affected in trans-

## Subcarrier deviation

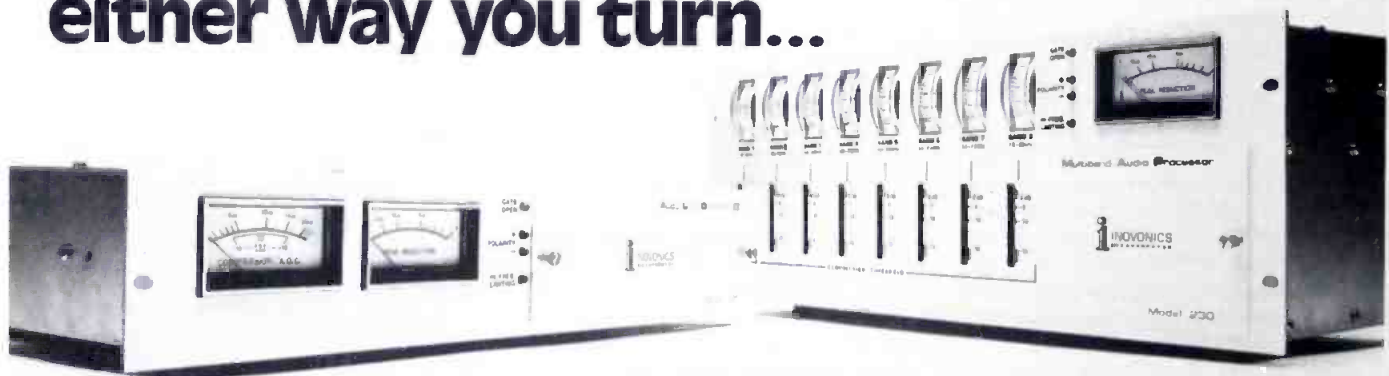
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(de-emphasized) audio output.

Crosstalk into the SCA subchannel is, in fact, largely due to a phase-modulation process. Conse-

quently, only the upper main-channel modulating frequencies are of significance; audio tones in the 30 Hz to 400 Hz region can seldom be heard as crosstalk into the SCA subchannel. As a result, crosstalk into the SCA system sounds shrill, tinny or thin, lacking bass response.

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mission by changing the subcarrier injection onto the main carrier. Increased subcarrier injection will yield a better signal-to-noise ratio. During monophonic transmission the subcarrier injection may be increased to a maximum of 30%, but during stereophonic transmission the subcarrier injection must be held to the relatively low value of 10%.

The recovered audio signal-to-noise ratio may also be altered in transmission by changing the subcarrier deviation, both peak and average. The average deviation is a function of the amount of audio processing, and the design of that processor. The peak deviation is dependent, among other things, on where in the processing chain the lowpass filtering (if any) and the pre-emphasis are located.

Greater subcarrier deviation will yield a greater signal-to-noise ratio. During monaural transmission the deviation must be kept low enough to prevent interference to the main channel, as well as to prevent excessive occupied bandwidth. In

practice these are not real constraints: the SCA receiver will be unable to tolerate such extreme subcarrier deviations.

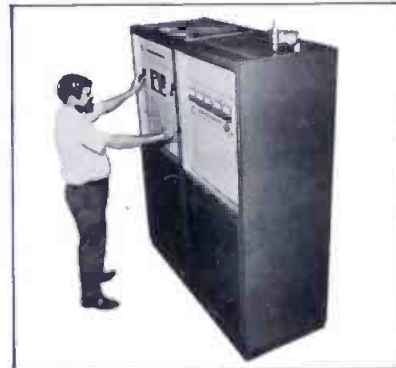
During stereophonic transmission the peak subcarrier deviation must be kept below a certain amount to prevent interference to the stereophonic subchannel. The allowable subcarrier deviation during stereo transmission is dependent on the amount of subcarrier injection onto the main carrier, as well as the frequency of the signal used to modulate the subcarrier. As the subcarrier audio test frequency is raised, the allowable amount of subcarrier deviation in general tends to decrease.

Figure 3 illustrates the allowable deviation of the SCA subcarrier when operating in the stereo mode. This plot is based on a subcarrier injection of 9%, and the premise that none of the subcarrier sidebands is allowed to penetrate the stereophonic subchannel to the extent of an amplitude greater than 0.1% (-60 dB). The allowable deviation

*continued on page 48*

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Circle (38) on Reply Card

## Subcarrier deviation

continued from page 47

tion of the subcarrier is shown in decibels referred to a deviation of 4.114 kHz, which is the maximum subcarrier deviation allowed at a modulating rate of 5 kHz using 9% subcarrier injection.

As an example of how to read the plot, the allowable subcarrier deviation at an audio modulating rate (frequency) of 3.6 kHz is about 2 dB greater than 4.114 kHz. At a modulating rate of 7.5 kHz, the allowable deviation is about 5 dB below 4.114 kHz. For these measured plots, the deviation was increased until the SCA subcarrier caused a crosstalk reading of 60 dB below 100% modulation as observed on the stereo monitor subchannel metering position.

For the computed plot, the allowable level was that which allowed no individual subcarrier sideband to appear in the stereo subchannel region at a level in excess of -60 dB. The rounded edges of the plot based on stereo monitor measurements merely reflect a less-than-brick-shaped response of the subchannel bandpass filter in the stereo moni-

tor. Both plots are based upon a subcarrier injection level of 9%.

Important to be seen from this information is that as a subcarrier audio modulating frequency is raised, the allowable deviation of the subcarrier is reduced. The amount of deviation reduction is rather gentle and predictable.

Program material applied to the SCA generator should be processed by a frequency-conscious limiter. An example of such a limiter would be the type generally used on the main channel, or prior to the stereo generator. It should be specified to have 150-microsecond pre-emphasis in its high-frequency controller. The output of that limiter should then be applied to a filter whose frequency response is as shown in Figure 4, trace A.

The output of the filter is applied to the SCA generator modulation input terminals. This filter will correctly adjust the amplitudes of the various audio frequencies so that the maximum allowable subcarrier deviation can result regardless of the audio frequency used for

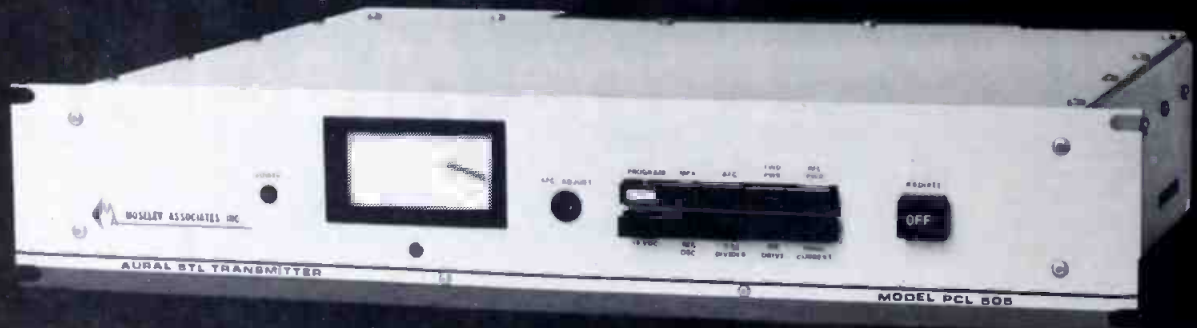
testing (or programming). The limiter sets a ceiling on the modulation and the filter lowers the ceiling as the audio frequency is raised, allowing the modulation level to stay within the bounds shown in Figure 3.

Such a filter is easy to construct, either in active or passive form, and has an interesting and useful aspect: if square wave signals are applied to it, it will not ring or overshoot. The implication here is that the audio can be clipped lightly (perhaps only on transients) for an additional modest increase in loudness, and overmodulation of the subcarrier (even on a transient basis) will not occur.

### Coming up

Part 2 of this article will appear in the September issue of **Broadcast Engineering**. Besides further discussing the post-limiting filter, it will give a short course for those wishing to construct their own filters, giving three versions: pre-limiting, inductor-capacitor, and opamp-capacitor. □

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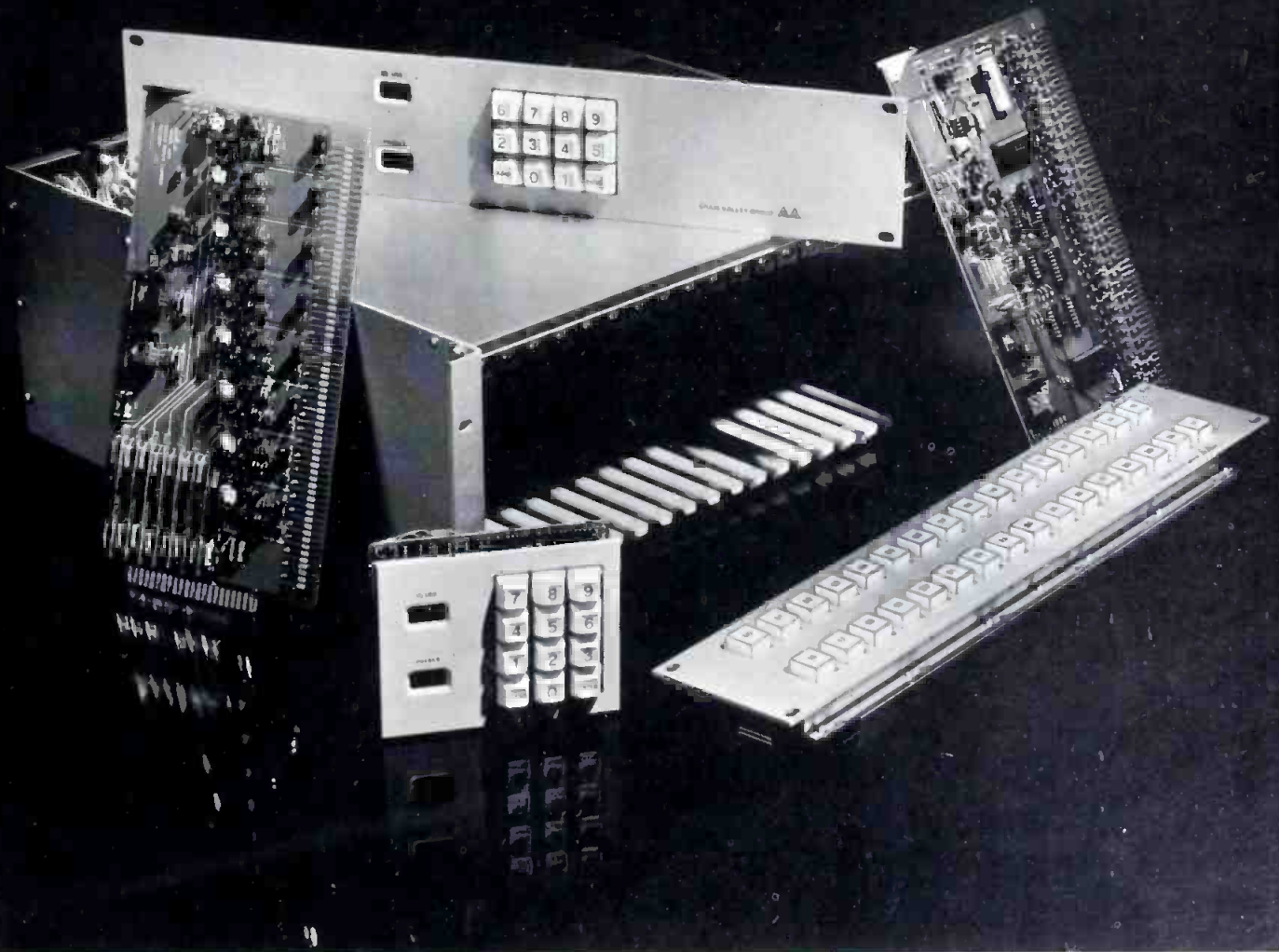
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# Routing switcher roundup

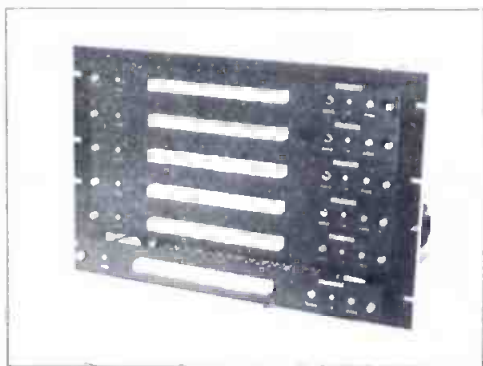
Part 2 (Part 1 of this roundup can be found in the July 1978 *Broadcast Engineering*.)

Manufacturer and model number	Model description
-------------------------------	-------------------

## Dytek Industries

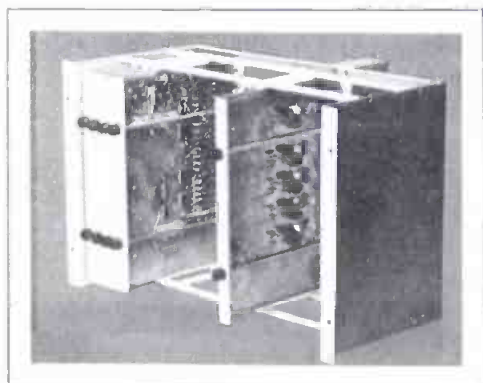
For more information circle bold face number on Reader Service Card: Dynasciences 8500 (100); Dytek Industries 12AV1 (101), DK-20AV10 (102); Edco Products EDVUE 56000 (103); Telemet 7930 (104), 7932 (105); Vamco Engineering 12AV1 (106), 20AV4 (107); Viscount Industries 1040 (108), 1035 (109), 1050 (110).

- |           |  |
|-----------|--|
| 12AV1     | The 12 Input, 1 output switcher is part of the Computer Image Video Controller line. It is available in audio only, video only, or audio-follow-video configurations. Has vertical interval switching or random switching. The self-contained, state-of-the-art unit may be stacked to provide additional busses. Occupies only 1¾ inches of rack space. |
| DK-20AV10 | This is a video/audio-only or audio-follow-video switcher featuring modular construction, BCD control, and vertical interval switching. System is expandable to 100 inputs and 100 outputs. All modules have front panel plug-in.  |



## Dynasciences

- |      |  |
|------|--|
| 8500 | The 8500 Series locally controlled routing switchers are designed for a wide variety of functions, including audio-visual routing, VTR source selection, house monitoring distribution, etc. Unit is modular with each 12-Input bus a totally self-contained unit which plugs into the basic switcher frame. Each bus contains interlocking, illuminated pushbutton switches; a video distribution amplifier; an individual voltage regulator; and solid-state video crosspoints and clamping amplifier. Vertical interval switching is provided. Available in individual frames containing one to six switcher modules. |
|------|--|



## Edco Products

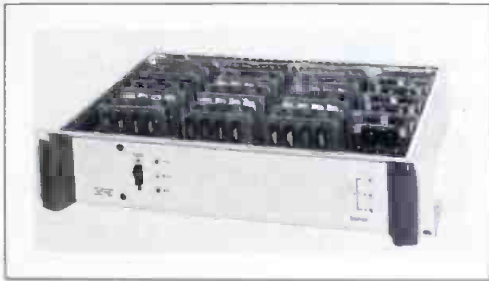
- |             |   |
|-------------|---|
| EDVUE 56000 | This video switching system has audio-follow capability, is easily expandable, and includes numerous control options, such as thumbwheel, dial, touchpad or computer interface. Basic module frame contains the frame and motherboard assembly. Two types of plug-in modules are mounted in the frame. The video input module (VIC-100) contains circuitry for 5 loop-through bridging inputs. Four VIC-100 modules may be plugged into each frame to permit 20 inputs. The video output module (VXC-200) contains circuitry for 20 video inputs and 2 outputs. Seventeen VXC-200 video output cards may be plugged into the basic frame. |
|-------------|---|

## Telemet

- |      |  |
|------|--|
| 7930 | This is a solid-state audio/video switching system based on plug-in printed circuit cards which are used with various card frames. Fifteen cards are available in- |
|------|--|

**Manufacturer  
and  
model number**

**Model description**

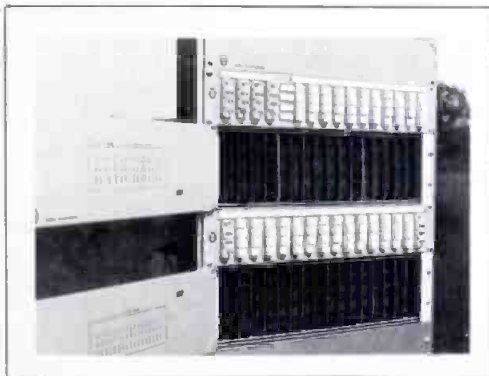


7932

cluding regulators, 2 in/4 out switches, dual output amplifiers, audio amplifiers, and vertical trigger cards. Features include remote control; modular construction; IC crosspoints and latching; less than 1  $\mu$ sec switching time; FET audio switching; and unlimited control versatility including pushbutton, pushbutton-preset take, digit decade, X-Y control, BCD control, and touch-tone control.

This modular audio/video switcher uses 4 in/1 out video cards, and 4 in/1 out audio cards. System can be expanded from 4 x 1 to a maximum of 12 x 3 in one chassis. Features vertical Interval switching; remote or local control; audio follow video; built-in power supply; IC control logic; and NTSC, PAL and SECAM capability (same as the 7930).

**Vamco Engineering**  
(subsidiary of Dytex Industries)



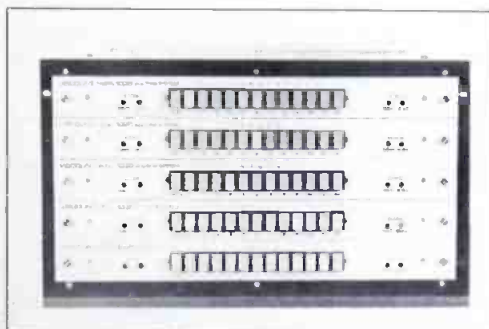
12AV1

This 12 x 1 audio-video switcher can be stacked up to 15 units high without DAs. Each unit has separate power supply. Switching is in the vertical interval and reverts to random nature upon loss of vertical drive signal. Bi-polar video switching for theoretical 100 dB off-mode switching isolation. Virtually no differential gain and phase.

20AV4

20 x 4 audio/video switcher that can be stacked up to 12 units high without DAs. Supplied with dual, auto-changeover power supplies for minimum down time in larger installations. Switching is in the vertical interval and reverts to random nature upon loss of vertical drive signal. Each video crosspoint board is 1 x 4 with on-card switchpoint status and on-card switching.

**Viscount Industries**



1040

Self-contained 12 input/1 output bus audio-follow-video switcher. Has quasi-electronic video crosspoints; solid-state video input and output amplifiers; dual video output; loop-through video inputs; LED input selection indication; and front-panel video gain adjustments ( $\pm 3$  dB).

1035

This fully expandable audio/video switcher features solid-state video crosspoints; solid-state video and audio input and output amplifiers; spare input for test signals; plug-in cards construction; and illuminated pushbuttons. Basic rack frame houses up to five 12 x 1 plug-in audio-follow-video cards. By using several rack frames, this system will accommodate configurations of 12 x 1 to 12 x 20 and 24 x 1 to 24 x 20, video only or audio follow video.

1050

This self-contained, locally controlled switching system is available in video only, audio only, and audio-follow-video configurations. Two standard case sizes (12 x 6 and 12 x 12) accommodate configurations of 12 x 1 to 12 x 12 switching systems. Features solid-state video and audio input and output amplifiers.

# Digitizing TV programs

By E. Stanley Busby, Jr.

## Why bother?

Some things people want to do to a video signal can be reasonably done only with a signal in digital form—for example squeezing a picture into a corner insert. There are other things that are better done, or more easily done or less expensively done to a signal in its digital form.

Predictably, at NAB there appeared a number of black boxes with analog input and output and digital guts which correct time-base errors, synchronize frames, reduce noise, do funny wipes and flips, squeeze dimensions, etc. New ones appear at each NAB convention.

Going back and forth from analog to digital is expensive and produces picture impairments, primarily due to filter imperfections. Why not digitize at the camera head and go analog only at the input to the transmitter's modulator? Two things are missing in this visionary system: a digital switcher and a digital tape recorder.

## The missing links

"Special" effects are simple to do to a digitized signal; it's mainly a matter of deciding when to switch from A to B. Fades, lap dissolves and soft edges are more difficult as they involve multiplication of digital values. Addition is easy. Multiplication by 1/2, 1/4, 1/8, etc. is easy, but multiplication by 0.61 and 0.39, because that's where you put the fader lever, is a job for the new high speed digital multiplier ICs.

Most black-box digital video processors sample an incoming composite analog signal at exactly three or four times the color subcarrier frequency, usually generating eight (sometimes nine) bits at each sample, providing up to 129 megabits/second. In PAL and SECAM countries, the rate can be even higher.

Digital memory is becoming less expensive. Bandwidth inside the box is cheap. But give a bucket of bits to the telephone company to deliver somewhere and, if they can lift it, they tend to charge according to how many bits are in it. Bandwidth can cost. Digital memory in the box is used over and over. Digits

remembered on tape stay there and occupy space. There seems to be a practical limit to how closely bits can be packed onto tape (it's currently about 30,000 bits to the linear inch per track). When digital video recording becomes practical, it is obvious that the more bits there are, the more tape is needed to hold them. Tape costs money.

## And then the surcharge...

Unlike the black box, digital microwave links and digital recorders are noisy channels. Once in a while, the statistics say, the noise gets bad enough that a bit gets mangled. In the case of tape recorders, tape dropouts can occur and infect a whole bunch of bits at once. Adding a parity bit (see Figure 1), every eight signal bits or so will detect any single-bit error in that word. It leaves it up to you as to what to do about it, and lies to you if there are two (or four or six or eight) errors in the word.

In the case of video, an erroneous sample can be concealed by examining nearby samples and hazarding a guess as to what this garbled sample ought to be, generating this guess and sending it along. It's similar to a drop-out compensator. It isn't perfect, but produces good results. Concealment of errors (as opposed to correction) is not as effective when applied to audio signals.<sup>1</sup>

There are schemes for using multiple parity bits for detecting errors more reliably, and schemes for adding even more extra bits to detect and correct errors.<sup>2,3</sup> Since bits in this case are costing money, one must decide what error rate can be tolerated and design accordingly.

## The bargain basement

With bits costing money it's small wonder that people figured ways to reduce the bit rate of a digital video signal. One method is called differential pulse code modulation, or DCPM. As you scan along a TV line, one picture element is seldom very much different than the one before. DCPM relies on this. It begins by sending a complete sample (say

once per line) just to start out right. It sends it slowly. Thereafter, it sends only the difference between it and the next sample, and the next, and the next, and so on. Small differences require a small number of bits to define them, and the overall bit rate is therefore reduced. If subcarrier is present the differences must be extracted from samples taken one subcarrier cycle ago. It suffers from two problems:

- When a large change occurs, i.e. a bright vertical object against a dark background, the system can't send a difference that big in one shot, and several sample periods can go by before the largest differences that can be sent add up to equal the large change. It's called slope overload.

- If an error occurs in one transmitted difference, everything after that is wrong until another "starting" sample is sent. Long errors look worse than short ones.

The satellite people and others have tested various difference sizes and sampling methods to find which approach to DPCM produces the least picture degradation.<sup>4</sup>

We think of a monochrome TV signal as occupying the spectrum from 30 Hz to about 4.2 MHz. Actually most of the spectral energy is clustered around harmonics of the horizontal scanning frequency. It is this feature that makes compatible color TV possible. In NTSC the color signal is stuffed into the cracks between harmonics of H, at odd multiples of H/2. There is a kind of filter called a comb filter, usually implemented using a one-line delay, which can separate luminance and chrominance (Figure 2).

Using such filters and some fancy footwork on the phase front, an NTSC color signal can be sampled at two times subcarrier frequency.<sup>5</sup> The in-band interfering frequencies caused by input signal components higher than half the sampling rate are steered into cracks in the spectrum where a comb filter can selectively remove them.

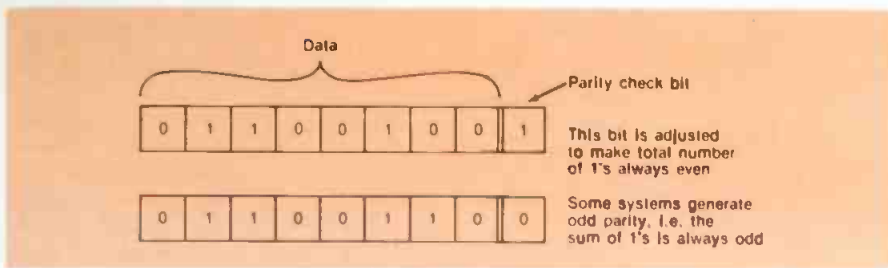


Figure 1 Example of even parity bit generation

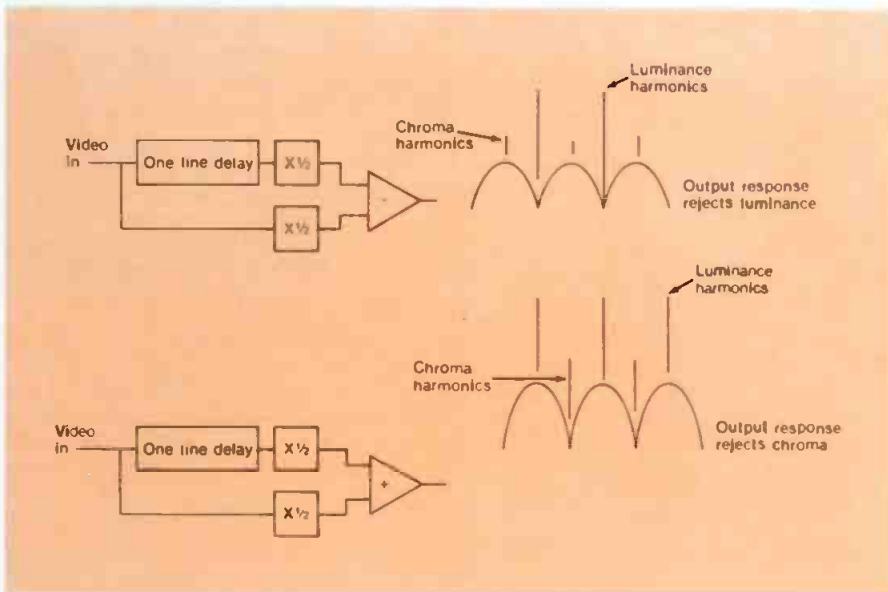


Figure 2 Simple comb filter

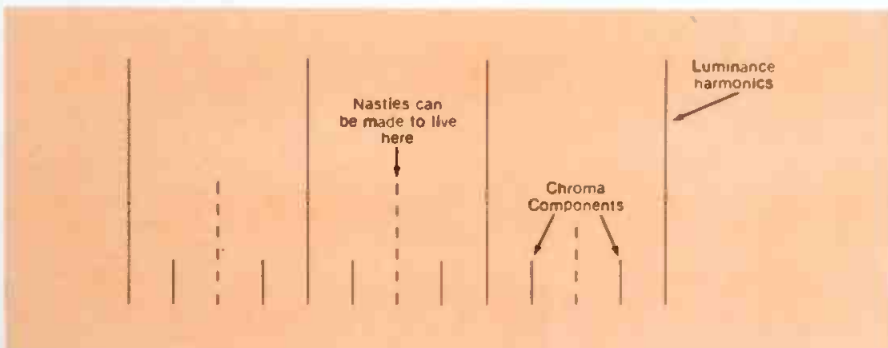


Figure 3 PAL spectrum

The chroma phase switching used in PAL places the chrominance components at frequencies which make it somewhat simpler to "comb out" the nasties resulting from sampling at twice subcarrier. (Figure 3)

**Something for nothing?**

The dodge of sampling at exactly twice the subcarrier is called sub-Nyquist sampling, gently and wrongly implying that we've disobeyed Nyquist's Law<sup>6</sup> and gotten away with it. Diagonal edges in the picture generate legitimate luminance components which live in the

mentioned cracks and are removed by the necessary comb filter, hence diagonal resolution suffers. Color resolution in the vertical dimension is cut in at least half, but this is no real problem since there has always been more of it than the eye can resolve and we have always lived with limited resolution in the horizontal dimension anyway. What is a problem is that practical comb filters operate by summing two or three successive scanning lines.<sup>7</sup> Sharp horizontal color boundaries, such as produced by keyed-in lettering and other highly colored graphics, experience

some squirmy effects when subjected to sub-Nyquist sampling.

**There's no such thing as a free lunch**

It has been proposed that the luminance and color difference signals be digitized before encoding into NTSC, PAL, SECAM or whatever,<sup>8</sup> sent or recorded that way and encoded just before transmission. It works out that a sampling frequency in the neighborhood of three times subcarrier is still required even when the luminance is sub-Nyquist sampled. It boils down to an economic choice...reduce the bit rate and suffer the consequences, or pay the price for the bandwidth. "You pays your money and you takes your choice."<sup>\*</sup>

**"To hear the replication of your sounds..."**

Shakespeare, JULIUS CAESAR, Act I, Scene 1.)

Audio, the red-headed stepchild of TV, could well benefit from digital processing. Analog tape recording in particular presents an agonizing trade-off between noise and distortion. It also suffers from flutter and wow. Some aspects of audio make it more difficult to handle than video. It is unstructured (it doesn't have frames and sync pulses) and its instantaneous amplitude is unpredictable (it doesn't obediently occupy one volt peak-to-peak) so valuable dynamic range must be reserved to accommodate peaks. It demands a higher signal-to-noise ratio than video. There are more people who know what good audio should sound like than there are those who can identify good pictures.

Digitized audio is finding a niche in two new market-places: for the home Hi-Fi listener, there are new systems which use the relatively wide bandwidth of a helical scan video recorder to carry digitized audio.<sup>9</sup> For the really professional recordists (the golden ears of Nashville) digital recorders have been developed which offer 20 kHz bandwidth, zero distortion, zero flutter

*continued on page 55*

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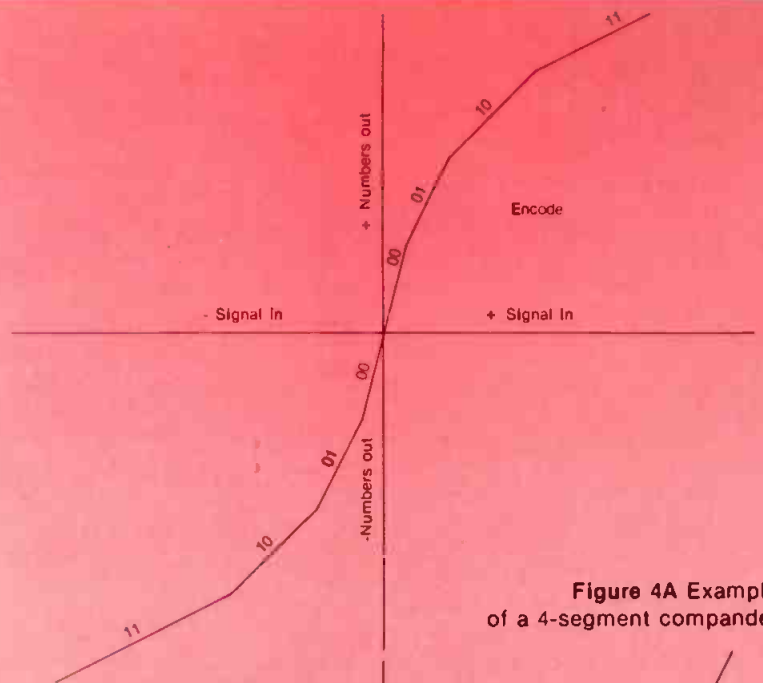


Figure 4A Example of a 4-segment compander

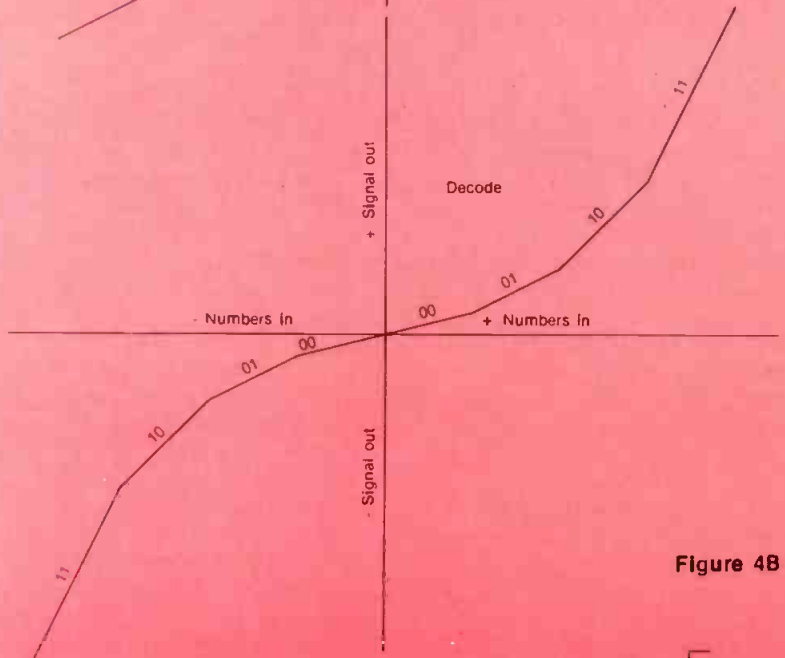


Figure 4B

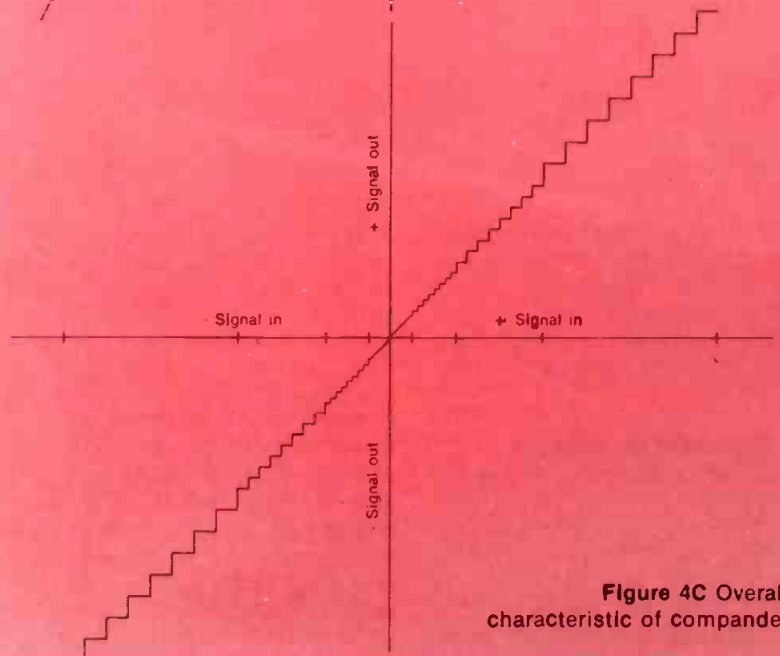


Figure 4C Overall characteristic of compander



## Digitizing TV

continued from page 53

and dynamic ranges of 90-odd dB (16 bits x 6dB = 96).<sup>10</sup> To obtain 20 kHz requires about a 50 kHz sampling rate. 50 kHz (exactly) has an interesting property. It can be derived by dividing 2.25 MHz by 45. 2.25 MHz is 143 x H (in NTSC) and is 144 x H (in PAL and SECAM).<sup>11</sup>

Many professional audio recordings are made in conjunction with an associated picture and 50 kHz offers a single sampling rate which can be locked to either TV system with crystal accuracy.

### Reducing the bit rate

There are properties of the human ear that allow certain liberties to be taken. Exposed to a loud sound, the ear becomes less sensitive to noise. The noise is "masked" by the sound. It doesn't regain that sensitivity for 50 to 100 milliseconds after the sound goes away. Some well known noise reduction schemes, such as Dolby, make use of the masking effect. The suppression of noise sensitivity is least for pure tones and greatest for uncorrelated sounds such as speech and music.<sup>12</sup> This is fortunate.

A digital system can be devised in which there is a non-linear relationship between numbers and voltage, i.e. some steps are bigger than others. Figure 4 shows one such relationship. Loud inputs are more coarsely quantized than small ones, and more quantizing noise is generated by them, but is masked by the loud sound itself. Such systems are called companders (for COMPression/exPANSion). A typical unit used for telephone communication produces an eight-bit output.<sup>13</sup>

- A sign bit defining the polarity of the signal.
- Three bits to define one of the eight segments on each side of zero.
- Four linear bits of magnitude to divide the segment into 16 parts.

Each advance from one segment to the next doubles the effect of one binary step. The dynamic range, the ratio of the largest to the smallest possible signals, is set by the smallest binary step. This is the same as in a 12-bit linear system, about  $12 \times 6 = 72$ dB. The dynamic signal-to-noise ratio is determined by how well the segment is defined, i.e. four bits plus the sign bit. 5 bits x 6dB puts noise-in-the-presence-of-signal about 30dB below the signal, which is adequate for voice communication.

A similar scheme, called floating  
*continued on page 56*

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## Digitizing TV

continued from page 55

point,<sup>12</sup> again uses a sign bit, two or three bits to define the general range of the signal to the nearest 6dB, and a number of linear steps (the more the better) which define where within that range you are. It has the advantage of being easy to convert digitally from floating point to linear and back again. Processing a digital signal is best done with a linear digitization, i.e. when all numeric steps represent equal voltage steps.

Further bit reduction can be achieved by looking at all the samples over roughly a 20 millisecond period and determining the range necessary to contain the largest sample of the bunch. The range information is then sent only every 20 ms instead of along with each sample. This method makes use of the ear's recovery time from loud sounds. The range information is vulnerable; if it gets mangled, you are in for a 20-millisecond blast instead of a one-sample tick.

This scheme is called near-instantaneous companding<sup>14</sup> and is being considered for digital microwave links in Europe.

Sampling rates in current use for digitizing program audio (as opposed to telephone service) range from a low of 32 kHz in Europe to 50 kHz used in the 3M Company's digital recorder. The BBC squeezes a 15 kHz bandpass out of their 32 kHz system. They conclude that 15 kHz and 13-bit resolution is good enough for television.<sup>15</sup> The 32 kHz (\$-50 ppm) is dictated by available inter-city digital links.

A digital audio mixing panel has been demonstrated by the BBC research department. It uses a high speed computer to digitally implement several filter and equalization shapes as well as mixing. It works at 32 kHz.

The 50-kHz people are seeking a solid 20 kHz bandwidth and typically use a resolution of 16 bits with linear encoding to obtain a large dynamic range.<sup>10</sup>

The cost-conscious consumer folks have settled between these extremes. Their aim is to produce superb Hi-Fi in the home at an attractive price.

When digital audio is sent through a noisy channel or recorded, more care must be taken to detect and correct errors, using a higher percentage of "overhead" bits than

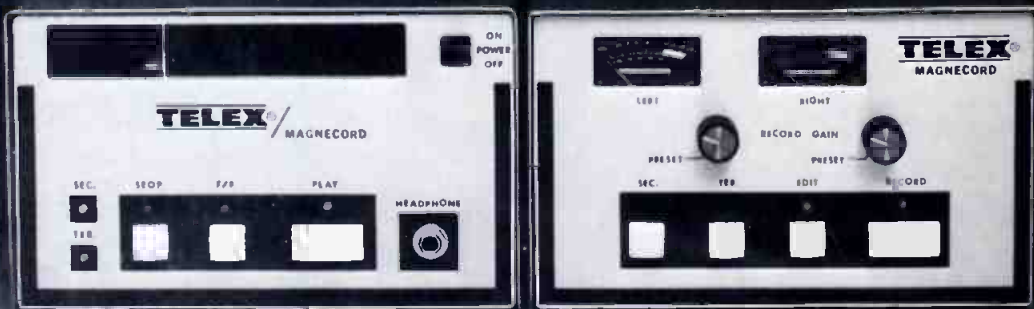
in the case of video. The ear perks up if the error rate gets much above one in ten million, whereas the eye can tolerate about one per 100,000 or even one per 10,000 if simple error-concealment means are used. About the best audio error concealment method consists of replacing the offending sample with the last good one. A slight further improvement can be made by averaging the samples on either side of the bad one and using that.<sup>1</sup>

### When to get nervous

The all-digital TV studio is years and years away. At the obvious risk of being proved dead wrong one week after publication, the author risks these predictions:

- An all digital audio studio will come first.
- The digital video signal will not represent a sampled composite signal but rather its components, i.e. luminance and one or two color-difference signals or even RGB. Sub-carrier will first appear at the transmitter or perhaps at the input to the telephone company.
- The first user will be in a SECAM country. Doing production work in SECAM is a drag. The SECAM user

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has the most to gain from a separate-component system, digital or otherwise.

• Editing will become simpler once subcarrier is banished from the studio.

• I will be too old, too blind, and too deaf to appreciate it.

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The bibliography at the end of the glossary of Digital Video Terms in the Journal, SMPTE, Jan., 1977 is an excellent resource for further reading on the subject of digital video.

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# Increasing power-grid tube life in FM broadcast transmitters

## Part I

By Warren Schulz, chief engineer, WFYR-Chicago

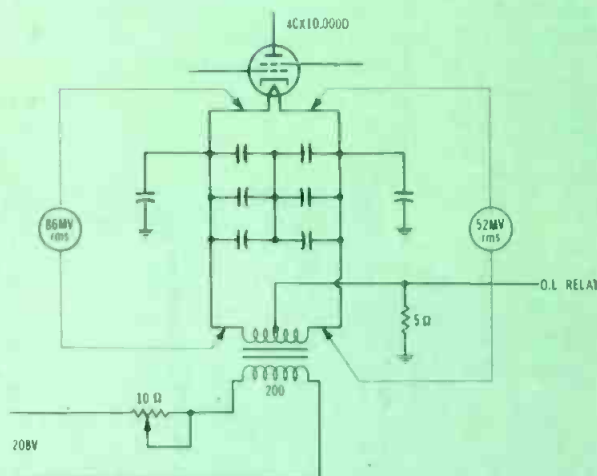


Figure 1

Extending vacuum-tube life is a common concern for both the station manager and engineer. The reasons might vary, but the goal is the same: to keep the station on the air for the most economical cost with the least amount of down time.

As someone concerned with the maintenance of FM broadcast transmitters in the 10 to 20 kW power-output range, I have employed various methods to gain maximum vacuum-tube life. These FM transmitters use the power-tetrode vacuum tube in a class-C configuration.

Vacuum-tube electron emitters can be divided into two types: oxide cathodes, and thoriated tungsten emitters. The typical receiver vacuum tube uses the oxide cathode emitter. Many of the high-voltage receiver rectifiers utilize the thoriated tungsten filament emitter. Typical tubes that use the oxide cathode are the type 4CX250 and the type 4CX300. Examples for the thoriated tungsten emitter are the 4CX5000 and the 4CX15000. These vacuum tubes account for the majority of tubes in use for the FM broadcast service. Although parameter optimization

will be confined to these tube types, the concepts are valid for other tube types used in a similar manner.

### Critical parameter

From my experience of maintaining transmitters for more than 100,000 hours of operation, I have very seldom seen (or personally caused) a tube to fail because of excessive or destructive voltages from a broadcast transmitter. Due to conservative operating parameters, it is nearly impossible to exceed the absolute values specified by the tube manufacturer. In a similar comparison, the broadcast manufacturer normally doubles the air movement requirement, thus insuring adequate cooling. The only item left to the user is adjustment of filament voltage.

Since the electron tube is operating with conservative plate dissipation, the filament voltage specified by the vacuum-tube manufacturer will be excessive. The manufacturer has specified a filament voltage to produce an emitter temperature that will be sufficient for absolute maximum ratings. Another consideration is that the tube will have stable operation with full plate dissipation in a specified warm-up period. When the vacuum tube is operating below maximum ratings, the emitter temperature can be reduced.

Another factor affecting filament temperature is ion bombardment. As the operating frequency is increased, the applied filament voltage can be reduced as the result of additional emitter heating caused by ion bombardment. By keeping the filament temperature at the lowest possible value, the tube life can be extended.

### Optimizing filament voltage

The first step is to adjust the transmitter controls to achieve the normal parameters for licensed power output. While you do this, operate the tube filament at the manufacturer's specified voltage. After several hours of temperature stabilization you then can make the final adjustment to the filament voltage. Slowly reduce the filament voltage a few percentage points at a time. At some point you will notice a small change in plate current. Increase the filament voltage about 1 to 2% above this point. The filament voltage is now set to the optimum value. This procedure is applicable to both types of emitter constructions. Maintaining the emitter temperature to the lowest usage value can

extend tube life about three times beyond life at rated filament voltage.

#### Some pitfalls

Some of the obvious items are easy to overlook. For a 4CX15000 tetrode, the filament voltage is 6.3 volts at 186 amperes. At this current level the filament connecting conductors take on massive proportions. The filament leads for a 4CX15000 tube had an 80-millivolt drop each, as measured in a working transmitter. At the specified current the filament leads are dissipating 15 watts each. A poor connection can cause a voltage drop, which, if left uncorrected, will cause damage to the connecting terminals, supply transformer, feed-through, or tube socket.

You don't need a research lab to test for poor connections. When you shut down the transmitter for maintenance, open the disconnect switch and do the "feel test" on a filament leads. They will be warm to the touch, but should be uniform in temperature. You should not notice any hot spots. If you do, take steps necessary to correct by retightening the suspected connections. You can use any audio-type RMS voltmeter to measure the voltage drop across the filament leads. Be very careful when you do this so that you do not end up welding the voltmeter to the transmitter cabinet. See Figure 1 for some typical voltage drops measured in a Harris FM10H3.

#### Emission problems

If you have a tube that will achieve licensed power with the manufacturer's specified rated filament voltage, but whose plate current drops when you attempt to reduce it, it is a sign of unstable emission. The tube has reached or is very near the end of its useful life. When the filament voltage control starts to operate as power-output control, it is time to either rebuild or replace the tube, as the case may apply.

#### A critical measurement

With an accuracy requirement of 1% for filament voltage, you will soon discover that the metering supplied with your transmitter is not acceptable. Some manufacturers supply a rectified multimeter to measure filament voltage. This is contrary to good design. Other manufacturers install a meter on the primary side of the filament transformer. This primary circuit meter will allow the operator to set the correct voltage only if he has some reference to go by. Every manufacturer provides a method of controlling the filament voltage; few supply a way to make an accurate measurement. So they are admitting to the control problem, but leaving it up to you, the user, to determine a way to measure the filament voltage.

My recommendation is to secure a good quality 4½-inch, iron-vane, AC-panel meter. This meter should be mounted in a portable cabinet with suitable connecting terminals. This external meter then can be used as a secondary standard to calibrate your transmitter metering system. Also, this meter can be hand carried for calibration by an outside laboratory. This meter could perhaps be calibrated in-house if you happen to have an accurate DVM.

It is very important that the DVM have a good RMS converter section. You should calibrate your external

*continued on page 60*

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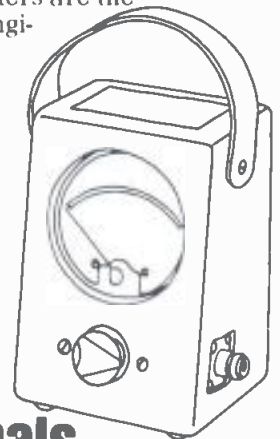
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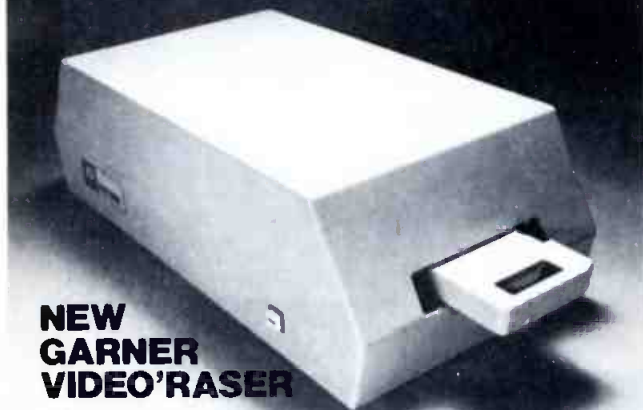
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search for the mainland of Asia. In 1502 he died poor and forgotten.

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## Tube life

continued from page 59

**TABLE I**  
Typical tube life performance  
listed in WFYR tube log books.

SERIAL NUMBER	STATUS
4CX300A SN-1	Tube failed at 4,395 hours due to low RF output.
4CX300A SN-4	Tube failed at 3,314 hours; was tripping overload circuit.
4CX300A SN-7	Tube failed at 3,090 hours due to low RF output.
4CX10,000D SN-SNK36219D	Tube still in service at 14,398 hours.
4CX15,000A SN-7K4 505	Tube still useable after 20,523 hours.
4CX250B SN-12	Tube still serviceable after 6,392 hours.
4CX250B SN-1	Tube failed after 7,225 hours.

standard meter to give you the true RMS or heating value of the applied filament voltage. When you measure the voltage from a 6.3-volt, 186-amp transformer you may encounter some waveform distortion. For this reason rectified-type meters are not acceptable.

Optimum tube life is directly related to the accuracy of the filament voltage. If you have power mains that dip up and down more than a couple of percent, it would be best to provide some type of voltage regulation to keep filament voltage constant.

### Record keep

I recommend keeping a logbook for all transmitter tubes. As soon as a new tube is received the serial number should be recorded, with the date of purchase, vendor, and meter reading when it was placed in service. On the larger power tubes you will find a serial number on the center filament contact ring. On the smaller oxide cathode emitter vacuum tube, it may be easier to scratch a single-digit number on the anode tip. In any event, accurate record keeping is a must. Record keeping is very important if a tube should fail within warranty of the manufacturer. The tube logbook will indicate your typical life trends for the tubes used in your transmitter. The tube logbook will help a new technician at your station determine which tubes are new, used or duds. Table 1 lists some typical entries found in the WFYR tube logbook.

### To be continued...

The second half of this article will appear in the September issue of Broadcast Engineering. Topics to be covered include new tube procedure, running a hot standby transmitter and physical maintenance. Don't miss it!

# Station-to-Station

## A broadcaster's approach to audio peak indicators

By James Guilbeau, WTUL Radio, New Orleans

There is an increasing awareness of peak-indicating deficiencies of the standard volume unit indicator (VU meter). Broadcast stations need two types of audio level indicators: an average level (VU meter) for listener aesthetics and a relative peak level for FCC legal compliance.

The VU meter was designed about 40 years ago to measure the average audio level. However, there also was recognition that peak levels were higher. When speech is measured over 1/8-second intervals, the instantaneous peaks are about 12 dB higher than average level. On a standard VU indicator, 0 VU is normally 4 dBm across a 600-ohm line; but the meter was designed to withstand 14 dBm (+10 dB) indefinitely.

FM broadcasting stations are prohibited by the FCC from exceed-

ing 100% peak modulation. Working backwards from that limit, a radio station would have to hold its average modulation at 25% (-12 dB) to avoid speech clipping more than 1% of the time. Most radio stations have a much higher level of modulation, frequently as high as 70%, using sophisticated audio processors to compress the audio and avoid recognizable distortion. At best, there is a lot of subtle amplitude non-linearity, even if no peak limiting or clipping takes place. Another disadvantage of high modulation levels is that it decreases the dynamic range, adversely affecting stereo separation as perceived by the broadcast listener.

WTUL sets its operating level for 10 dB peak headroom. Using a broadcast test record with a 400 Hz, 0 dB reference level, and the

audio board VU meters indicating to 0 VU, the transmitter modulation is set to 32% (-10 dB). During normal music passages, when the VU meters peak near 0 VU, the modulation monitor shows instantaneous peaks, reading 100%.

The test record has another band, with a 1.5 millisecond, 3 kHz, +10 dB tone bursts superimposed on the 400 Hz, 0 dB reference level. The +10 dB tone bursts are completely invisible to the VU meter, but the modulation-monitor-peak flasher light and peak indicating meters show the correct modulation level. The VU meter accuracy falls off when tone bursts of less than 100 milliseconds are measured, and the operator needs a relative peak indicator to achieve high modulation, with maximum fidelity. It was

*continued on page 62*

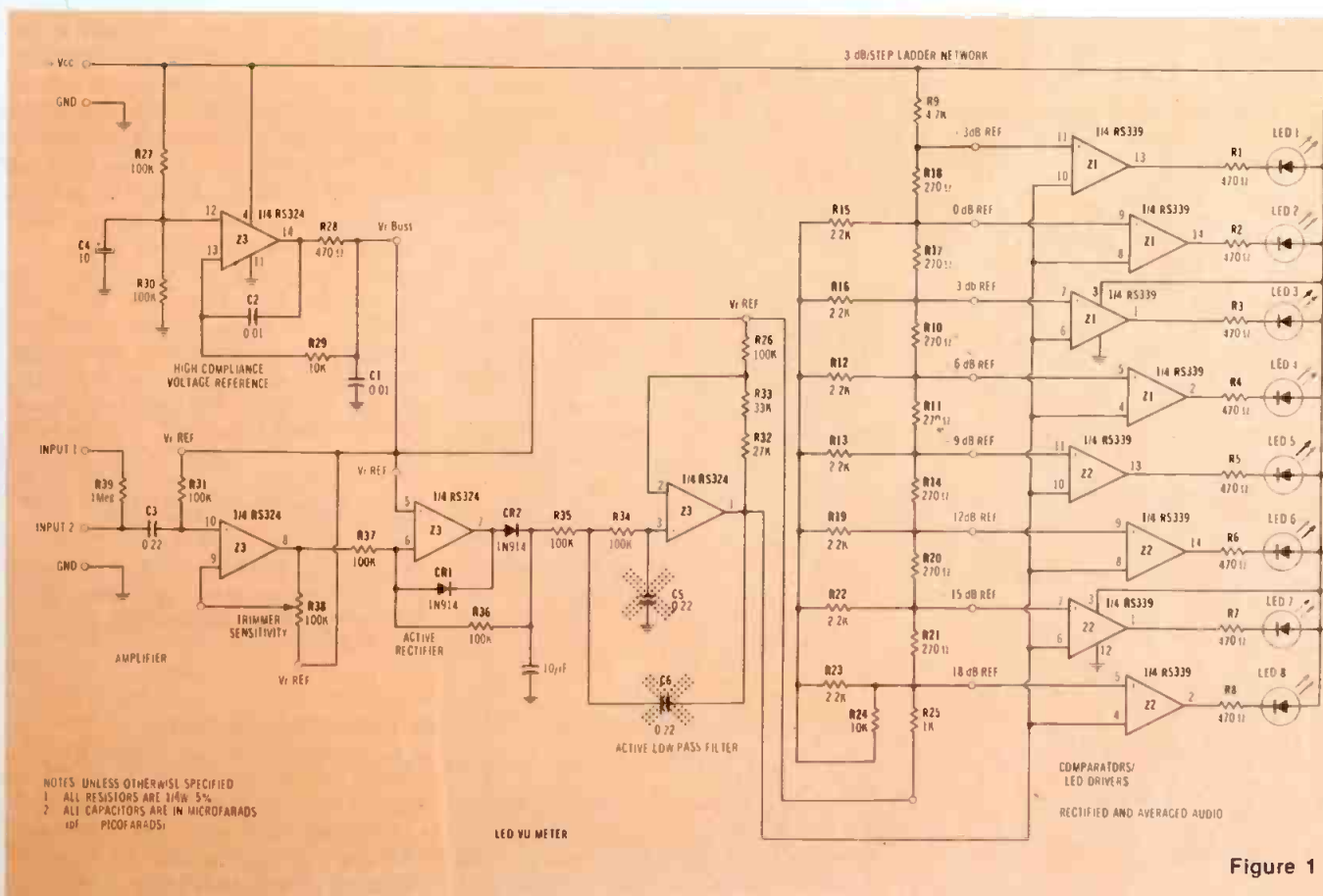
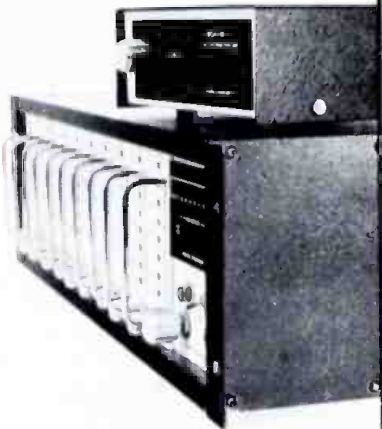


Figure 1

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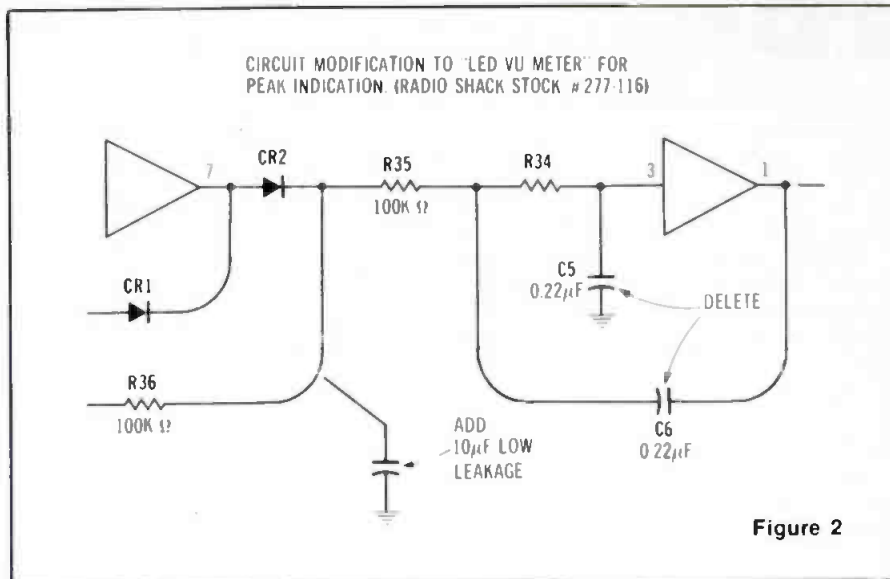
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## Station-To-Station

continued from page 61



decided to use a multicolor-light peak indicator.

The circuit is a modification of the widely available Radio Shack "LED VU Meter" printed circuit board. The modified circuit will respond accurately to peaks or tone bursts of +14 dBm (or 100%) as short as one millisecond; and the light will take two seconds to drop down to -15 dB (18%). The decay-time constant closely approximates the European Broadcast Union's peak program meter. The circuit is flat to 15 kHz and down about 3 dB at 50 kHz, allowing the peak composite modulation from the modulation monitor to be displayed, although it is normally on the mono output of the stereo board.

The circuit was originally an amplifier, active rectifier, active low-pass filter, driving an 8-level comparator. The active low-pass filter is converted to a voltage follower by removing C5 and C6, and the active rectifier converted into a peak integrator by connecting a 10  $\mu$ F capacitor between the junction of R35, R36, and CR5 to ground. The new 10  $\mu$ F capacitor must be of top quality, low leakage (military grade) for the desired time constant. This gave the following relative peak

indications referenced to 100% modulations:

Green: -18dB (12.5+), -15 dB, -dB

Yellow: -9 dB, -6 dB, -3 dB

Red: 0 dB, +3 dB (141%)

The basic Radio Shack parts are a PC board with a detailed instruction manual (stock #277-116) excluding the assorted resistors, capacitors, and two red, three yellow and three green LEDs; a LM 324 quad opamp (stock #276-1711); and two LM 339 quad comparators (stock #276-1212). The LEDs were Fairchild FLV 260, 360, and 460 high-intensity type. The total parts cost is less than \$20. The PC board is only 2 inches by 2 inches and uses 12 VDC at 135 mA.

### References

"Audio Program Level, the VU Meters and the Peak-Program Meter," H. Schmid, *IEEE Transactions on Broadcasting*, Vol. BC-23, No. 1, March 1977.

"Electroacoustics," *Reference Data for Radio Engineers*, Fifth edition, 1968, Chapter 35.

STR151 Broadcast Test Record, Columbia Special Products, 51 West 52nd Street, New York, NY 10019.

## Improvements for the production area

By J. A. Everett, General Manager, Central Florida TV Broadcasting Co.

The following are some ideas to help in the production area of television studios. There is also an idea to save on the unnecessary

purchase of drapery in studios.

Properly set up, the "low lit" (Figure 1) will allow for better lighting of commercials involving



liquids in glass or plastic containers. The frosted glass top will allow any individual bottle or glass to be set in a specific display style or arrangement simply by placing a colored cardboard the size of the "low lit" top under the display, then cutting out the areas directly beneath the display glass or container; this allows the light from inside the "low lit" to shine directly up through the display or bottle and nowhere else.

This light will highlight the product, give body to the liquid inside the glass or bottle, and show bubbles or carbon (coke, beer, etc.) action extremely well. This can be highlighted with supplementary light from other directions, back light, etc. It works well and is sure to please any sponsor. In addition, you'll get the best-looking product in the least amount of time.

The portable easel (Figure 2) will help when there are extra easel cards to be handled or pulled. It is also extremely noiseless with the proper fiber wheels.

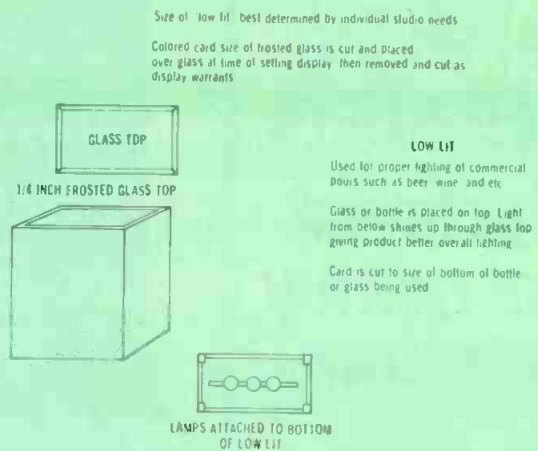
The supporter for studio flats (Figure 3) can be installed behind existing drapery, out-of-the-way sections of the studio, or on all sides. Its benefit is appreciated in better maintenance of flats, easier handling and storage, and simpler movement. Properly positioned, these rails will place the flats close enough to the drapery to enhance its appearance as the folds fall against the flats uniformly. When not in use and to allow movement of flats being used, unused flats are simply hung on the inner rail area.

A way to save money when building a second studio is to make use of the drapery in both studios (Figure 4). Even when remodeling a section between two studios, allow for passage (through the wall) of drapery from one studio to the other.

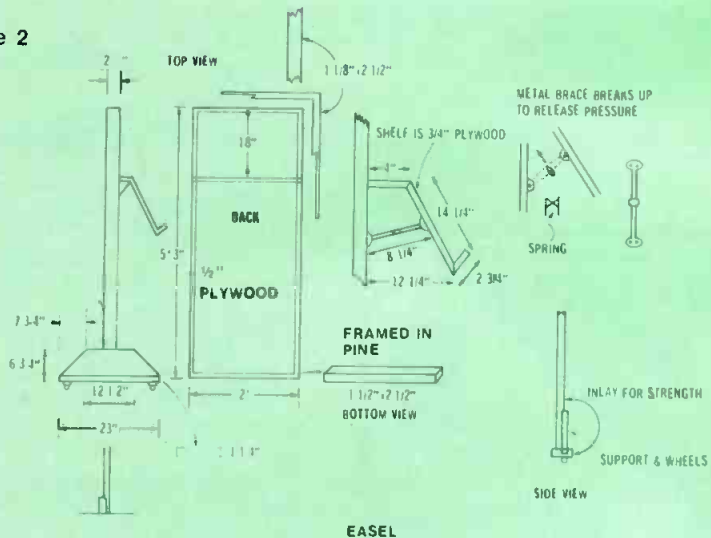
This idea will make better use of existing drapery, allow for use of all drapery in both studios, cut down on the need to buy drapery for two complete studios, and save money when new purchase of drapery is required. Remodeling, of course, is not for all stations because of cost. But unless you're going through solid concrete, it's not that expensive to cut through cinder blocks or wood; and, most studios can do the job in-house simply by determining where it is best to go through by

*continued on page 64*

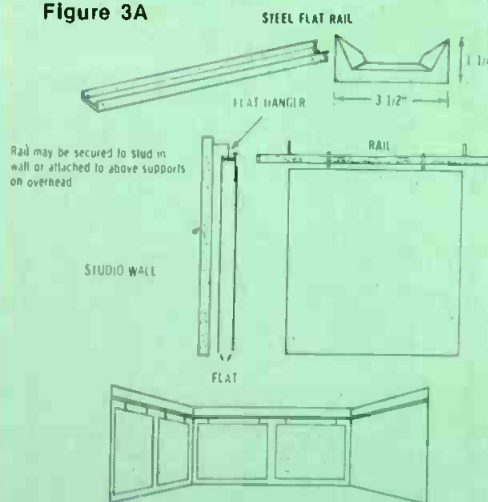
**Figure 1**



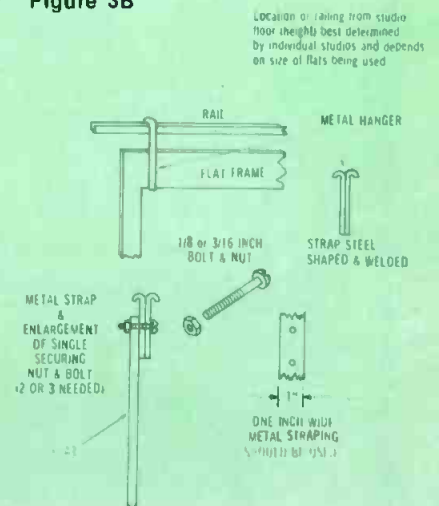
**Figure 2**



**Figure 3A**



**Figure 3B**



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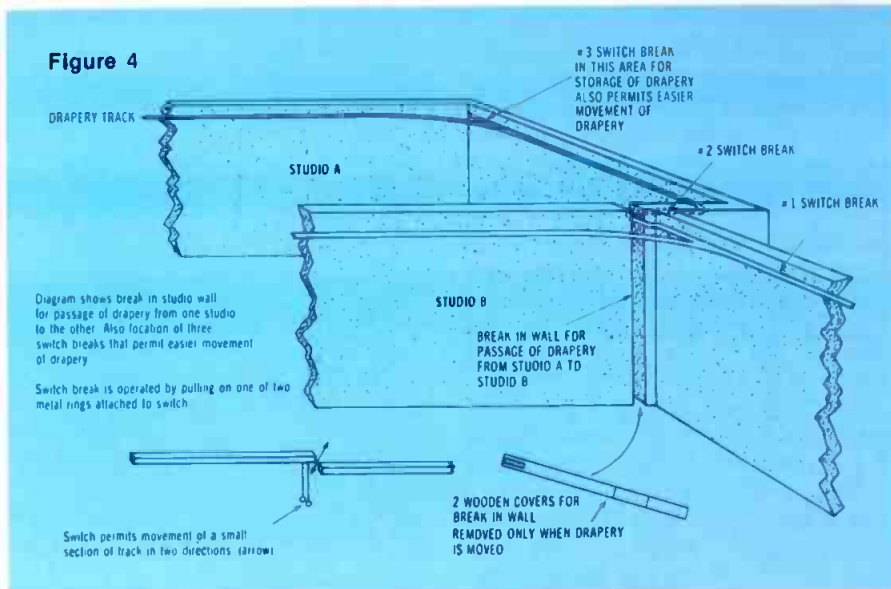
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## Station-To-Station

continued from page 63



referring to blue prints. There is no problem with sound as long as the two covers are backed with sound-

proofing or tightly fitted to the break. I've used it and found no problem with noise leakage.

## Monitoring VTR air pressure

By Bill Robinson, Chief Engineer, WHTV, Meridian, Mississippi

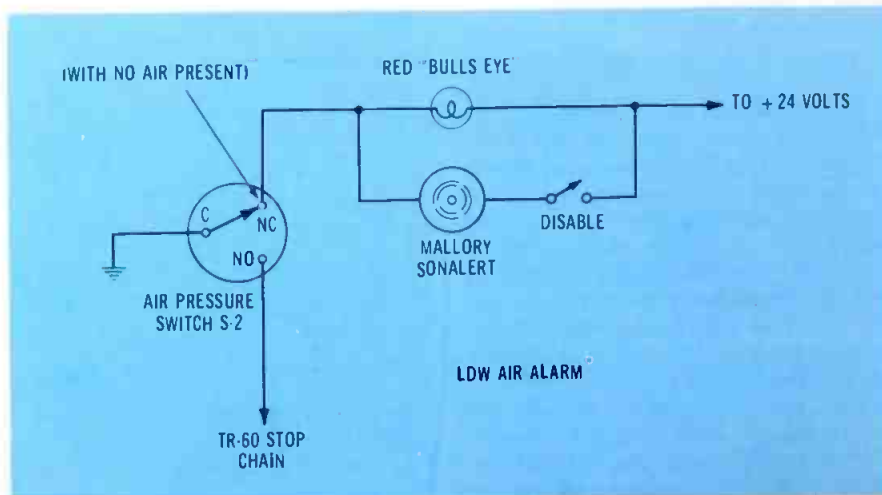
Here is an idea that might be helpful to VTR owners that want to monitor continuously, with an alarm, the air pressure being delivered to their machines.

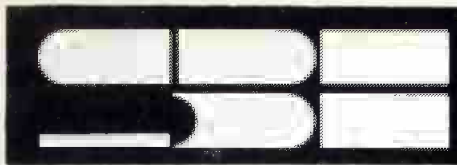
We were looking for a way to alert us if and when, for one reason or another, the air pressure to the tape machines fell to a level too low to operate the head wheel panels. Inside our RCA TR-60 machines the air pressure switch (S2) is the device used to place the machine in an inoperable state should low air exist. Its normally open contacts are in the stop chain circuit, and should low or no air be present, this circuit opens, preventing the machine from

being started.

The normally closed side of the air switch is run to a large red "Bulls Eye" and a Mallory sonalert with a disable switch for just the sonalert. The lamp is left connected all the time.

We leave the air off our machines at sign-off so it's a good idea to disable the sonalert unless you can stand the noise. We used a fairly loud sonalert so you can hear it in other parts of the building. The +24 volts is obtained from the house supply. All parts were mounted on a 3 1/2-inch rack panel placed in the VTR rack between the machines.





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Viking Motor Inn. John Lowery of Digital Video Systems discussed the concepts of digital video processing and demonstrated the DVS-DPSI time base corrector, digital store, etc.

## Society welcomes new membership

The Society welcomes another New SBE Chapter and is happy to announce that its newest addition is Chapter 53, Miami, Florida. This group was organized under the direction of Jay Mathis, chief engineer of WPLG-TV in Miami and will encompass the entire South Florida area.

A number of other areas throughout the country have scheduled first and second meetings so the society is looking forward to a "Welcome Aboard" to some more new chapters very soon.

The national office reports that SBE membership is growing, chapter activity is increasing, members are rapidly re-newing their annual membership and a constant effort to further improve the posture of the national office as viewed by the membership. The national office will provide information on membership, chapter activity and the certification program to anyone sending in a request.

### CHAPTER REPORTS

#### Chapter 5 - Atlanta, Georgia

The program for the May 15 meeting was presented by Susie Ball, zone sales manager for Motorola Two-Way Communications. The informative presentation covered the availability and methods of using 2-Way communication effectively.

#### Chapter 9 - Phoenix, Arizona

KOY Radio was the location for the June 20 meeting which featured a demonstration of the Harris MS-15 stereo generator and exciter by Walt Rice and Rick Stevens, Harris representatives.

#### Chapter 14 - Connecticut Valley

The May 25 meeting was held in the studios of WTNH-TV in New Haven. Art Silver, guest speaker from CCA Electronics, gave a very informative seminar on all phases of AM stereo transmission. A question and answer period followed.

#### Chapter 18—Philadelphia, Pennsylvania

The regular monthly meeting was held June 20 at the Presidential Hotel. Ben Everett of Spin Physics gave a very entertaining and informative presentation on the refurbish-

ing of video recorder heads for quadruplex machines. This was the last meeting for the summer.

#### Chapter 20—Pittsburgh, Pennsylvania

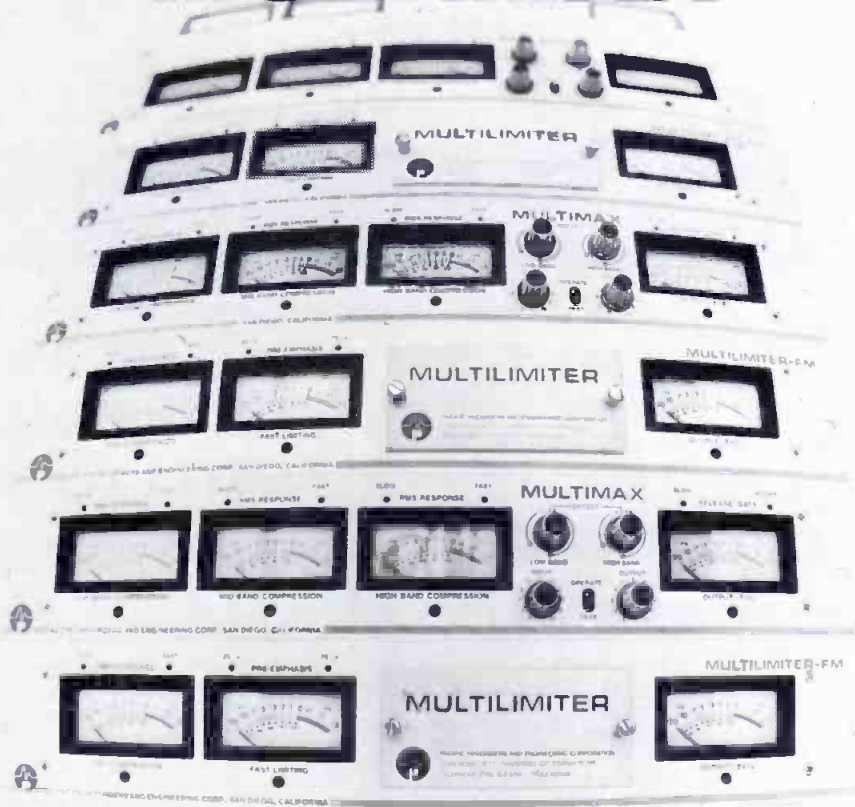
The regular monthly luncheon meeting was held June 15 in the

#### Chapter 21—Spokane, Washington

The May 30 meeting included a field trip to the KSPS Ed TV new Satellite Receiving Station for PBS program service which opened June 1st. The weekly noon meetings will continue all summer.

*continued on page 66*

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## SBE

continued from page 65

### Chapter 22—Central New York

The June 15 meeting was held at the New York Telephone Building in Syracuse. The meeting featured a tour of the New York Telephone Company Video Center and the Electronic Switching System conducted by John Opela.

### Chapter 25—Indianapolis, Indiana

The June 8 meeting held at Indiana University School of Nursing featured the Latest Techniques in Video Switching, conducted by Morrell Beavers, representative of Vital Industries of Gainesville, Florida.

### Chapter 37—Washington, Maryland, Virginia

The June 28 meeting was held at 7:30 PM at TeleColor Productions in Alexandria, Virginia. Walley Warren of RCA spoke on RCA's FM transmitters and particularly their new FM exciter (BTE-115).

### Chapter 39—Tampa Bay Area

The June 24 meeting began at 11 AM at Cypress Gardens. The chapter saw the film and TV facilities, the water ski show from the photo

press section, the photo boat with models and had complete use of facilities.

### Chapter 41—Central Pennsylvania

The June 15 meeting held at L.R. Hoffman Crystal Plant in Carlisle featured Lew Bergett guiding a tour of the Hoffman Crystal Manufacturing Plant. Members were able to see first hand how crystals are grown and processed for use in the communications industry.

### Chapter 43—Sacramento Valley

The June 28 meeting at KTXL featured *It Come From Outer Space, Part II*. Members examined a receive only earth station capable of hitting every broadcast bird in the American sky. They swept the skies, raiding signals from Westar I & II, Satcom I & II and Comstar A & B.

### Chapter 45—Charlotte, North Carolina

The regular monthly meeting was held June 12 in the Barclay Cafeteria. After a brief business meeting a program on AM & FM equipment performance was presented by Richard Mertz & William Culpepper, both Chapter 45 Members. □

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# zoom in!

This is the official column of the American Society of TV Cameramen (ASTVC). The ASTVC can be contacted by writing to P.O. Box 296, Sparkill, NY 10976; (914) 359-5985.

## Regional Repette Wraps it Up

(Editor's Note: The following article was submitted by Mary Zoller, ASTVC's San Diego rep working out of KCST-TV.)

Somewhere among the tinsel, glitter, and dazzle...between the Desert Inn and the Country Club, I found the Las Vegas Convention Center—home of the 56th annual National Association of Broadcasters. It had an aura of excitement all its own...somewhat like the Lexington Market at dawn but also like Barnum & Bailey's opening day in anytown, U.S.A. It happily combined a well laid out, thoughtfully put together exhibit of wares with the excitement of a three-ring circus. In one ring I saw the giant screen with "John Denver in Australia" looking down over two-thirds of the convention; a subtle barker provided by the Bosch-Fernseh people. In another ring were found all the latest in transmitters, towers, audio and microwave gear. It was connected to ring three by the enormous and elaborate exhibits of Ampex and RCA.

It was ring three which was the center attraction for a cameraman. It displayed all the industry's latest in cameras, lighting equipment and related accessories. What a haven. It seemed like every booth had something grand to offer.

It quickly became evident that to share each piece of gear, its pros, cons, and stats was, at best, impractical. I think it should suffice to say that there are any number of excellent cameras on the market—large, medium, small, inexpensive, moderately priced, costly, portable, studio, or practically any combination of the above. I like the viewfinder Ikegami has come up with for hand held cameras—with theirs you no longer have your left eye in a 2-inch cup. I liked the minuteness of the little Sony hand-held camera, the CCU for the RCA TK 47, the viewfinder on the Bosch Fernseh, the feel of the Philips, the versatility of the Fulmar 702 pedestal, and so on.

There was a lot to see in related fields, too, like lighting. And, by the way, most lighting companies I talked to are again giving seminars—Kliegl, Sylvania, Colortran, etc. (Prices vary depending on size of your group, depth and length of

seminars, and proximity to related company business—a great idea for your next ASTVC meeting?)

Other things of interest I found include: the Digitimer clock system. In addition to its digital readout in the middle of a traditional clock face, it has 60 LED dots around the face, each of which goes out with the passing of a second.

Whoever said that NABs are only for Chief Engineers and purchasing people are really on the wrong track. I gained a tremendous amount of knowledge, met some fascinating people, and felt a real sense of pride at having attended such an event. If you haven't been to one lately, you really should plan on the next one: I am. □

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## new literature

**Cohu Incorporated**—Television camera tube sensitivity is compared graphically on a new chart published by Cohu's electronics division. Image pickup tubes ranging from the standard vidicon to the intensified image isocon, and including silicon-target, silicon intensified target, and color image isocon, are listed. Comparisons of operating light values for each tube are shown in lumens-ft<sup>2</sup>. Light values are also compared to the natural light range from midday sunlight to overcast starlight. Included on the chart is a listing of Cohu low-light television cameras with a brief description of each camera.

Circle (90) on Reply Card

**Beau Products**—A 24-page catalog describes the many advantages of the new thermoplastic line of barrier terminal strips, including its ability to withstand breakage. Catalog no. 300 also covers the company's line of single-row and double-row barrier terminal strips. The catalog describes the wide variety of top-side and bottom terminals, as well as jumpers, straddle plates, quick-connect terminals, marker strips, and imprinting. The guide includes complete specifications along with dimension drawings for all barrier terminal strips and hardware.

Circle (91) on Reply Card

**KR Electronics**—A glossary of commonly used filter terms, descriptions of basic filter types and standard test circuits for filters, and details on a broad range of standard and custom LC filters are included in a new 8-page catalog. Standard filter lines, standard DIP and miniature filters, as well as specifications on custom filters which include low pass, high pass, band pass, band reject, matched phase and other features, are described and listed.

Circle (92) on Reply Card

**AMP Incorporated**—Catalog 73-204 is a 45-page catalog fully describing circular plastic connectors which are available in three interconnection series: standard, high, and

power densities. Included are detailed engineering information, performance characteristics, mated and component dimensions, and housing features for approximately 350 separate items. Contact arrangements and specifications, soldered and posted type contacts, accessories, and application tooling are covered in the catalog.

Circle (93) on Reply Card

**Trompeter Electronics**—A 40-page catalog with sections on patching, connectors, and cable assemblies has been published. Products are available in standard, miniature and subminiature coax, twinax, triax, and quadrax. A complete line of unique audio patching is included. The catalog also contains an illustrated treatise on noise in cable systems.

Circle (94) on Reply Card

**Anixter-Pruzan**—A free 16-page catalog for video products describes all of the items required to equip a video studio.

Circle (95) on Reply Card

**UMC Electronics**—The new line of Beaucart audio consoles introduced at the 1978 NAB show is described in detail in a 2-page catalog sheet. The new audio consoles are 8-channel, stereo units expandable to 16 channels with the addition of top plug-in channel modules. Consoles incorporate three fully metered matching stereo busses out (program, audition, and utility) plus a fully metered mono feed buss as standard. The catalog lists all important features of the line and includes full specifications and dimensions.

Circle (96) on Reply Card

**Rohde & Schwarz**—Edition 80 of the company magazine reviews R&S's standard-frequency range, the new broadband, doppler direction finder PA 005 for radio detection, the central control unit GB 059 for transmitter backup after the n-plus-1 principle, and also automatic test equipments for RF engineering. Fur-

# A Rare Sight

ther articles introduce the compact radio-telephone test assembly SMDU 56 and relay matrixes PSU and PSN for measuring systems based on the IEC (IEEE 488) interface bus.

Circle (97) on Reply Card

**TRW LSI Products**—TRW's 30-MHz, 8-bit analog-to-digital converter is described in a 12-page data sheet. The monolithic TDC-1007J A/D converter is packaged in a 64-pin DIP and is well suited for commercial TV and other digital signal processing applications. Included in the data sheet is detailed information on an optional, edge-connected, printed circuit card that hosts the 2-Watt device. A complete schematic diagram is also provided.

Circle (98) on Reply Card

**Gotham Audio Corporation**—"Microphones," a 74-page pocket book on microphone technology is available. It gives an easy to understand overview of the often misunderstood workings of the most important transducer in the recording, broadcasting and public address equipment chain. This booklet is for anyone who comes in contact with microphones both from the operating as well the artistic point of view. It keeps the formulas and calculations down to bare essentials while concentrating on useful application information. For example, it clearly shows why the use of an omnidirectional microphone for the distant pickup of an orchestra can only be recommended under very special circumstances; but never as a general practice.

Circle (99) on Reply Card

**Cohu Incorporated**—A product data sheet describing a new screen splitter designed to interface with Cohu's 2800 and 4400 series television cameras is now available. The screen splitter, which is a factory-installed option, will provide horizontal, vertical, or moveable window split screen presentations for multiple-camera video systems. The position for the screen split, plus both the size and position of the window, is continuously variable.

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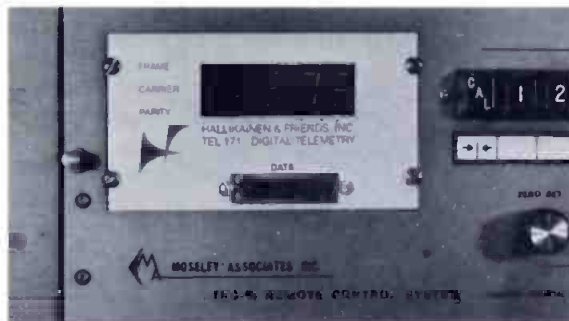
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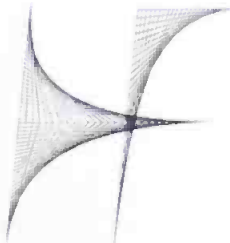
That's right. Our TEL 171 converts your Moseley TRC15AW or AR to digital metering transmission, a method that eliminates the offset and gain drift in analog metering — and one which eliminates errors in meter reading.



Our components fit right into the Moseley units, substituting the audible metering generator, the meter and the metering demodulator. Our components use the same mounting hardware, making installation sure and simple.

The studio display shows readings from -1999 to +1999. These readings are updated four times a second to keep you informed. Should the metering carrier be lost, or a framing or parity error occur, the display goes blank and a front panel LED indicates the problem.

A front panel connector is provided for connection to a transmitter logger or ATS system. The price is \$375.00. Place your order today.



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Circle (54) on Reply Card

## new products

### X-Y recorder

Philips' X-Y recorder, the PM8131, plots up to the DIN A-3 format (15 by 10 inches or 38 by 25 cm). Built for R & D applications where very high resolution is required, the single pen recorder is a stable instrument with minimal temperature drift.

The unit's high resolving power is also attributable to its input sensitivity from 50  $\mu$ V to 1 V per cm in 14 calibrated ranges for both X and Y axes. Overlapping for near calibration provides the facility to take advantage of the recording area by means of a variable range control.

The PM8131 has independent and fully variable zero offset facilities on both axes which offset the recording range of the instrument up to four times the scale length for all input sensitivities in each axis, equivalent to 16 complete recording areas.

Although this unit is designed for low-level inputs, it is also well protected against overloading.

Circle (101) on Reply Card

### Microphone mixer

The "Porta-Mixer" model PM77 from Photomart offers all users of ENG recording equipment and/or motion picture recorders a lightweight mixer for up to three microphones and one line input.

The self-powered, battery-operated microphone mixer, weighing only 25 ounces, may be fastened to the recorder with supplied "Velcro" strips or by use of an accessory snap-clip, may be worn on the belt or hung from a shoulder strap.

Long battery life for the Porta-Mixer is assured by a pop-in rechargeable Nicad battery chargeable while installed with the supplied trickle charger or externally with an accessory charger unit.

Circle (102) on Reply Card

### Digital metering

Digital metering for the Moseley TRC15AW & AR is now available. TEL 171, introduced by Hallikainen and Friends, uses digital transmission from the transmitter site, and is designed as a quick retrofit to existing units with no machining necessary.

Circuit boards use the existing wiring harnesses for connection; conversion takes three to four hours maximum. The system is self-cal-

ibrating and updates readings 120 times a minute. It can display all parameters including phase angles on the 15 positions of the TRC. The unit gives a station economical digital metering advantages and minimizes operator errors.

Circle (103) on Reply Card

### Camera pedestal

A video camera pedestal designed to support studio and ENG-type video cameras weighing up to 90 pounds is available from Innovative Television Equipment.

The ITE-P6 utilizes constant torque spring assemblies to provide counterbalance for the lighter weight cameras which are becoming more prevalent in both studio and field applications. Features include crab steering and column elevation, both controlled by the steering wheel. Its dual, 6-inch ball-bearing wheels have polyurethane tires equipped with adjustable cable guards, and are gimbal-mounted to insure smooth movement on floor surfaces. The pedestal will elevate from 33 inches to 52 inches and has a doorway width of 28 inches. Weight is 150 pounds.

Circle (104) on Reply Card

### Automation accessory

RCA has introduced a new automation accessory for the TCR-100 videotape cartridge recorder which allows the machine to be totally integrated into a TV station's technical automation system.

The built-in accessory provides for electronic cartridge identification, automation system interface, and programmable random play of any cartridges loaded into the TCR-100. Machine identification of up to 22 cartridges in the TCR-100 magazine is accomplished without threading or cueing the cartridges. Individual cartridges are identified with external bar code labels which are scanned as the magazine carries the cartridges past a sensing device.

Scanning and identification of all 22 carts is accomplished in only 11 seconds. The resulting information is combined with the proper bin location, and stored in the system's memory. The data then is supplied to the station's technical automation system as a table of contents, as required.

The accessory also contains a



microprocessor control system to provide completely random play of the TCR-100 magazine contents.

Circle (105) on Reply Card

#### Preamp

Micro-Trak's new model 6405 Pro-eminance Turntable Preamp features a self-contained power supply, small physical size, and mounting brackets which allow panel mounting, mounting on a sidewall or floor of a cabinet. Distortion is spec'd at .05% THD + IM, and noise at -73 dBm (effective input noise -117 dBm).

Circle (106) on Reply Card

#### Headset tester

A headset tester manufactured by Tone Dynamics and marketed by Television Equipment Associates is a small general-purpose unit facilitating subjective testing using voice or internal oscillator. A visual indicator of output level is provided by a meter on the instrument.

Six combinations of carbon or electromagnetic mikes can be tested on one unit and sockets can be specified by user. An optional artificial voice is available for checking mike sensitivity or setting up amplified electromagnetic mike systems.

The receiver level on the earphone can be pre-set on each of the connectors by changing an associated internal resistor. The instrument has a self-check system to verify operation and system gain.

Circle (107) on Reply Card

#### Amplifier

Opamp Lab's power operational amplifier kit, model SM-100K, offers dual 50 watts RMS or mono 100 watts RMS over the DC through audio range. The unit consists of a panel chassis with hardware, two 440KR power amplifiers, a 536 power supply, PC-SM100 convertible stereo 50-watt or mono 100-watt PC board, and all necessary components.

Circle (108) on Reply Card

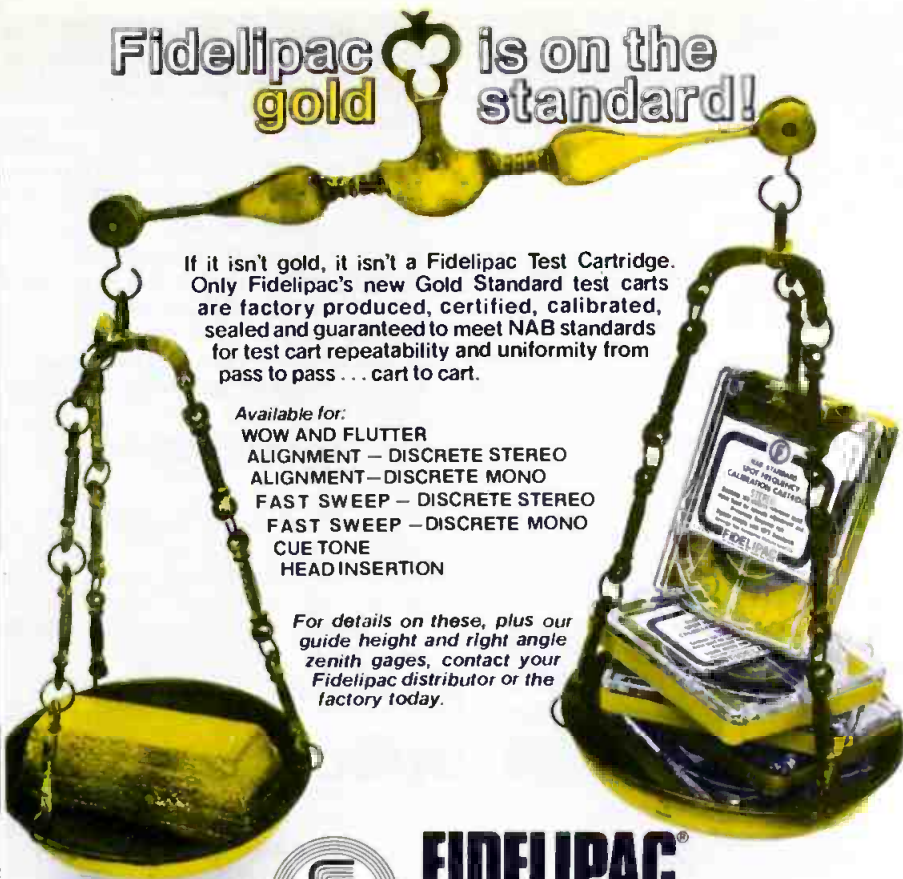
#### Audiocassette editor

3M Company has developed a prototype of an electronic editor for audiocassettes. The Wollensak unit, CE-20, eliminates the need to master and edit recordings on reel-to-reel tape before transferring to cassette (which saves one generation). The unit also makes manual tape editing unnecessary.

Circle (109) on Reply Card

continued on page 72

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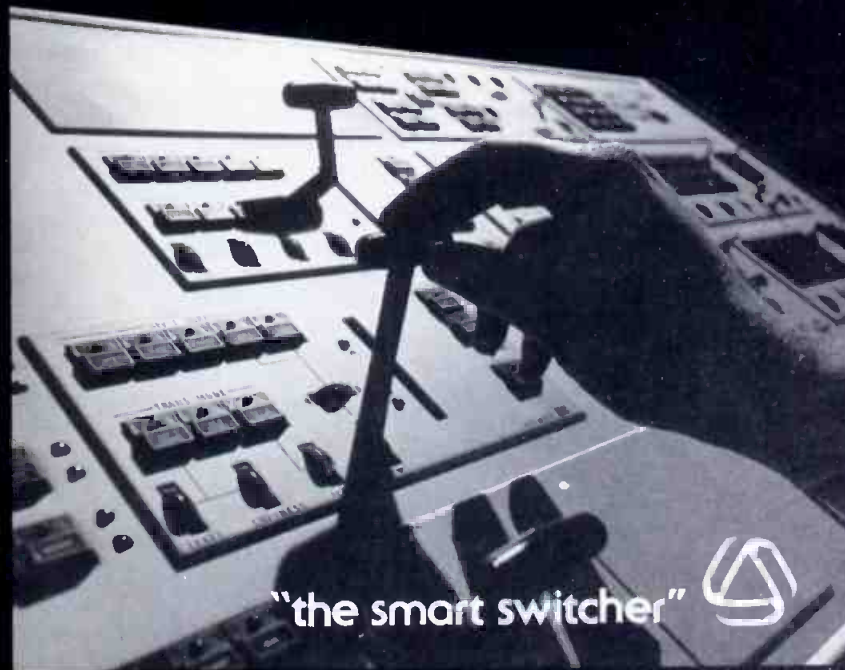
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Circle (56) on Reply Card

# new products

continued from page 71

## Edit code generator/reader

A new SMPTE edit code generator/reader, with slave gen. has been introduced by Kaitronics. The model ECS-8081 has the combined features of a generator and a reader. It can upgrade an existing helical scan

VTR editing system to SMPTE time code standard. It can also be integrated into the automatic computer-aided editing system.

The thumbwheel switch presets hours, minutes, seconds and frames. The built-in slave gen allows the unit to slave or jam sync to an external source of edit code, typically the existing code of a tape, and continuously adding on the edit code, picking up the count where it left off the tape. This makes pre-recording of edit code on master tape unnecessary.

Circle (110) on Reply Card

## Multi-role lens

A multi-role lens that needs no re-registration or camera adjustment is available from Rank Precision Industries.

Varotal MRL™ from Rank Taylor-Hobson provides a common set of optical zoom lens modules for both standard and portable television cameras. Three interchangeable lens fronts give wide angle, narrow angle or standard capabilities with a total focal length of 56 to 1.

Available for most broadcast television cameras, Varotal MRL accepts manual or servo zoom and focus modules, and includes a set of three turret range extenders (1.4X, 2X and 2.8X), with automatic aperture compensation.

Circle (111) on Reply Card

## Portable camera

A new EFP/ENG dual-unit portable color television camera designed specifically for working from small vans is available from Ikegami.

The camera, the HL-52, features a camera head that weighs a mere 9.3 pounds. It can use three 3/8-inch Plumbicons or Saticon pickup tubes, and incorporates Automatic Beam Optimization to compensate for extreme picture highlights.

The unique feature of the HL-52 is the format of its camera control unit. The CCU incorporates a removable miniature remote control unit; this unit can be packed in the control console in a production van and the CCU stowed well out of the way.

The small size of the remote control unit makes it possible for several HL-52 cameras to be controlled from even a small van with great economy of space. Moreover, with AC power available, the van-to-camera distance can be as great as 200 meters.

Circle (112) on Reply Card

## TV graphics and titling system

The CHYRON IV graphics and titling system from CHYRON Tele-systems features operational and display features newly introduced to TV, such as instant italics, 64-color palette, and action graphics.

The system is designed with 27-nanosecond resolution, a library of 25 fonts in 14 different type faces, and an italics feature that automatically converts any font in the library into italicized characters having a 14-degree slant or a 28-degree slant.

The standard 64-color palette for characters and backgrounds is operated by a keystroke that produces a color matrix of all available

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colors on the edit monitor. The graphics animation capability of the CHYRON IV is provided by the program sequence controller which establishes the appearance, sequence, and dwell time of the pre-recorded text and graphics.

Options include second channel, camera font compose unit, customized font creation service, multiple keyboards, multiple VIDIDISC transports, RS232 interface, and right-to-left writing.

Circle (113) on Reply Card

#### Turntable cabinet

Sit-down and stand-up turntable cabinets are available from Grinnon Fixture. The Utopia II models feature exterior surfaces all completely covered with pattern #385 formica. The brass or aluminum hardware 12-inch-high shelf support is made of 1-inch square steel tubing, painted flat black.

The shelf holds a couple of records, and the next records to be played. The drop door at the front is for access to pre-amps and turntables. The cabinets are shipped completely assembled, and can be purchased with all equipment mounted and wired.

Circle (114) on Reply Card

#### 3-way loudspeaker system

Model 327 loudspeaker system by KLH has a 10-inch woofer, 4-inch cone midrange, and a 2½-inch cone tweeter. Its crossover points are at 900 and 3600 Hz. The 327 has brushed aluminum midrange and tweeter reveals with opaque driver screens. Its nominal impedance is 8 ohms, and its minimum impedance is 5 ohms. Frequency response is at 55-18,000 Hz. Maximum power handling is 80-watt capacity; minimum power requirement is 20 watts.

Circle (115) on Reply Card

#### High-speed prime lenses

Cinema Products has made available a new series of high-speed prime lenses designed for 16mm cinematography. Prime lenses included in the ULTRA T series are 9mm (T1.35), 12.6mm (T1.25), 16mm (T1.25), and 25mm (T1.25).

ULTRA T prime lenses feature focus and iris rings with built-in gears for motor-drive operation; easy interchangeability between CP mounts and other mounts; precisely calibrated focusing scale that can be removed to permit change from footage scale to optional metric

*continued on page 74*

## IMPORTANT NOTICE

TO FM STEREO BROADCASTERS

Overmodulation is a serious violation of the FCC Rules and Regulations.

Certain audio processing devices carrying the designation "Insta-Peak II" and "WBL Wide Band Composite Level Control" manufactured by Elcom Engineering Co. provide modulation levels not possible from other control equipment. The Elcom system uses "Keyed Integration," split band limiters, and broad band phase coherent overshoot elimination in the composite stereo channel.

Many stations have attempted to duplicate this increased level using conventional audio control devices. The result is overmodulation and FCC violation notices.

Don't assume that your monitor is indicating incorrectly and try to match the loudness of a competitor who is modulating fully—he is undoubtedly using the advanced Elcom control.

For further information contact:

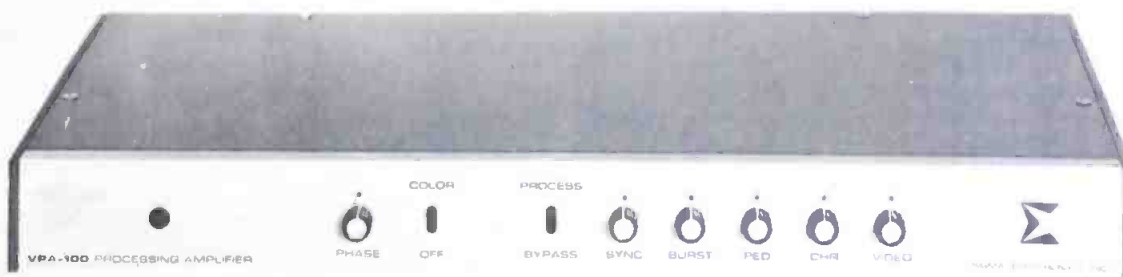
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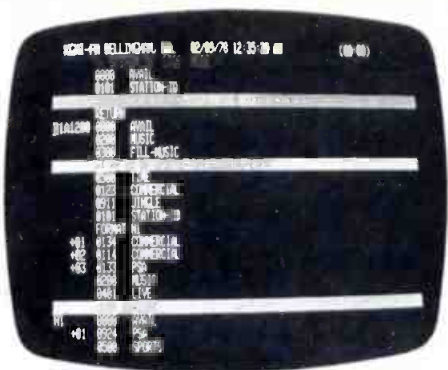
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## new products

.....  
continued from page 73

scale; iris ring marked in "T" stops only, with optional free or click-stop operation; precision spacer shims under all mounts to permit fine tuning by user; helical focusing mount with an intermediate fine-pitch, close-tolerance brass ring for aluminum-brass-aluminum thread contact for minimum wear characteristics and maximum focus scale expansion.

### Display monitor

The 620 display monitor from Tektronix is a low-cost, electrostatically deflected display designed to accommodate OEM requirements. The 620's 10 x 12 cm view area, 5 MHz Z-axis bandwidth, and 2 MHz vertical and horizontal bandwidth result in a versatile instrument with good viewability even in high ambient light. The display monitor only dissipates 22 watts.

The 620 display offers a newly patented packaging design. This design allows nesting of an empty 1/2 rack package for the user's electronics—either vertically stacked or side-by-side—with the display monitor. In addition, rack-mount packaging is available.

To facilitate repairs in the field, the 620 circuitry is contained on only two circuit cards. The 620 will be UL listed for incorporation into other equipment or for stand-alone application.

Circle (116) on Reply Card

### Portable color camera

Philips' new 3/8-inch Plumbicon camera, the LDK 14, is a fully automatic, self-contained ENG portable of minimal weight and low power consumption, together with a rugged, shockproof design.

According to Philips, picture quality is of such high standard that the LDK 14 is well qualified for use as an EFP portable or studio camera with an optional remote control unit.

The camera can use a wide array of studio and field-fixed, standard zoom and extended-range zoom lenses. In addition, unique mounting accessories enable the portable camera to be mounted quickly on a tripod with a top or side-mounted 5-inch viewfinder for flexibility in studio use or field production.

Features include a new camera

yoke with the focus coil placed nearest the tube, thereby reducing focus power and operating temperatures; increased static and dynamic resolution; f 1.4 optics; low-light operation; contrast compensation; and highlight discharge circuitry.

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### Monitor

The 650 HR is a high-resolution addition to the 650 series of Tektronix 12-inch color picture monitors. The 650 HR features a new, high-resolution Trinitron® picture tube, which has over 50% more resolution capability than the standard Trinitron.

The 650 HR is available in NTSC, PAL and SECAM configurations. The NTSC model has a 1.3 MHz chrominance channel bandwidth for high color resolution. In the monochrome operating mode, the subcarrier notch filter is removed from the luminance channel (NTSC and SECAM), providing 6 MHz luminance bandwidth. In the auto mode, the notch filter is automatically disabled if no burst is present. In the PAL model, the notch filter remains in the luminance channel since the high notch frequency does not limit performance.

Circle (118) on Reply Card

### Type C VTRs

A new line of Type C VTRs is available from RCA Broadcast Systems.

The studio model (TH-100) is a compact, high-performance, helical-scan VTR which uses the NTSC high-band direct FM recording system. It consists of five modular subsystems: tape transport, electronics package, operating control, meter panel, and power supply.

The TH-100 features a new tape-handling system which provides motion-picture-style videotape editing capabilities for flexibility in post-production editing. A single

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control dial provides bi-directional search capability in two different search modes.

Its companion model, the TH-50, is a small, lightweight, battery-operated unit specifically designed for ENG/EPF applications requiring portability.

Circle (119) on Reply Card

#### ENG camera

Panasonic has introduced its first ENG camera, model AK-750. The self-contained, portable color camera is designed to operate with low power consumption, offering longer operation on its batteries.

The AK-750 is a three-tube camera. The user has the option and selection of either 2/3-inch Plumbicon, Newvicon, Vidicon or equivalent tubes. The camera comes with an optional 4/5-inch V/F and remote control unit for studio system application.

Features include high-gain SW; built-in bar generator; built-in vertical aperture; 1.5-inch detachable viewfinder with built-in level indicator and battery warning indicator; tally lamp; single-block chassis for mechanical stability; VTR playback on viewfinder; VTR start/stop trigger on camera head; and standard C-mount adaptor.

Circle (120) on Reply Card

#### Video switcher

A digital remote-controlled video switcher from Fung Engineering, designed to be used with Fung's companion RF data modulator/demodulator system, is now available. Utilizing single coaxial cable, this new concept in switching TV surveillance cameras and control equipment is provided with provision for up to eight video inputs.

Circle (121) on Reply Card

#### Monitor FM tuner

Studer ReVox America introduced the B760 digital frequency synthesizer FM stereo broadcast monitor tuner with a 15-station programmable memory. Using a micro-processor for all digital tuning and memory functions, the B760 is step tunable in increments of 25 kHz over the frequency band from 87 to 108 MHz. A quartz-reference digital frequency synthesizer accurate to within 50 ppm virtually eliminates drift.

Front-end features include two broadband RF stages followed by six tuned filters and a symmetrical push-pull mixer. Eighteen varicap

*continued on page 76*

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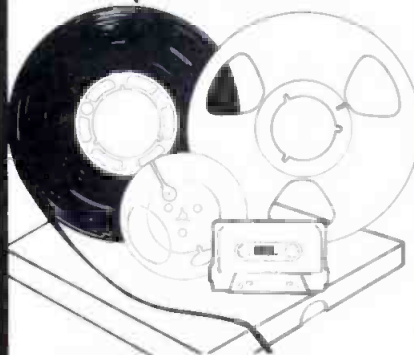


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## new products

continued from page 75

diodes are used to provide a healthy overload margin for distortion-free performance in high signal strength areas. The IF section uses a phase linear toroid filter for long-term stability without the necessity for periodic alignments.

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### Transmitters

McMartin Industries high-powered mobile and/or fixed versions of the RPU-1150 and RPU-1430 provide broadcast-quality transmitters for the newly revised bands for remote pickup units. The solid-state transmitters feature high VSWR and thermal overload protection.

Each unit provides talkover line input capability and function, with a compressor limiter on both line and microphone inputs. Dual frequency operation with switch selectable channel elements are controlled from the front panel. A front panel multimeter is provided to indicate modulation; forward and reflected power; and voltage and current readings on the output power transistors.

Both units utilize harmonic and spurious suppression techniques that

attenuate all undesired signals below present FCC and international standards. The RPU-1150 and RPU-1430 remote broadcast transmitters incorporate the latest in FM solid-state technology and are designed for high audio-quality remote broadcast program origination.

The RPU-1150 operates in the band of 150 to 170 MHz with a continuous power output of 50 watts.

The RPU-1430 operates in a frequency band of 450 to 455 MHz with a continuous power output of 30 watts. The units, identical in size and appearance, use the same accessories except for antennas.

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### 9-inch color monitors

The PMT-9 series of 9-inch color monitors by Unimedia utilizes an in-line gun, self-converging picture tube with rare earth phosphors. Other features include pulse cross, A or B video selection, A plus B video selection, switchable sync and a professional blue set-up switch.

The PMT-9 monitor can be rack mounted in 8 3/4-inches vertical rack space side by side with a waveform monitor, audio amplifier, wide band monochrome monitor or another PMT-9-inch color monitor.

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### Cassette tapes

The Magnetic Tape Division of Fuji Photo Film USA is offering two newly-formulated cassette tapes, FX-I and FX-II.

The pure Ferrix formulation used in FX-I is a pure gamma hematite formulation with optimum particle size and density achieved through the processing of iron oxide.

The FX-II formulation is a Berthollide iron oxide compound (Beridox).

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**WANTED:** Recording gear of all ages and variety. Microphones, outboard gear, etc. Dan Alexander, 6026 Bernhard, Richmond, CA 94805, (415) 232-7933. 4-78-6t

**WANTED:** Pre-1926 radio equipment and tubes. August J. Link, Surcom Associates, 305 Wisconsin Ave., Oceanside, Ca. 92054, (714) 722-6162. 3-78-1f

**WANTED:** Good condition 1 KW and 5 KW AM transmitters for missionary radio station in Western Caroline Island of Palau. Reasonable price or tax deductible receipt for donation. Contact Butch McBride, Pacific Missionary Aviation, Box 224, Agana, Guam 95910. 8-78-2t

**WANTED:** A reliable combo-man. Heavy emphasis on engineering including routine maintenance on automation, FM transmitter and stereo and solve related problems. Contact Manager, WDBI-FM, Tawas City, Michigan. 7-78-2t

**USED CAROUSELS,** Audimax. WYXI, Athens, Tn. 745-1390. 8-78-1t

## EQUIPMENT FOR SALE

**28 FOOT CUSTOM TELEPRODUCTION VAN:** 2 camera, color broadcast standard, 20x1 lenses; mics, turntable, R/R and cart tape, 11-in. mixers; wave and V-scopes; SEG/chroma key; 1K page character generators; 3/4" decks, editor, TBC; all accessories included. Write Dept. 427, Broadcast Engineering, P.O. Box 12901, Overland Park, Kansas 66212. 8-78-2t

**FOR SALE:** 2-IVC Model 100 & 200 color cameras w/varitol lenses, Gibraltar crab dollies and cradle heads. Four IVC 1" recorders (Model 600 & 800). Thompson CSF Image Enhancer, Telemet Chroma Keyer, Ball Brothers special effects generator and miscellaneous television equipment. Complete IVC 200 telecine island with 16mm projector, dual slide unit and multiplex. Will sell entire lot or individually. Contact Pat Howley, Merrill Lynch, 165 Broadway, New York, NY 10080, (212) 766-4772. 8-78-1t

**DATATRON 5050 EDITOR** modified for 3 VTR's. Ideal way to break into time code editing. (216) 822-3770. 4-78-1f

**RCA VTY MODIFICATIONS KITS** for TR4/22/50/60/61/70. Splicer (single-frame), TEP Interface, Time Code Edit Interface Kit, Audio Splice Timing Mod (Audio Insert Editor), Wideband Audio Amplifiers, most mod kits, some modules available. LAWHED, LTD., 388 Reed Road, Broomall, Pa. 19008, (215) 543-7600. 4-78-1f

**LIGHT PEN** Tektronix 4501 scan converter and homemade interface. (216) 822-3770. 4-78-1f

**770 FT. & 550 FT.** of 3-1/8" cablewave air heliex with two terminators, 100 K.W. capacity, excellent condition, used six months. (404) 687-5825, Jack Price, Columbus, Georgia. 8-78-1t

**HOUSTON FEARLESS MINI** Color Film Processor. Mini-TV PAC silver recovery, bleach regeneration unit with replenishing and mixing tanks, \$2,500.00, complete. Clyde A. Parker, WOKR, 4225 W. Henrietta Rd., Rochester, N.Y. 14623. 8-78-1t

**AMPEX TBC-793.** Includes ALL options. Factory quality control. Brand New. \$2,500.00. Dave Castellano (209) 957-1761. 7-78-2t

**USED TAPE CARTRIDGES,** 50 for \$35.00, 100 for \$50.00, plus freight. Write for list. CART MART, P.O. BOX 3066, FORT WORTH, TX. 76105. 7-78-3t

**SPINDLER-SAUPEE** 35mm Dual Drum Slide Projector, Model 32 with 9" F-5 Lens. Dave Castellano (209) 957-1761. 7-78-2t

**HAVE AMPEX AG-440, Revox A77.** Will trade for large quantities of old or new LP records. Thomas Robinson, P.O. Box 40632, Portland, OR 97240. (503) 224-2732, keep trying. 8-78-1t

**BEST OFFER:** Collins FM1000B 1 kw FM transmitter. Operational, sold as is. 301-934-4612. 8-78-1t

**5 KW TRANSMITTER—Gates BC5A** now in use with many spare parts. Currently on 620 KHz. Transmitter in good condition and available within three months. Contact Howard M. Ginsberg, C.E., WVMT, Box 12, Colchester, Vermont, 05446, or 802-655-1620. 8-78-2t

**TV TRANSMITTER AND FILTERPLEXER:** RCA TT25 BHLF, complete with spares. Excellent condition, in service. Available end of year. T. Bradford, 803-799-1010. 8-78-1t

**GENERATOR:** Cat. D326, 100 KW, 120/208v, 1800 hours, excellent condition, right price. In service, available October. T. Bradford, 803-799-1010, Columbia, S.C. 8-78-1t

**GE 4TT55 TV XMTR ON CH 22, LAST ONE BUILT.** COMPLETE SYSTEM AVAILABLE. D. Zulll (213) 466-5441. 8-78-1t

**EASTMAN KODAK—285** 16mm film projector. Ampex—VR1200B Quad Videotape Recorder. Fernseh—KCN Portable Camera, UNITEL PRODUCTION SERVICES, New York, NY, 212/489-8840. 8-78-1t

**800 FEET 1-5/8" BRAND NEW CABLEWAVE** Foam low VSWR Wellflex Transmission line with connectors. Best offer over \$4,000. H. M. HOLZBERG ASSOC., P.O. BOX 322, Totowa, N.J. 07511 or 201-256-0455. 8-78-1t

## EQUIPMENT FOR SALE (CONT.)

**BROADCAST CRYSTALS** for AM, FM or TV transmitters, frequency change, repair or replacement of oven types. Also vacuum types for RCA, Gates, Collins, etc. transmitters. Quality products, reasonable prices and better delivery! Don't be without a spare crystal. Frequency change and service for AM and FM monitors. Over 30 years in the business. Eldson Electronic Co., Box 96, Temple, Texas 76501. Phone (817) 773-3901. 12-74-1f

**ASACA—5 Cameras—4 ACC 7000, 1 ACC 1000** for sale. Used for demonstration only, value over \$150,000. Best cash offer. Art Florman, F&B/CECO, 7051 Santa Monica Blvd., Hollywood, Ca. 90038, or call (213) 466-9361. 8-78-6t

**BROADCAST AND STUDIO EQUIPMENT.** New and used. Cart and reel recorders, consoles, limiters, monitors, mic's, turntables, preamps, speakers, racks, furniture, reconditioning services, parts (including PT6). Authorized Spotmaster distributors. Contact us for best prices and trade-in deals. AUTODYNE, P.O. Box 13036, Orlando, Fla. 32809. (305) 855-6868. 9-77-1f

**USED TV BROADCASTING EQUIPMENT FOR SALE:** TV Transmitter System consisting of the following: General Electric 4TT10A1 Visual & Aural Transmitter; Standard Electric AL634 30 KW Amplifier; Standard Electric TF813 Dummy Load; Standard Electric Visual & Aural Harmonic Filters; Standard Electric Diplexer; Ward Electronics TA-860 Color Phase Equalizer and video low pass filter system; Spare plate transformer for Standard TF813 Amp.; R.C.A. BW5 sideband response analyzer; 1 R.C.A. Channel 5 1 KW filterplexer. For further information or details please contact: Mr. Rod Reld, Chief Engineer, CKVR CHANNEL 3 LIMITED, Box 519, BARRIE, Ontario, L4M 4T9, (705) 726-9711 or Toronto Line 364-8819. 7-78-2t

**FOR SALE BY THE UNIVERSITY OF ALABAMA** IN BIRMINGHAM, BIRMINGHAM, ALABAMA. COMPLETE THREE CAMERA MONOCHROME TELEVISION PRODUCTION SYSTEM. FOR COMPLETE DETAILS CALL 205-934-5230. 8-78-1t

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**AMECO MODULATORS,** Dynair Mini-cha's & 625 line sync. gen. Alaun Eng., Box 1088, Lacadana, Ca. 91011, 213-957-0618. 8-78-1t

**IMPRESS YOUR MANAGER—Save money** on all your broadcast needs. Call collect, Val-tronics, Inc., 717-655-5937. 8-78-1t

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**STUDIO ENGINEER** wanted for sunny South Florida television station. First phone required. Experienced in videotape camera control and switching. Send resume to Personnel Department, WPEC, Fairfield Drive, West Palm Beach, FL 33407. (305) 848-7211. 8p78-11

**CHIEF ENGINEER NEEDED** for U.H.F. T.V. Station in the South. Send resume to Broadcast Engineering, Dept. 423, P.O. Box 12901, Overland Park, KS 66212. 8-78-11

**ASSISTANT CHIEF ENGINEER** for KMST-TV, CBS in Monterey, California. 1st phone, strong electronics background, and transmitter experience required. Great chance for ambitious engineer who has a good start in Broadcasting to continue on in all phases of a TV operation and to do it on beautiful Monterey Peninsula. Contact Robert Hensky, Chief Engineer, 46 Garden Court, Monterey, CA 93940. (408) 649-0460. EOE. 8-78-11

**REPRESENTATIVES WANTED** for high quality line of Television Test Equipment. Name manufacturer looking for representation throughout U.S. on an area basis. Range of equipment sells to broadcasters as well as video equipment and transmitter manufacturers. Send inquiries to Department 425, Broadcast Engineering, P.O. Box 12901, Overland Park, Kansas 66212. 8-78-21

**WANTED:** First phone with fair amount of technical ability; some announcing. Salary open. Call 916-233-2713. 8-78-11

**TELEVISION MAINTENANCE SPECIALISTS.** Are you a specialist in the maintenance of quad video tape recorders?, or studio and portable camera systems?, or computerized editing systems? A large southeastern TV production center has positions available for highly qualified and experienced technicians specializing in any of these areas. Paid insurance, 3 weeks paid vacation, 12 holidays per year. Send complete resume to Box 426, Broadcast Engineering, P.O. Box 12901, Overland Park, KS 66212. An Equal Opportunity Employer. 8-78-21

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MUST HAVE EXPERIENCE ON 50 OR MORE KW. AM TRANSMITTERS. STL. STUDIO EQUIPMENT. QUALITY MINDED WILL SUPERVISE MAINTENANCE TECHNICIANS OF 100 KW AM STATION LOCATED IN CARACAS, VENEZUELA. SEND RESUME TO SEMACK TRADING CO., 120 WALL STREET, NEW YORK, N.Y. 10005, At: JS.

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### CHIEF ENGINEER

Top 35 TV market in Southeast. Must have EE degree and television engineering management experience. Television station is also a major production house for nationally syndicated programs. Excellent opportunity to advance from smaller market or number 2 position. Send resume to Dept. 424, Broadcast Engineering, P.O. Box 12901, Overland Park, KS 66212. Equal Opportunity Employer, M/F. 8-78-11

**ENGINEER**—Must have 1st Class license. Two years experience operating quad VTRs and TV equipment. Two years electronic training. Salary negotiable. Contact Jim Masten, Net Television, Inc., 2715 Packard, Ann Arbor, MI. 48104, 313-971-3600. EOE/MF. 8-78-11

**VIDEO MAINTENANCE ENGINEER.** Exp. on cameras, switchers, quad VTR's, etc. Very busy & exciting production house. Full benefits. Send resume and salary requirements to: Bob Churchill, Telemation Productions, Inc., 3200 W. West Lake Ave., Glenview, IL 60025. 8-78-11

**OPERATING AND MAINTENANCE ENGINEER** with First Class FCC License. Immediate openings, ideal community, located in Alaska. Send resume and salary requirements to: George Howard, Chief Engineer, Northern Television, Inc. Box 2200, Anchorage, Alaska 99510. An EOE. 7-78-21

**KCET-TV** requires Broadcast Maintenance Engineer with 5 years experience (2 years school can apply towards experience); First Class FCC license. 4 day work week; liberal company benefits. Submit resume and salary history to KCET Personnel, 4401 Sunset Boulevard, Los Angeles 90027. Women, minorities, handicapped, disabled veterans are encouraged to apply. 8-78-11

**VIDEO TECHNICIAN/SHOP manager** needed at large nonprofit media center. Extensive experience with maintenance and repair of 1/2" VTRs, 3/4" VCRs, cameras and editing systems, also, experience supervising shop functions and personnel. Contact: Suzanne Langle, Young Filmmakers/Video Arts, 4 Rivington St., New York, NY 10002. 8-78-21

**TV CHIEF ENGINEER,** position immediately available in New York City. Solid experience W/AE 600's, Pc 70's, RCA Computer Studio Facility. Solid experience required. Salary open. North American Video, 212-369-2552 or B. Grodin, home 914-238-9229. 8-78-21

**VIDEO TAPE MAINTENANCE ENGINEER.** Large, medically oriented corporation based in Nashville needs highly qualified videotape maintenance engineer for new, color teleproduction facility. Requirements include five to eight years broadcast television experience, FCC 1st Class License, experience with VTRs, color cameras, video terminal equipment, audio equipment, and digital control circuitry. Production experience is a plus. Salary in high teens. Please submit resume to: Tom Bain, Hospital Corporation of America, One Park Plaza, Nashville, TN. 37203. Equal Opportunity Employer. 8-78-11

**TELEVISION—CCTV Video Maintenance Technicians.** Full Benefits. Greater New York, Suffolk County or New Jersey Area. Send resume to: VPC, P.O. Box 268, New Hyde Park, N.Y. 11040. 6-77-11

**MAINTENANCE ENGINEER WANTED** for California major market VHF located in one of nation's fastest growing areas. Requirements include minimum 3 years maintenance experience with strong background in studio maintenance. FCC First Class License. Electronics school graduate or equivalent technical education, including digital technology. Send resume to Personnel Director, KNTV, 645 Park Avenue, San Jose, Calif. 95110. AEOE (M/F). 8-78-11

**EXPERIENCED MAINTENANCE ENGINEER** wanted for a full service production company. Salary commensurate with experience. Contact Tom Werner at One Pass Video, 900 Third Street, San Francisco, California 94107, (415) 777-5777. 8-78-11

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1	13	25	37	49	61	73	85	97	109	121	133	145	157	169	181	193	205	217	229	241	253	265	277	289	301	313
2	14	26	38	50	62	74	86	98	110	122	134	146	158	170	182	194	206	218	230	242	254	266	278	290	302	314
3	15	27	39	51	63	75	87	99	111	123	135	147	159	171	183	195	207	219	231	243	255	267	279	291	303	315
4	16	28	40	52	64	76	88	100	112	124	136	148	160	172	184	196	208	220	232	244	256	268	280	292	304	316
5	17	29	41	53	65	77	89	101	113	125	137	149	161	173	185	197	209	221	233	245	257	269	281	293	305	317
6	18	30	42	54	66	78	90	102	114	126	138	150	162	174	186	198	210	222	234	246	258	270	282	294	306	318
7	19	31	43	55	67	79	91	103	115	127	139	151	163	175	187	199	211	223	235	247	259	271	283	295	307	319
8	20	32	44	56	68	80	92	104	116	128	140	152	164	176	188	200	212	224	236	248	260	272	284	296	308	320
9	21	33	45	57	69	81	93	105	117	129	141	153	165	177	189	201	213	225	237	249	261	273	285	297	309	321
10	22	34	46	58	70	82	94	106	118	130	142	154	166	178	190	202	214	226	238	250	262	274	286	298	310	322
11	23	35	47	59	71	83	95	107	119	131	143	155	167	179	191	203	215	227	239	251	263	275	287	299	311	323
12	24	36	48	60	72	84	96	108	120	132	144	156	168	180	192	204	216	228	240	252	264	276	288	300	312	324

Please check every section which applies to you.

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- A. AM Radio Station
- B. FM Radio Station
- C. TV Station
- D. ETV Station
- E. CATV Facility
- F. CCTV Facility
- G. Consulting Engineer
- H. Educational Radio
- I. Recording Studio
- J. Distributor
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1	13	25	37	49	61	73	85	97	109	121	133	145	157	169	181	193	205	217	229	241	253	265	277	289	301	313
2	14	26	38	50	62	74	86	98	110	122	134	146	158	170	182	194	206	218	230	242	254	266	278	290	302	314
3	15	27	39	51	63	75	87	99	111	123	135	147	159	171	183	195	207	219	231	243	255	267	279	291	303	315
4	16	28	40	52	64	76	88	100	112	124	136	148	160	172	184	196	208	220	232	244	256	268	280	292	304	316
5	17	29	41	53	65	77	89	101	113	125	137	149	161	173	185	197	209	221	233	245	257	269	281	293	305	317
6	18	30	42	54	66	78	90	102	114	126	138	150	162	174	186	198	210	222	234	246	258	270	282	294	306	318
7	19	31	43	55	67	79	91	103	115	127	139	151	163	175	187	199	211	223	235	247	259	271	283	295	307	319
8	20	32	44	56	68	80	92	104	116	128	140	152	164	176	188	200	212	224	236	248	260	272	284	296	308	320
9	21	33	45	57	69	81	93	105	117	129	141	153	165	177	189	201	213	225	237	249	261	273	285	297	309	321
10	22	34	46	58	70	82	94	106	118	130	142	154	166	178	190	202	214	226	238	250	262	274	286	298	310	322
11	23	35	47	59	71	83	95	107	119	131	143	155	167	179	191	203	215	227	239	251	263	275	287	299	311	323
12	24	36	48	60	72	84	96	108	120	132	144	156	168	180	192	204	216	228	240	252	264	276	288	300	312	324

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State \_\_\_\_\_ Zip \_\_\_\_\_ Phone ( ) \_\_\_\_\_

1	13	25	37	49	61	73	85	97	109	121	133	145	157	169	181	193	205	217	229	241	253	265	277	289	301	313
2	14	26	38	50	62	74	86	98	110	122	134	146	158	170	182	194	206	218	230	242	254	266	278	290	302	314
3	15	27	39	51	63	75	87	99	111	123	135	147	159	171	183	195	207	219	231	243	255	267	279	291	303	315
4	16	28	40	52	64	76	88	100	112	124	136	148	160	172	184	196	208	220	232	244	256	268	280	292	304	316
5	17	29	41	53	65	77	89	101	113	125	137	149	161	173	185	197	209	221	233	245	257	269	281	293	305	317
6	18	30	42	54	66	78	90	102	114	126	138	150	162	174	186	198	210	222	234	246	258	270	282	294	306	318
7	19	31	43	55	67	79	91	103	115	127	139	151	163	175	187	199	211	223	235	247	259	271	283	295	307	319
8	20	32	44	56	68	80	92	104	116	128	140	152	164	176	188	200	212	224	236	248	260	272	284	296	308	320
9	21	33	45	57	69	81	93	105	117	129	141	153	165	177	189	201	213	225	237	249	261	273	285	297	309	321
10	22	34	46	58	70	82	94	106	118	130	142	154	166	178	190	202	214	226	238	250	262	274	286	298	310	322
11	23	35	47	59	71	83	95	107	119	131	143	155	167	179	191	203	215	227	239	251	263	275	287	299	311	323
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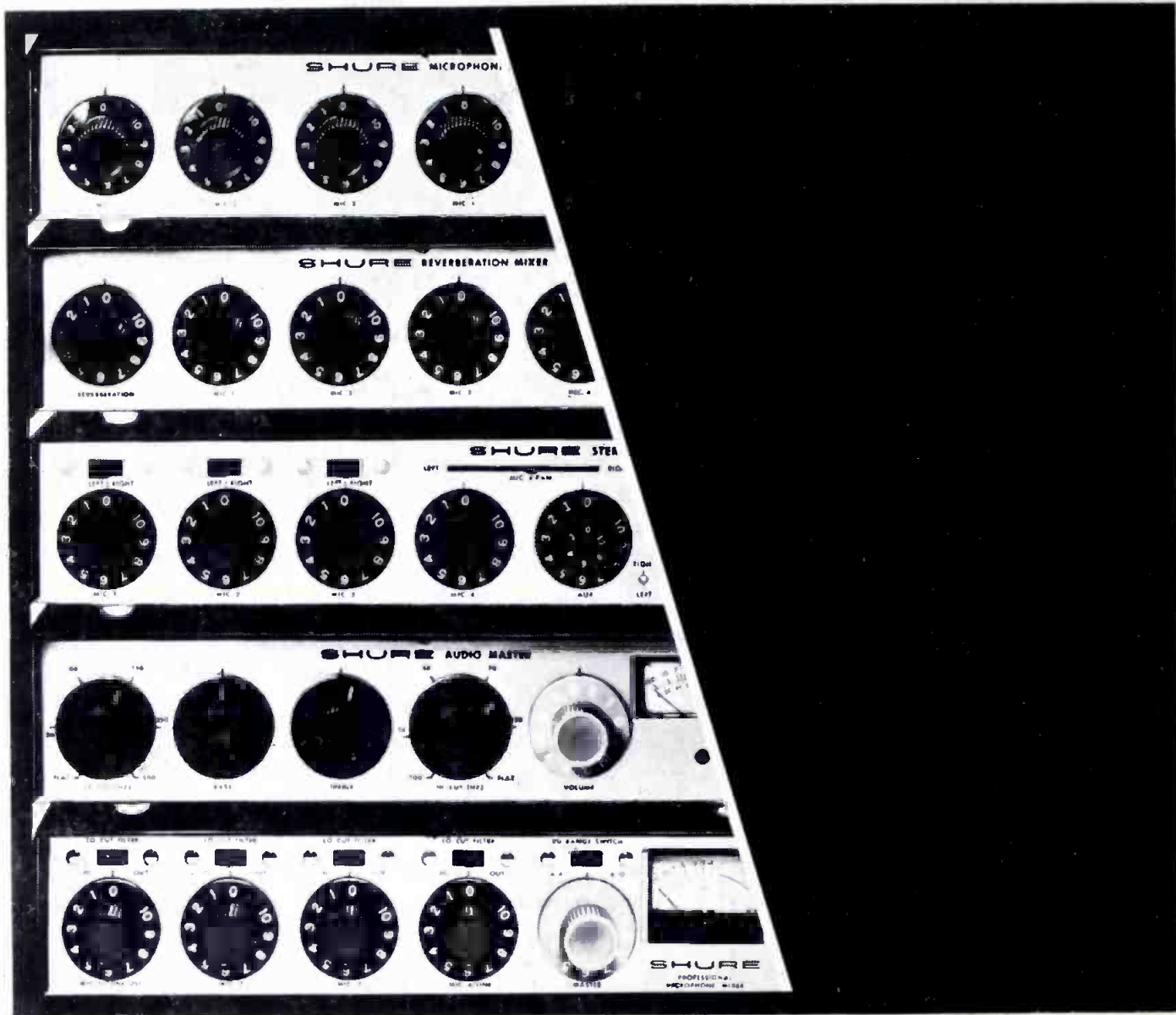
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