FEBRUARY 1978

BM/E

BROADCAST MANAGEMENT/ENGINEERING

DIGITAL TECHNOLOGY FOR BROADCASTERS - PART IV.

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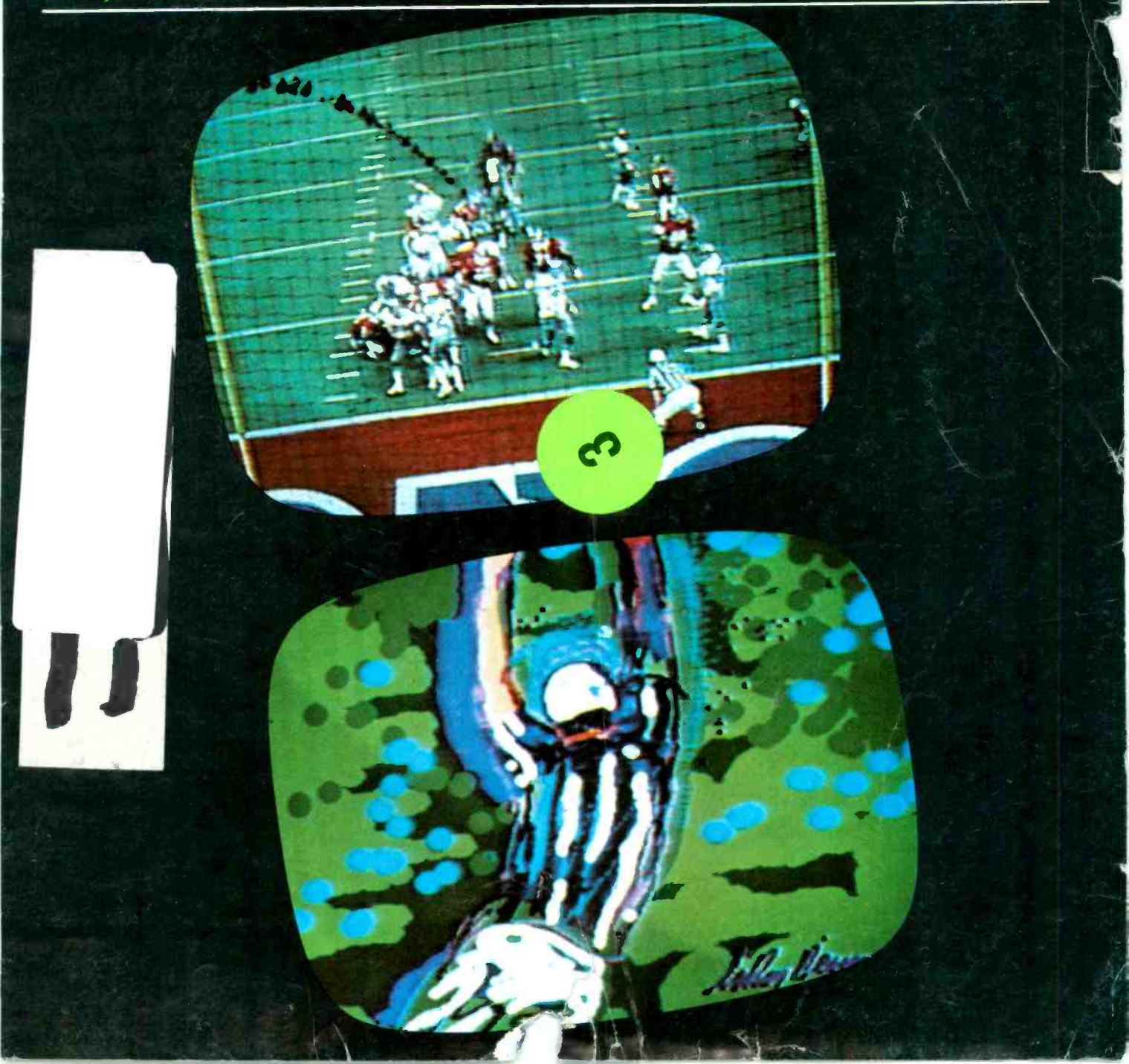

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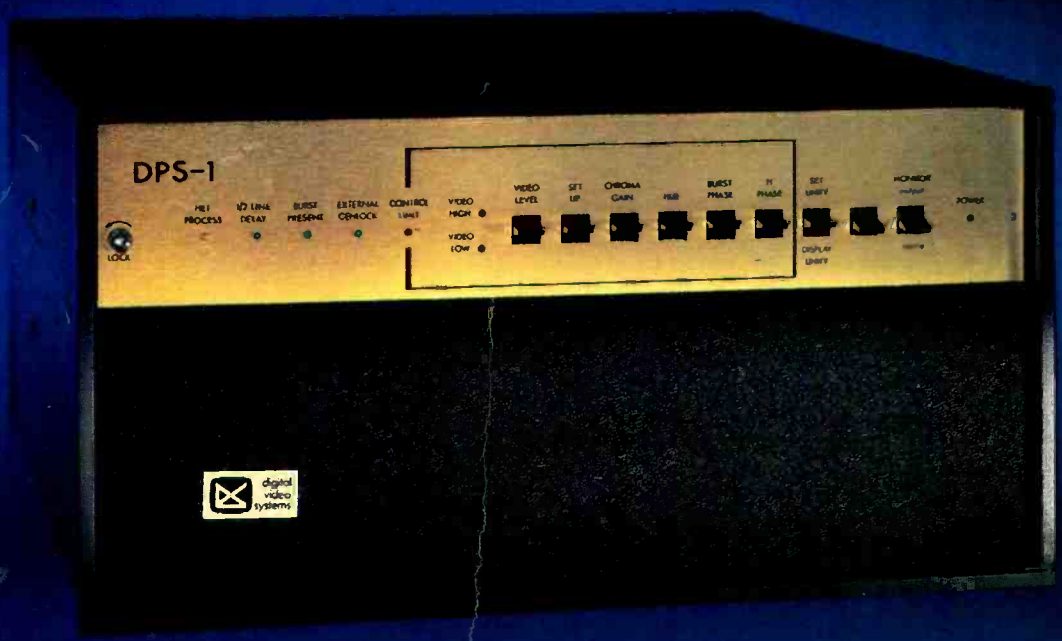
The DPS-1 by Digital Video Systems.



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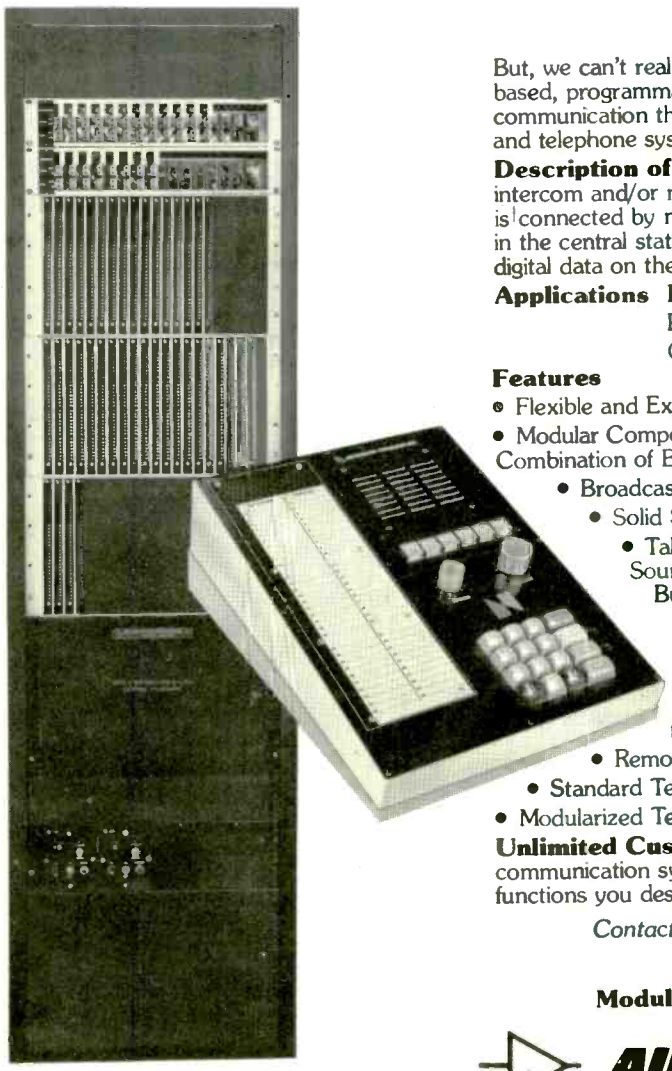

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Applications

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On-Air	Audio Routing - Monitor, Cueing, Programming

Features

- Flexible and Expandable. Requires only 4 Wire Cable
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- Broadcast Quality Audio
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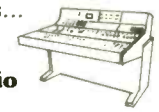

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This month's cover shows the results of CBS Action Track™ (top) and Leroy Nieman's work on Ampex's AVA during Super Bowl XII. Both devices are examples of the leading edge of digital technology.

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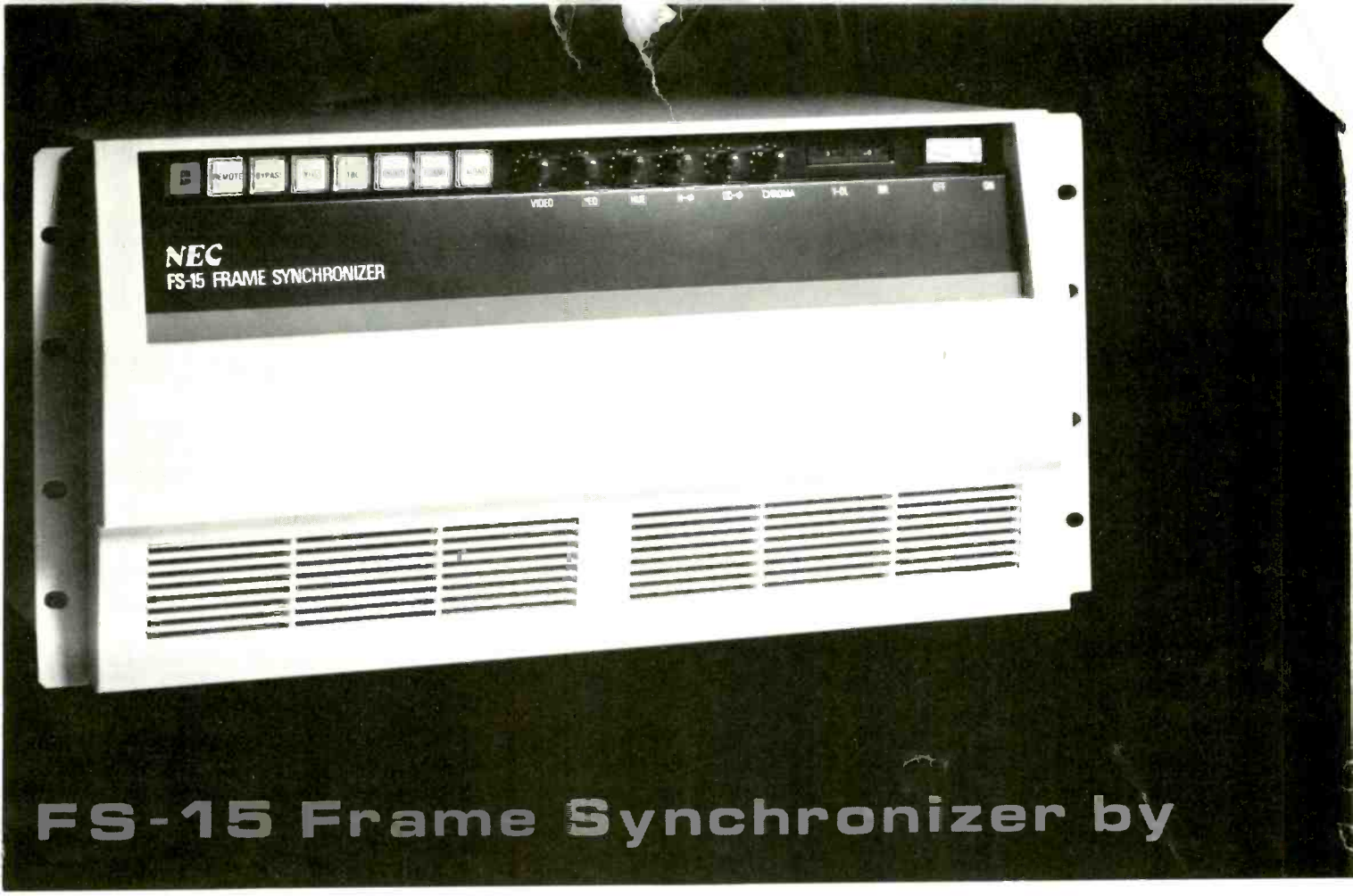

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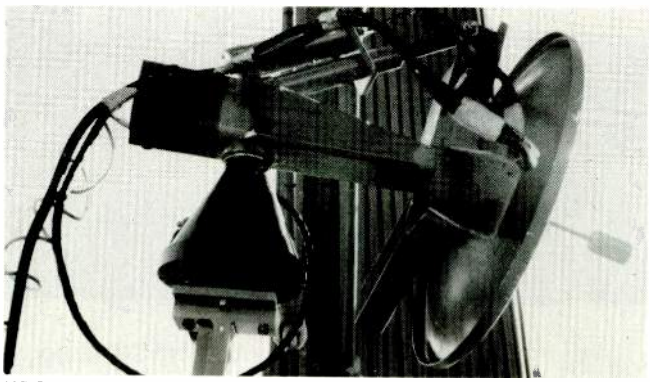
BROADCAST INDUSTRY NEWS

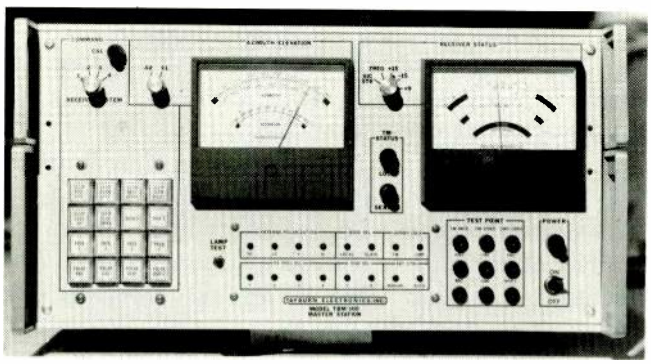
NAB Favors SBA Proposal To Allow For Loans To Broadcasters

The National Association of Broadcasters supports the SBA's proposed amendment that would lift restrictions prohibiting financial aid to broadcasters. NAB said it would help broadcasters in general "and aid a heretofore underrepresented segment of society — minorities — who desire to acquire a broadcasting station."

However, NAB "strongly opposes" the SBA concept that the Federal Communications Commission issue a license or certificate as a prerequisite to the issuance of a loan commitment. This could cause difficulties for the very people the amendment is designed to help, since many "would be seeking SBA funding prior to entering a contract with the owner of a broadcast station."



KRON's Mt. Sutro tower installation of Tayburn "steerable dish."



Master station controls four receive points individually.

KRON-TV News Ratings Up Dramatically

With "Regional Bureau" concept November ratings showed that KRON-TV's news program at 11 p.m. had rocketed to second place in San Francisco. The 11 O'Clock news had been dead last in the ratings as recently as this past summer.

This spectacular improvement, in which KRON picked up 14,000 new men and women viewers in the 18 to 49 age bracket, can be attributed largely to its use of a "regional news bureau concept" which was described in last month's BM/E special ENG report.

Though just one of the three planned regional bureaus is fully operational at this time, the others should go live this year. Each bureau is linked to KRON by steerable microwave dishes. Due to a garbled telephone transmission when BM/E interviewed KRON personnel we incorrectly identified the manufacturer of the antennas and the design principle used. Correction: The name of the firm that built the antennas is Tayburn Electronic of Carlsbad, Calif., and the design principle used was "cosecant." Also KRON's chief engineer is Larry Pozzi, not "Posey." Full and correct details on the KRON story will follow.

NAB Urges Rejection Of "Performance Right" Study

The NAB thinks that a study prepared for the Copyright Office covering the establishment of a performance right in sound recordings "reaches unsound and unsupported conclusions, particularly with regard to the economic impact of the performance right on the radio broadcast industry." NAB urged the Copyright Office not to "arbitrarily and capriciously" accept the conclusions as fact when preparing its report to Congress. The study is a narrowly drawn one that does not even analyze all the possible consequences, ignores numerous valid explanations for how stations can remain on air despite consistent reported losses (the study concludes that "hidden profits" may be the reason), and reaches conclusions not supported by experience or by data cited in the study, according to NAB. It is difficult to respond to the study, NAB said, because the Association has no access to much of the data utilized in the study, and because the time allowed for analysis of and response to the study is inadequate.

Communications Subcommittee Probes Ratings Services And Advertising Practices

The House Communications Subcommittee began looking into broadcast audience measurement services and their relationship to advertising practices at a panel hearing in mid-December. According to Subcommittee chairman Lionel Van Deerlin (D-Calif.), "The audience ratings can mean life or death for broadcasters. They determine what the American public sees and hears. It is clearly in the public interest to determine whether they accurately reflect the nature of the markets they purport to measure." This session was to be the last in a series of fact-finding panel sessions in which the Subcommittee has

continued on page 8

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explored possible revision of the 1934 Communications Act.

Radio 1976: For The First Time, Over Two Billion

In December the FCC released the data from financial reports by radio broadcasters covering the year 1976, and they show the industry going over the two-billion-dollar mark for the first time in its history. The figure is $2.02 billion, up 17.1 percent from 1975. Pre-tax profits were up 96.9 percent to $178.6 million. Network advertising (before commissions), was a small part of total sales at $92.2 million. This was 26.8 percent over 1975, but the networks still lost about $5 million. However, the networks 0 and 0 stations made about $15 million, to put the nets in the black. The major sections of the radio take were about $490 million, for national and regional spot advertising, and about $1.63 billion for local advertising. This emphasizes the new character of radio broadcasting of the past decade or so, the market it has carved out to flourish alongside television.

RCA To Market One-Inch Video Tape Recorders Produced By Sony Corp.

RCA Broadcast Systems will market worldwide Sony Corporation's line of TV broadcast one-inch non-segmented helical-scan tape recorders. The new products include the BVH-1000 studio model, the BVH-500 portable recorder, and accessories such as the BVT-1000 digital time base corrector. They will conform to the recording format which is being established by the Society of Motion Picture and Television Engineers for non-segmented helical scan recorders, and will be available in NTSC, PAL and SECAM models.

The recorders will be marketed under the RCA label, said J.E. Hill, division vice president and general manager, RCA Broadcast Systems. He added that they will receive extensive product support from RCA, including complete spare parts availability, field engineering service, and customer training seminars on the systems. RCA will demonstrate these recording systems at the 1978 NAB convention in April, with deliveries commencing soon after.

Tests For Channel Separation Worry NAB

The National Association of Broadcasters has expressed concern over tests conducted by the FCC December 13-14 to determine the extent of potential interference to AM stations when the channel separation has been reduced from 10 to 9 kHz. The NAB believes that two nights of testing are not enough to lead to significant conclusions, and furthermore, it said that tampering with channel space would lead to interference, adverse effects on directional antennas, AM stereo and receiver design. The purchase of new equipment and conversion of existing equipment necessitated by such a change may be too costly for marginal radio licensees to undertake, says the NAB. Requests for additional AM facilities, NAB states, can be met by expanding the present AM broadcast band.

NAB Position On Quadraphonic Broadcasting

In comments filed with the FCC on quadraphonic broadcasting, the NAB has also opposed any possible reduction in FM channel spacing. The NAB has urged the FCC to make a quick decision on a system of quadraphonic broadcast-

continued on page 10

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FRAME SYNCHRONIZER
Locks all remote signals to house sync. Network, ENG, Remote pick-ups, and satellite signals will mix with local signals with no distrubance.

Sampling video at 4 times subcarrier for superior technical standard and picture quality.

TIME BASE CORRECTOR
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Will act like having another camera in the studio for still shots. Will freeze any full frame picture. Will retain last frame of interrupted incoming signal automatically until picture is restored.

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No matter how a slide or scene comes in, you can compress and/or change its aspect ratio as you wish, down to one picture element, and position it anywhere on the screen.

ELECTRONIC ZOOM
See or read information not possible without zoom.

In sports, determine if ball is good, simply freeze and enlarge. Call foul plays more accurately. Zoom capability on a remote or recorded scene. Zoom while chroma key tracking.

VERY SPECIAL EFFECTS
With 2 channels or more, open new unlimited vistas of movie-type effects.

GENERATE your own effects with Vital's pre-programmed microprocessor.

Record 4 pictures on one recorder and play back any one full screen with no perceptible degradation.

Observe or monitor 4 TV channels on one receiver; listen to any one audio.

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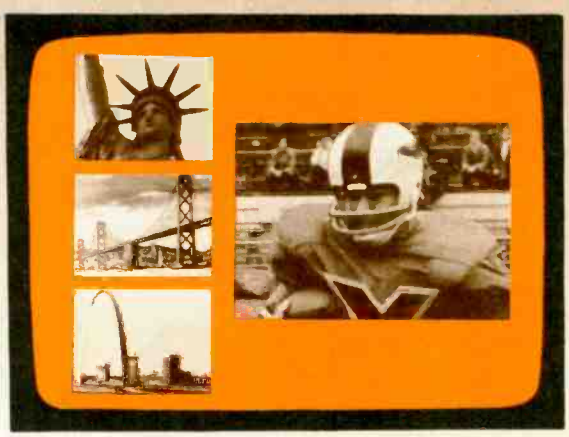

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sees . . ." Pointing out that inauguration of quadraphonic FM, as well as AM stereo, will put increasing demand on already scarce STL (studio transmitter link) channels, the NAB proposed that additional spectrum space be allocated for broadcast STL usage.

Projected $200 Million Market For Optical Communications By 1982

Practical offshoots in optical communications, "now promise to become an economic reality by the early 1980s," according to a study by Frost & Sullivan, Inc., in New York City. The study, entitled "Optical Communications Components and Systems Markets," projects that the overall market at $50 million in 1977 will move up to $200 million by 1982 and exceed $600 million by 1987. The commercial telecommunications market, to be $350 million by 1987, is being eyed by the many new companies in the field, but the giant industrial companies, like AT&T, IT&T, GT&E, will supply much of their own needs.

According to the study, computer applications promise great entrepreneurial opportunity, as the market grows from $500,000 in 1977 to $4 million in 1978, $20 million in 1982, and $75 million in 1987.

In atmospheric systems, the military market will always dominate, says the study, with a $60 million market by 1987. The commercial market, mainly in security systems, will increase from about $3 million annually to $15 million ten years from now.

The Frost & Sullivan study warns, however, that the "rosy" projections are based on engineers resolving certain problems — such as adverse effects of moisture and temperature on some optical glasses over the long term, and the limited lifetime of injection lasers and other critical components.

Another important area to be resolved is that of product standards; many connector manufacturers won't commit themselves to producing optical connectors in a volume that is necessary to lower costs significantly.

Positive Findings On TV From Roper Survey

Public attitudes toward TV continue to be favorable, according to results of a survey by the Roper Organization, Inc. Television, which has led all other media on the question of where people get most of their news, continues to hold a 15 point lead over the second place medium. The survey also shows TV as maintaining its wide lead as the most believable medium. TV increasingly overshadows newspapers as a source for becoming acquainted with candidates for national office. Newspapers continue to lead TV in acquainting people with local candidates, though both are up as sources of information in this latest Roper study. "Talking to people" as a source of information on local candidates has been declining in recent years.

Television entertainment ranks fourth among seven listed causes of violence in young people (parents with both young and older children rank it fifth). While 39% evaluated violence

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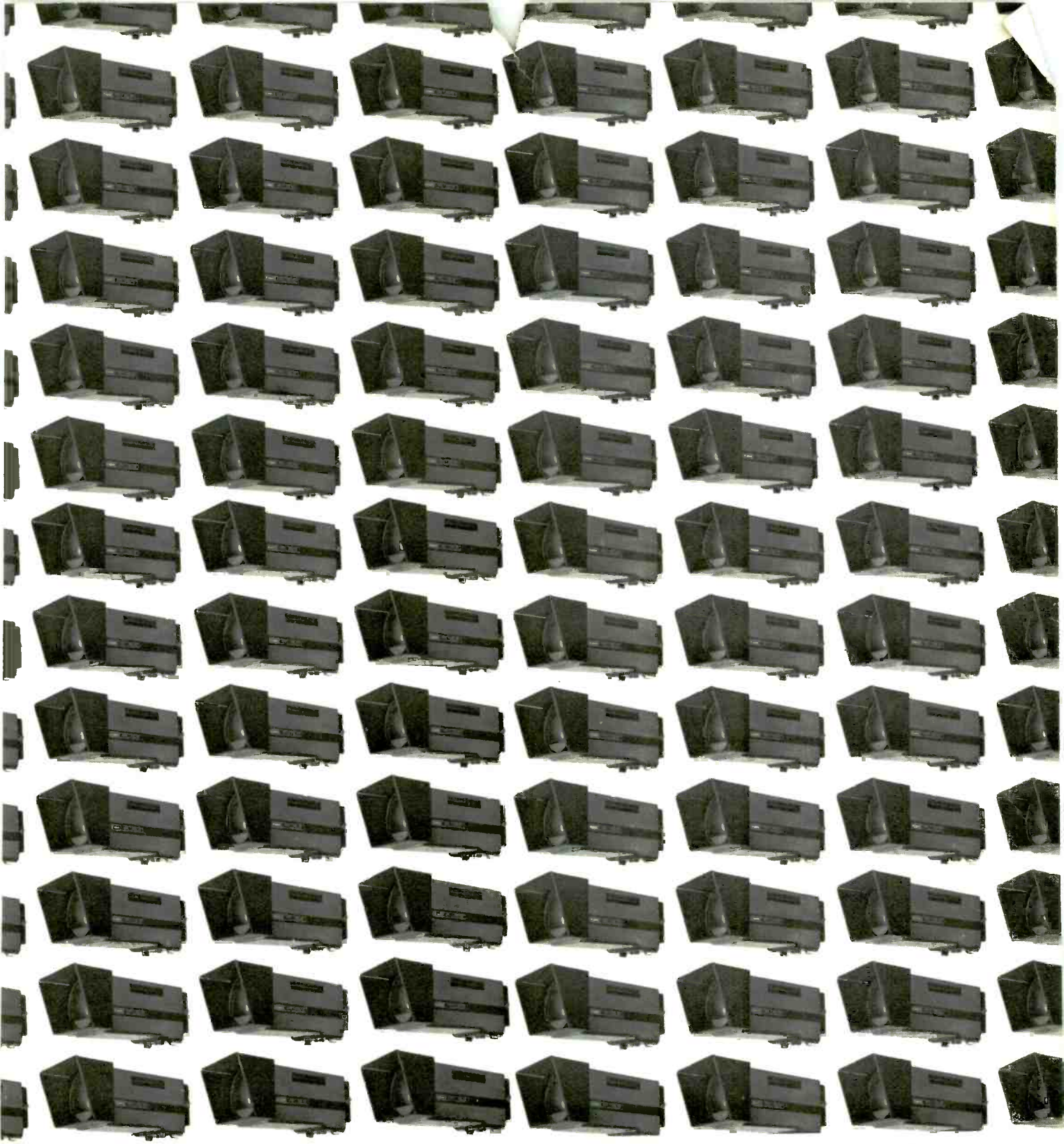

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on TV as a major cause, "not enough discipline at home" (79%), "broken homes" (45%), and "too much free time (43%) were more widely perceived than TV as a main cause of "some children being more aggressive and abusive than they should be."

The survey also indicated that women are not portrayed as "old-fashioned." Opinion was nearly evenly split on whether, however, they were portrayed as more liberated than they really are or portrayed realistically. Men are evenly divided on these two latter views, and women are slightly inclined to think that women are shown as more liberated than they are today (47% vs 43% saying that the portrayal is realistic).

A large majority is still shown to hold a favorable attitude toward the concept of commercially-sponsored television (74%) but the minority disagreeing with the concept shows an increase. Sixty-four percent of parents said that it is all right to have commercials in children's programs.

These findings represent the results of the Roper Survey of 1976. The organization has conducted similar surveys in 1959, 1963, 1968, and 1972.

NRBA Proposes Plan For Increasing Minority Ownership Of Broadcast Properties

In a meeting with House Communications Subcommittee chairman Lionel Van Deerlin (D-Calif.), the National Radio Broadcasters Association unveiled a proposal to encourage the development of minority broadcasting. The NRBA proposes that the Small Business Administration be authorized to make direct loans to prospective buyers of broadcast properties and that the Congress amend the Communications Act to provide for longer license terms, at least for radio properties. With such steps, the financial community would be assured of the government's interest in a stablized communications industry and thus would be more likely to provide the appropriate funding. For its own part of the plan, the NRBA has devised a Minority Ownership Aid Program that will provide guidance and informational services to prospective minority purchasers of broadcast properties. The NRBA asked that its proposal be viewed as an alternative to 45-day notice to sell proposal and NAB's tax certificate plan whereby a licensee who sells to a minority buyer would be exempt from

continued on page 16

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The new portable

HITACHI SK-80

The remarkable new SK-80 has three superior 2/3" Saticons at its heart, for unexcelled image and color fidelity. Hitachi's sophisticated electronics coupled with the high resolution capability of the Saticon set a new high level of performance for a portable EFP camera under the most demanding conditions.

Moreover, the SK-80 feels and handles like a true portable should. And its 2-hour battery belt with 1-hour charge time assures you of adequate power for continuous long-term shooting when you're on location. The standard C-mount and optional Arri adapters give you the added versatility of selecting the exact lens that fits your shooting requirements.

But performance is only half the SK-80 story. A special training tape on videocassette is available with complete camera set-up and maintenance instructions, to help you keep your SK-80 making its excellent pictures. Beyond this, our six Hitachi regional offices are all staffed with qualified engineers and fully stocked with parts. They stand ready to back up our vast national network of servicing dealers.

We urge you to check out the performance features of the SK-80, as well as its low price, before specifying any other camera. Arrange a demonstration with your local Hitachi dealer or call the Hitachi regional office nearest you.

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How to get TV station quality even if you're not a TV station.

Introducing the Panasonic AK-920.

There are many ways of getting TV station quality from a Plumbicon® color camera. You can either own a TV station. Own a lot of money. Or better yet, own Panasonic's new Plumbicon color camera, the AK-920.

Not only does it give you TV station quality in the studio, it gives you TV station quality almost everywhere else. That's because it's fully self-contained, with the YI/Q encoder and the RS-170 sync generator built into the camera head.

But perhaps the best part about the AK-920 is the technology that has been put into it. Like a new color-trap circuit in the encoder and level-dependent circuit for reduced color noise, which is particularly important under low-light conditions. And for excellent edge detail and high frequency response, there's an adjustable horizontal aperture circuit built into the camera head.

And since the AK-920 is a Plumbicon camera, you get performance that's hard to beat. Like low noise, low dark current and lag, high sensitivity, as well as the capability to reproduce high brightness details without burn-in or blooming.

The result of all this very impressive technology is equally impressive performance. Like horizontal resolution of more than 500 lines at center. A S/N ratio of 48 dB with recommended illumination of 150 footcandles at F/4. And a + 6 dB gain switch for minimum illumination of just 15 footcandles at F/1.8.

You also get precise stability of alignment as well as the reliability that you expect from Panasonic. Because the prismatic optical system, the three one-inch pickup tubes, and the deflection coils are mounted on an aluminum die-cast chassis.

Also included are removable camera head side panels for easy maintenance. A self-contained, multi-function viewfinder. Color bar generator. And focus-wobble and saw-tooth-generator test circuits. Plus some rather impressive options. Starting with the AK-9220 remote control unit. To a 10:1 zoom lens with built-in 1.67X and 2.5X lens extenders for versatility in location shooting. To a vertical aperture corrector, AK-9620. To the AK-9720 cable equalizer for the RBG signals.

There are also three different versions to choose from. The AK-920ST with studio-grade Plumbicon tubes. The AK-920IT with industrial grade Plumbicon tubes. And the AK-920 without tubes.

So before you buy any color camera, audition the AK-920. It's Panasonic's way of giving you TV station quality, even if you're not a TV station.

For more information, write Panasonic Company, Video Systems Division, One Panasonic Way, Secaucus, N.J. 07094

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capital gains taxes if he used the revenue to buy another broadcast facility within a specified time.

NAB Minority Task Force Aims For Doubling Minority Ownership In Three Years

The Minority Task Force of the National Association of Broadcasters is exploring ways to reach the goal of doubling the extent of minority ownership of broadcast stations during the next three years.

The Task Force has urged the FCC to expedite action on a request by the NAB that the commission issue a tax certificate when a broadcast property is transferred to a buyer which is minority owned or controlled.

Members of the Task Force are: chairman Donald Thurston, president, Berkshire Broadcasting, North Adams, Mass.; Ragan Henry, president, Broadcast Enterprise Network, Philadelphia, Penna.; Benjamin Hooks, executive director, National Association for the Advancement of Colored People, New York City; Eugene Jackson, president, National Black Network, New York City; William Leonard, vice president, CBS, Inc., Washington, D.C.; Donald McGannon, chairman of the board and president, Westinghouse Broadcasting Co., New York City; Lloyd Morrisett, President, The John & Mary Markle Foundation, New York City; Thomas Murphy, chairman of the board, Capital Cities Communications, Inc., New York City; William Kennedy III, president of North Carolina Mutual Life Insurance, Durham, N.C.; Edward R. Lucero, president of Colorado Equity Capital Corp., and Minority Enterprise Small Business Investment Corp., Denver; and Vincent Wasilewski, president, NAB, Washington, D.C.

'Immediate Refund' Of Illegal Fees Demanded

Reminding the FCC that the U.S. Court of Appeals struck down the fee schedules established by the FCC in late 1976, the National Association of Broadcasters has asked the Commission for an "immediate refund of all fees illegally assessed to broadcast licenses." In a letter to chairman Charles D. Ferris, NAB president Vincent T. Wasilewski noted that "the government has been the beneficiary of millions of dollars in interest garnered from the fees illegally collected under the 1970 and 1975 fee schedules," and that "some of the fee moneys have been wrongfully held by the FCC for as long as seven years . . ."

BBC Transmits Color TV Over Optical Fiber Loop

The British Broadcasting Company, in collaboration with Standard Telephones and Cables, has completed successfully a series of color TV test transmissions over a 12-mile optical fiber loop. The system was manufactured and installed in normal Post Office cable ducts by STC between the towns of Hitchin and Stevenage, 20 miles north of London. The link used five repeaters spaced at two mile intervals. No basic problems were identified in the use of fiber optics as a medium for transmitting digital TV. After analysis, the test results will provide guidance for specification and design of production equipment.

NAB Asks For Less Demanding Copyright Requirements

The National Association of Broadcasters has asked the Copyright Office to

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consider less demanding requirements for recorded broadcast programs produced strictly for broadcast use rather than commercial distribution. In its comments, NAB said the bulk of affected programming would be locally produced news and public affairs programs. Recording extra copies of these for deposit and registration purposes "would be costly in terms of labor, tape and equipment diverted from other uses," NAB said.

This burden, NAB also said, would discourage stations from authorizing educational uses of broadcast programming. Some less burdensome alternatives, said NAB, would be: treating broadcast programs, which would be classified as "published" only as a result of authorized off-air recording for educational uses, as "unpublished," thereby not requiring submission of deposit copies for all copies; registration of regularly broadcast programs as a single work; monthly deposit of a limited number of sample programs of a program broadcast on a daily or other regular basis.

Radio Listeners Like News Delivered In Lively Manner

According to an Ohio State University School of Journalism study, radio listeners are more likely to remember the content of a news broadcast when the announcers project their personality into their voices and present the news in a friendly, expressive manner — but without the personal exchange of "happy talk" format and one with a minimum of that type of delivery.

Researchers also found no significant difference in listeners' retention of content for newscasts in which key information was repeated over those in which there was no repetition.

Cable-vs-Broadcasting Inquiry Extended

As reported in this department in August, the FCC in June opened an inquiry to collect data on all aspects of the effects of cable TV on broadcasting, asking every conceivable question on the factors in cable growth, the extent of broadcast audience change on broadcast revenue, and many others. Some of the questions seem to demand economic research of the most massive kind. The original data for replies was December 1, 1977. But, as might have been expected with such a weighty topic, the date has been advanced to March 15th, with replies May 15th. The importance of the inquiry for cable broadcasting regulation

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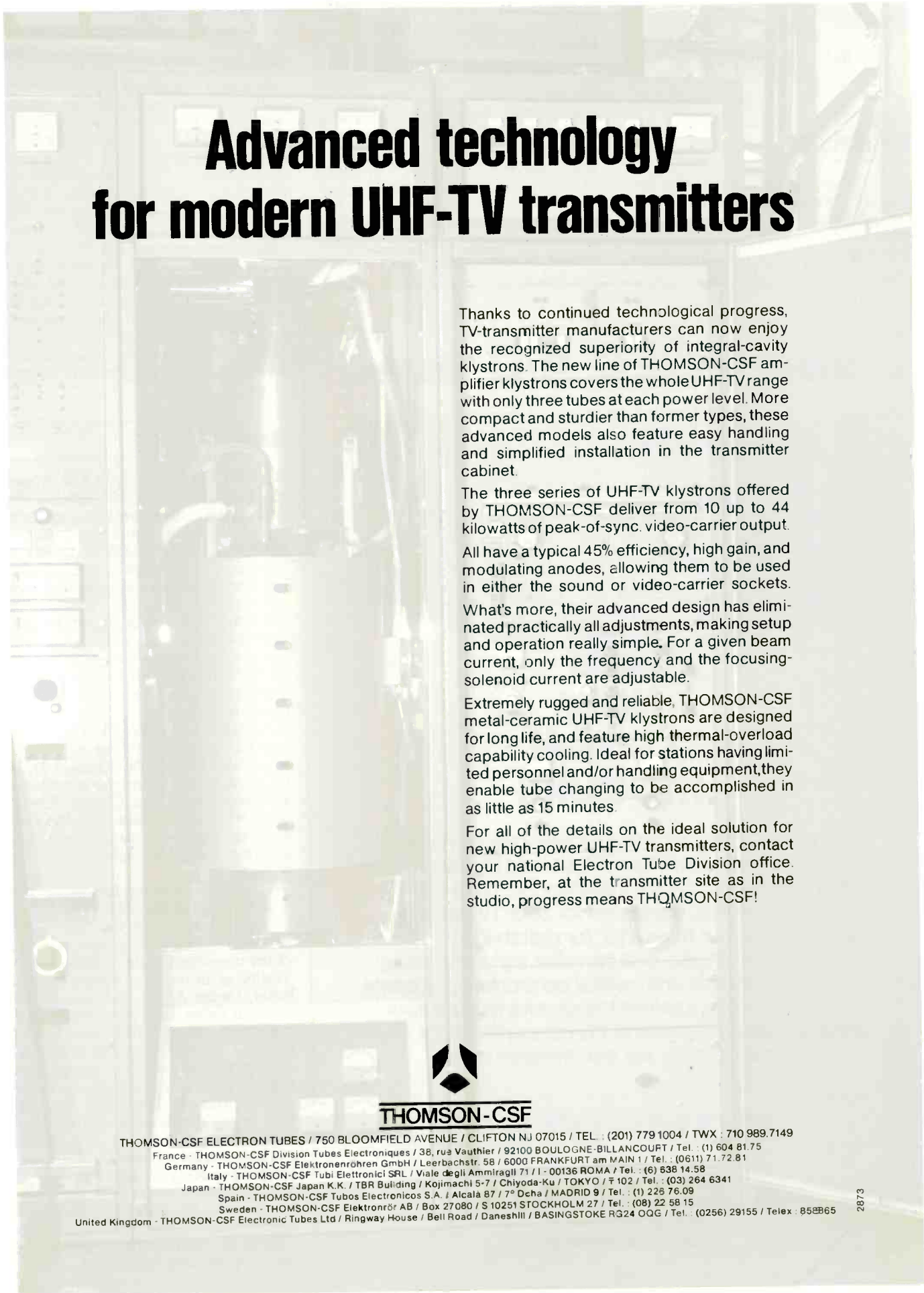
Advanced technology for modern UHF-TV transmitters



Thanks to continued technological progress, TV-transmitter manufacturers can now enjoy the recognized superiority of integral-cavity klystrons. The new line of THOMSON-CSF amplifier klystrons covers the whole UHF-TV range with only three tubes at each power level. More compact and sturdier than former types, these advanced models also feature easy handling and simplified installation in the transmitter cabinet.

The three series of UHF-TV klystrons offered by THOMSON-CSF deliver from 10 up to 44 kilowatts of peak-of-sync. video-carrier output.

All have a typical 45% efficiency, high gain, and modulating anodes, allowing them to be used in either the sound or video-carrier sockets.

What's more, their advanced design has eliminated practically all adjustments, making setup and operation really simple. For a given beam current, only the frequency and the focusing-solenoid current are adjustable.

Extremely rugged and reliable, THOMSON-CSF metal-ceramic UHF-TV klystrons are designed for long life, and feature high thermal-overload capability cooling. Ideal for stations having limited personnel and/or handling equipment, they enable tube changing to be accomplished in as little as 15 minutes.

For all of the details on the ideal solution for new high-power UHF-TV transmitters, contact your national Electron Tube Division office. Remember, at the transmitter site as in the studio, progress means THOMSON-CSF!

THOMSON-CSF

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Germany - THOMSON-CSF Elektronenröhren GmbH / Leerbachstr. 58 / 6000 FRANKFURT am MAIN 1 / Tel. : (0611) 71.72.81
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Spain - THOMSON-CSF Tubos Electronicos S.A. / Alcala 87 / 7° Dcha / MADRID 9 / Tel. : (1) 226 76.09
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2873

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is obviously immense; anyone with relevant data or options should make a statement to the FCC. (Docket 21284).

FCC Briefs

An FCC rulemaking on **amending the Annual Employment Report, Form 395,** asks for comments by March 24th on possible changes in the form to reflect more accurately job positions in broadcasting, and also on adding additional requirements for reporting hirings, terminations, promotions, and job salary levels (Docket #21474) . . . . The FCC has issued Technical Memorandum #6, showing how to **convert TV and FM broadcasting field strength curves** to the metric system: to get it send a self-addressed label (not envelope) to Room 7202, FCC, Washington, D.C. 20554, attention Tech Memo #6. . . . . The following eight **broadcast forms have been revised, and the new versions should be used,** says the FCC (in a few cases, earlier versions can also be used) 301-A, remote control authorization; 309, C for international or experimental TV, facsimile, or development broadcast; 313, auxiliary radio broadcast authorization; 324-A, annual financial report of broadcast networks; 341, application for noncommercial educational TV, FM or AM license; 345, assignment of broadcast translator station CP or license; 349-L, application for FM booster license; 349-P, CP for construction or changes in FM booster . . . . **WPAT-TV, veteran good music station** of Paterson NJ (See *BM/E* "Audio for the 80's" report, October), has a CP to put its transmitter in the World Trade Center in New York, which will bring excellent coverage of the whole metropolitan area.

News Briefs

By 1980 **FM radio likely will attract more audience than AM.** Already FM is strongest in the evening hours, reaching 50.5 percent. According to Robert Cole, vice president, CBS-Owned FM stations, FM is progressively increasing throughout the day and in all significant dayparts as well . . . . **WCVB-TV** (Channel 5), in Boston, won the honors for outstanding new program and took 13 other awards in the 1977 (first annual) Boston/New England Area Emmy Awards voting. Two other Boston stations, **WNAC-TV** (Channel 7) and **WBZ-TV** (Channel 4) won four awards and three awards, respectively. **WFSB-TV** (Channel 3), in Hartford, received the most awards for a station outside the Greater Boston area, winning an award for the outstanding children's series, and outstanding individual achievement for writing.

The **cable industry has asked the new Copyright Royalty Tribunal** to take cognizance, in the future development of its cable related policies, of the transitional state of the industry. Testifying in hearings before the Tribunal, Daniel Aaron, chairman of the National Cable Television Association and vice president of Comcast Corp., said that constant review of rules governing the industry is necessary. Stephen Effros, representing the Community Antenna Television Association, urged the development of easy-to-follow rules and form . . . . Retail and direct **sales on cable TV are developing quickly.** A new company to perform these services is Alron Communications, Inc., Melville, N.Y. According to Alron chairman J.H. Scheinman, merchandising services by his company may be offered to some

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If you want Plumbicon* picture quality from your ENG camera– specify Plumbicon TV camera tubes.

As predicted, the Plumbicon ⅔-inch camera tube changed the entire course of broadcast journalism and helped make ENG the world's most important medium of information.

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The Sony BVT-1000. Consider the logic.

A time base corrector is part of a system. A system that includes a video tape recorder.

Isn't it logical that a company which manufactures video tape recorders would have an inside track on what it takes to correct time base error in a VTR signal?

We're talking, of course, about Sony Broadcast.

The company that pioneered professional U-matic video recorders. And introduced the BVH-1000 1" High Band Video Recorder, that has the whole broadcast industry moving in a new direction.

Sony Broadcast has matched these impressive video recorders with an equally impressive digital time base corrector. The BVT-1000.

And before you face up to the difficult decision of which TBC is best for you, consider the logic of the BVT-1000.

1. The economy of a complete package. Sony Broadcast knows that line-by-line velocity compensation, complete video processing with advance sync, drop-out compensation, and the ability to handle both direct and heterodyne color are not just "options."

They're requirements. Requirements that broadcasters need and use in day-to-day operations.

So we make all these so-called options standard built-in features of the BVT-1000. And you save dollars in our greater production efficiency.

2. The advantage of superior technology. The economy of the BVT-1000 doesn't mean you sacrifice quality.

Far from it.

The BVT-1000 incorporates unparalleled technological excellence. Excellence demonstrated by a unique A/D converter that expands the effective number of bits per word, resulting in a higher signal-to-noise ratio than theoretically expected in an 8-bit system. Which leads to transparent picture quality.

With the Sony Broadcast BVH-1000 1" recorder, the BVT-1000 provides locked recognizable color pictures from still-frame to seven times normal speed. And to greater than thirty times normal speed in monochrome. So your editing techniques are faster and more critically accurate than ever before possible.

And for use with U-matic format recorders, the BVT-1000 offers special advantages. A wide 4H window and special anti-gyro circuitry compensate for wide errors and maintain both color and luminance stability.

Advance sync control allows phase correction using LED indicators at the TBC, for system integration. And the video level can be monitored by LEDs that show at a glance high or low level relative to one volt peak-to-peak.

3. The logic of a systems approach. If you are into electronic news gathering, or if you're part of the new revolution in 1" high band machines, the chances are very good that you're already using Sony recorders.

The BVT-1000 gives you an opportunity to add new logic to your broadcast equipment. The logic of an all-Sony system.

For full information about the BVT-1000 or any of the other professional video products in the Sony Broadcast family, call your nearest Sony Broadcast office.

Sony Broadcast

Sony Corporation of America, 9 West 57 Street, New York, New York 10019
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News Briefs

subscribers within a year. Programming will be geared for each specific community.

"Yukon Passage," this TV season's first National Geographic Series (NGS) television special, recorded **"impressive" audience shares** over the Public Broadcasting Service (PBS). The National Geographic specials are made possible by a grant from the Gulf Oil Corp. Other NGS specials scheduled this season are: "The Legacy of L.S.B. Leakey," "The Great Whales," and "The Living Sands of Namib," all on PBS.

New York City Ballet's widely acclaimed production of **"Coppelia" was televised** nationally on "Live From Lincoln Center" on January 31, over the Public Broadcasting Service (PBS) . . . . The **National Radio Broadcasters Association's 5th annual convention** will be held September 17-20 at the Hyatt Regency Embarcadero Hotel in San Francisco . . . . Dr. Harold Niven, NAB convention manager and James H. Hulbert, senior vice president for station services attended a **meeting of broadcast industry suppliers.** Additionally, NAB sent assistant general counsel James J. Popham to advise the group on royalty provisions of the new copyright law. Bo Donovan, Tuesday Productions vice president, who headed the meeting, noted that "all other convention organizers have turned a deaf ear to the problems we face and the **NAB should be commended** for taking a positive step forward . . . ."

The first woman manager and first black television managers in the country were among those addressing the **eighth annual convention of the North American Broadcast Section** of the World Association for Christian Communications (NABS-WACC). Donald H. McGannon, chief executive and president of Group W — Westinghouse Broadcasting, speaking on the conference theme of ethical frameworks in broadcasting, said that "it is especially important that broadcasters maintain and foster a steady dialogue between the station and the people they serve." Rep. Lionel Van Deerlin (D-Calif.), chairman of the House Communications Subcommittee, told the gathering that the task of reforming federal broadcasting legislation is one of "making certain the law serves the consuming public, and not just varied industrial or business interests." He also noted that members of Congress are dependent upon the continued support of local broadcasters for re-election.

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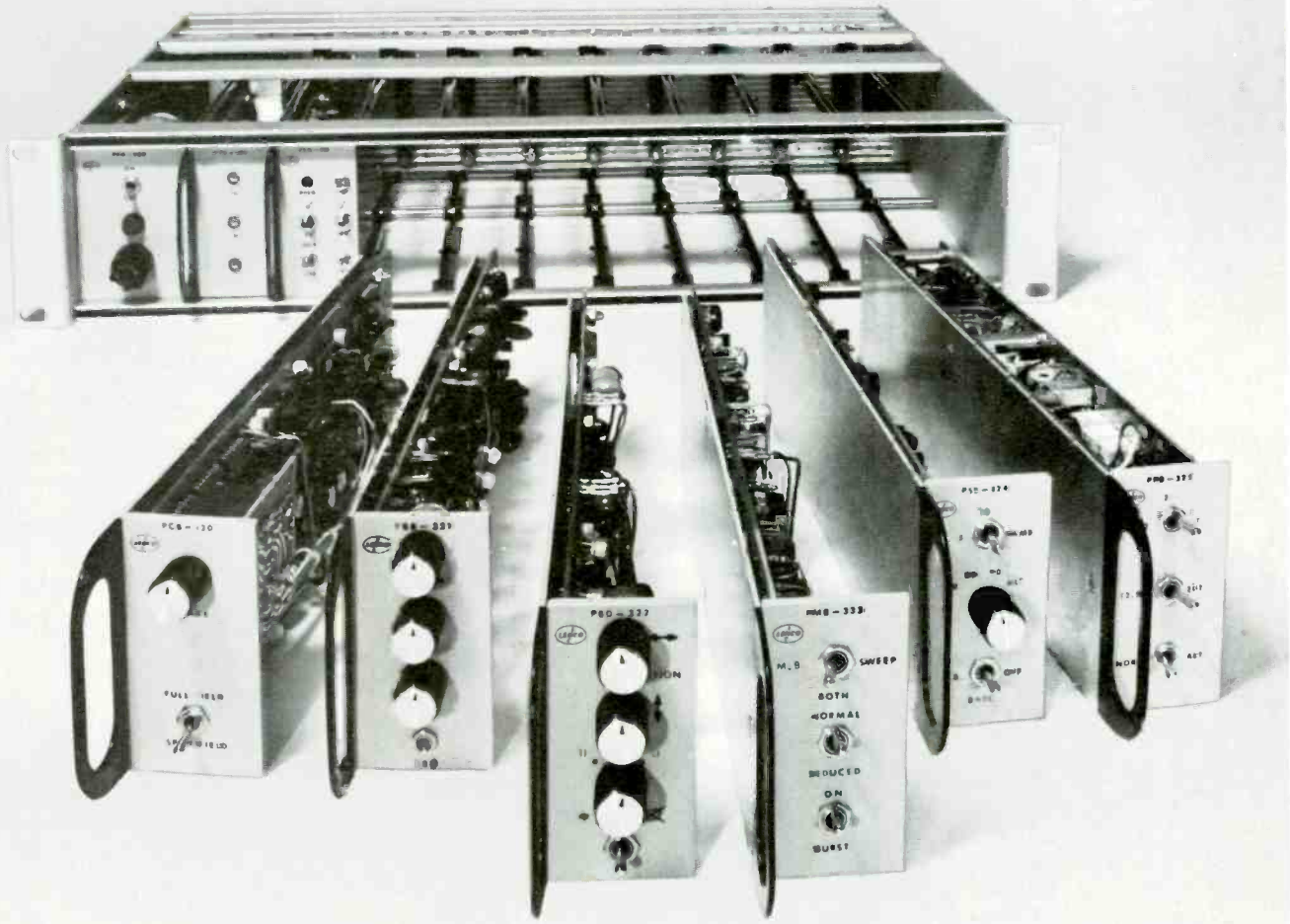
Introducing the you-name-it, you-got-it video test set.



Here, finally, is a totally integrated modular video test set designed specifically for professional use. Lenco's 300 System lets *you* specify video test signals to meet *your* system requirements, not the manufacturer's.

Use the Lenco PSG-310 Digital Color Sync Generator, or one of your own generators, with any one, a combination, or all of the test modules. Mix 'em or match 'em any way you want. There are 29 test signals available to answer *all* of your system test specifications.

And with the Lenco 300 System, you get a lot more for a lot less. For instance, all of our advanced test signal modules have composite video delay, making Lenco the *only* manufacturer that can *individually time* the test signals to your system.

You won't have to wait to find out how much better the 300 System test set is, either. We'll deliver it to your studio within two weeks. And we're so sure of your acceptance of Lenco equipment that we offer a *two-year* warranty on all parts and labor—and that includes freight to and from our factory!

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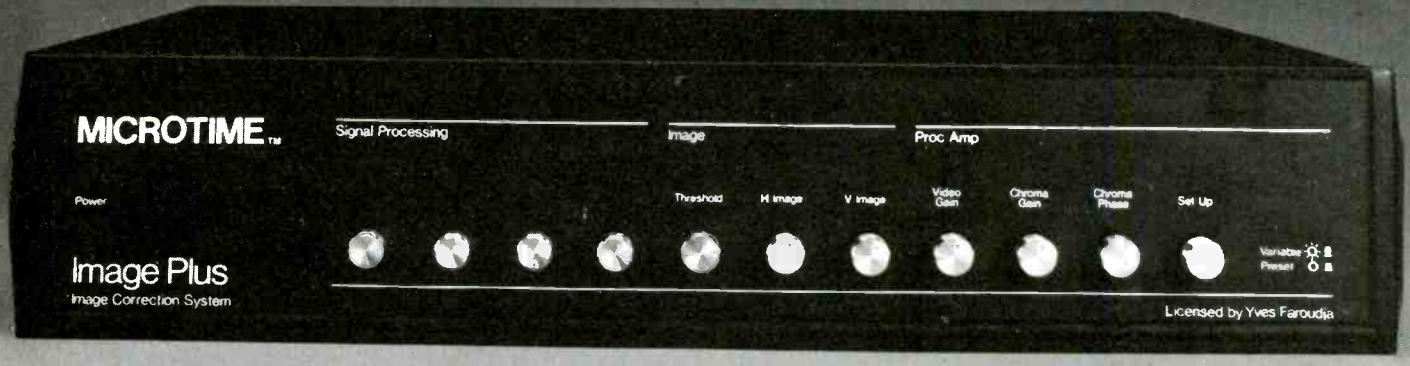

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News Briefs

"Laser Beam Information Systems" is the theme of a three-day seminar presented by the University of Chicago Center for Continuing Education in four cities around the country: March 6-8, Chicago; April 26-28, Los Angeles; June 7-9, New York; August 7-9, Minneapolis. Seminar leader is Leo Beiser, a pioneer in laser beam information systems who heads his own consulting service . . . . Columbia University is presenting a three-day seminar on **"Computer-Communication Network Design and Analysis,"** March 13-15 in New York and May 15-17 in Chicago. Seminar leader is Dr. Mischa Schwartz, professor of electrical engineering and computer science at Columbia University.

The **earth station planned** as control center for satellite service, supplied by RCA American Communications to NASA's communications network, has been officially dedicated in ceremonies at the Goddard Space Flight Center. A second RCA earth station at Goddard will be completed in the summer of 1978 . . . . The **Georgia Cable Television Association** will hold its annual meeting on February 17 and 18, 1978, at Stouffer's Pine Isle Resort at Lake Lanier Islands.

Business Briefs

Alan Gordon Enterprises, Inc., supplier of professional photographic equipment, has been sold to three of the company's longtime executives by Mrs. Vera Gordon, who had held 100% of the company's stock. Purchasing the company were its president Grant Loucks and senior vice presidents Don Sahlein and Robert Kuhagan . . . . **"Sound of '77,"** a five hour year-end radio special, produced by Billboard Broadcasting Co., was aired in 600 markets during the last week of December and the first week of January. This is the first venture into syndication for the company, a division of Billboard Publications. Sponsored by Discwasher, the program has been produced in three separate formats — rock, country, and MOR . . . . Chyron Corp., Plainview, N.Y., has formed a new **Video Products Division,** which will be responsible for marketing and distribution of the Chryon ¾-inch Video Cassette Cleaner and Evaluator and other specialized video products. Richard P. Boyd has been appointed director of marketing for the new division, and Don P. Cadora has been appointed director of sales.

"Music Country" is the theme for a new series of custom station identification jingles produced by KLAC Radio, Los Angeles. The jingles were written by Euel Box, who also worked with station general manager Bill Ward to record the rhythm tracks. The jingles will be featured in on-air promotion and programming throughout the upcoming year. The package will be syndicated nationally by Toby Arnold & Associates . . . . **UA-Columbia Cable Vision, Inc.** will use RCA American Communications, Inc.'s satellite to carry sports and special events live from Madison Square Garden to cable TV systems around the country starting Sept. 27, 1978 . . . . To upgrade the facilities of two of its TV stations, Radio Caracas Television has ordered **RCA** broadcast equipment valued at approximately $400,000.

American Broadcasting Companies, Inc. has been granted approval from the FCC to change the call letters of the ABC owned FM radio station in Washington, D.C. from **WMAL-FM to WRQX-FM** . . . . The first license issued to an independent common carrier for communications through both RCA and Western Union domestic satellites was to **Transponder Corp.**

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Business Briefs

of Greenwich, Conn. Transponder Corp., the common carrier associate of Transcommunication Corp., received the FCC approval of its application for license of a transmit and receive satellite earth station for Kansas City, Mo. This earth station is the first phase in the company's plan to expand the present receive-only earth station network from its present TV program function to multiple two-way all-purpose operations . . . . **Innovative Television Equipment** has been appointed broadcast videomarket representative in the United States and Canada for the Miller line of fluid heads and wood and metal tripods.

Moseley Associates, Inc., of Goleta, Calif., has received type acceptance from the FCC of their Models RPL-3A, RPL-4A and RPL-4B Remote Pickup Transmitters. The models AMP-3A and AMP-4A RF Power Amplifiers, for use with the RPL-3A and RPL-4A/RPL-4B respectively, are included in the type acceptance for operation with these systems . . . . A definitive agreement has been signed for the **merger of Spectral Dynamics Corp.** into a new wholly-owned subsidiary of Scientific-Atlanta.

Showtime, the pay TV subsidiary of Viacom International Inc. has signed an agreement with Liberty Communications, Inc., to carry Showtime's satellite service to Liberty's cable operations in Beaumont, Port Arthur, and Orange, Texas . . . . **Showtime** has also signed an agreement to supply its satellite service to Muskegon Cable TV in Michigan . . . . In January, the **CBS Radio Mystery Theater** began its fifth year, with a selection of classic horror stories.

The daily **Backspin** radio feature is now being offered for national syndication by Toby Arnold & Associates. Eacy daily episode features a number one song from a recent year, along with short nostalgia flashbacks by Charlie Van Dyke, morning personality at KLIF, Dallas . . . . Another syndication package offered by Arnold is a series of custom station jingles inspired by the movie "Star Wars." The **theme is "Music Force"** and utilizes contemporary electronic effects.

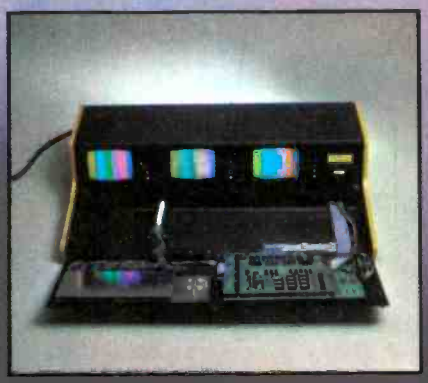
Hughes Aircraft Co.'s microwave communications products will use a new RCA headend for testing the performance of Hughes' AML (amplitude modulated link) microwave equipment. The headend, believed to be the largest such system in existence, is capable of handling 41 video and 22 FM channels simultaneously and was chosen because it met the 40-channel capacity of Hughes AML systems . . . . **Bardwell & McAlister** has acquired Motion Picture Equipment Co. and Hollywood Scene Dock. MPE and Hollywood Scene Dock manufacture a complete line of grip equipment, Century stands, reflectors, Duro-diffusion, flags, dollies, etc. This acquisition will augment Bardwell & McAlister's studio lighting equipment line.

Warner Cable Corp. is rebuilding its Russellville, Arkansas, system with truck amplifiers supplied by Delta-Benco-Cascade . . . . **MPCS Video Industries, Inc.,** located in New York City, has installed an 800 number (800-223-0622) to allow video buyers nationwide to call toll free.

Joel D. Dolin has been appointed president and chief executive officer of Leaseametric, division of Metric Resources Corp., Burlingame, Calif. . . . . **Richard A. Weiner,** general manager of KGMB-TV, Honolulu, Hawaii, was recently elected president of the Hawaiian Association of Broadcasters . . . . **Jack G. Carnegie,** general manager of radio station WIFE, was elected president of Radio Broadcasters of Indianapolis, Inc.

A new dimension for electronic field production.

The new EFP-1 Portable TV Production Console is designed for use on multi-camera remote telecasts, to replace or back up a large mobile van, to complete



a shoot in poor access locations, handle low-budget remotes, and to provide additional in-house studio facilities.

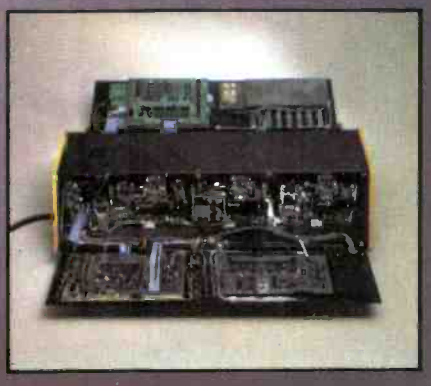
It provides all the necessary audio mixing, video switching, intercom, system timing, test signals and monitoring for remote broadcasts at a very reasonable price.

Video sources, such as cameras, VTRS, and character generators, can be timed at the console without the need for waveform monitors or vectorscopes. The

monitors are set up using the integral color bars and stairstep signals. The audio mixers are set using a 1000 cycle tone and a 4" illuminated VU meter.

All components are greatly derated to ensure stability and reliability. Service is a snap . . .

the front and rear panels are hinged, giving direct access to plug-in PC boards. The microprocessor controller greatly simplifies the operation, puts all



routing, wipes and script assistant functions under simple key pad control.

These are just a few of many great features, all in a compact, rugged unit that fits in a station wagon. Get full details now. The EFP-1 is the console of the future — for a price that makes sense today.

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(716) 754-4346

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Better ideas for better quality.

Your goal is better sound quality. Our goal is to come up with better ways for you to get it.

So far, we think we've done pretty well, with ideas like:

☐ a limiter that works as a fast peak limiter and an average-responding limiter – simultaneously and independently.

☐ an audio level optimizer that combines a compressor, peak limiter, and de-esser in one package.

☐ a multiband audio processor that gives you independent compression adjustments in eight frequency bands.

☐ a single-ended noise suppressor that can also restore program dynamics.

☐ tape record and reproduce electronics that set new standards for features, performance, and reliability.

☐ a tape tension control kit that improves speed accuracy and high-frequency performance.

There's more to come. We're working on still other ideas for helping broadcasters and recording studios get better sound. Of course, when those products come along, they'll have the same high quality and dependability that you expect from Inovonics.

All of our better ideas are available from Inovonics dealers throughout the country. See one soon, and pick up an idea or two.

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New Jersey: Joel Associates
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Kentucky: Sonic Services
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Tennessee: Broadcast Equipment & Supply
Missouri: Communications Systems
Texas: Savco; Collins Radio
California: Taber Mfg & Eng; VIF International; Accurate Sound; Sound Dynamics; Sigma Audio
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RADIO
PROGRAMMING & PRODUCTION FOR PROFIT

Fresh Thought Pays On The Radio Air

IN NOVEMBER THIS department noted that radio broadcasting is rewarding creativity in programming more than ever before. In a small community a radio management is quite often forced to develop its own "package" because a specialized format like those that work in large cities may not have a large enough following. And stations in larger cities that are outside the circle of format winners will probably have rough going in head-on competition with the leaders.

Smart radio managements sidestep the head-on battle. They find their own methods for winning listeners and serving the community, remembering that the second objective is also essential to station success (entirely aside from satisfying the FCC). In the following are a few examples of homemade programming from around the country, described not because they are ultimates for imitation (they are not), but simply to encourage the maximum of variety in program thinking.

KMOX, St. Louis — Gala concerts by local talent

This one can make good use of local professional and semi-pro performing groups. "Prelude to the Holidays" was a three-week concert series, free to the public, presented in Crestwood Plaza, a local shopping center, aired by KMOX, and jointly sponsored by Crestwood and KMOX. Included were concerts and recitals by such performers as Richard Hayman, harmonica star and conductor of the St. Louis Pops Concerts; Southern Illinois University Concert Chorale; Gateway Brass Quintet; students from St. Louis Conservatory of Music; Washington University Madrigal Singers; and a number of others of similar nature. The concerts took place three evenings a week in the mall of Crestwood Plaza.

St. Louis, a metropolis, obviously can draw on considerable resources for such a series. Could a radio station in a small community do anything like it? Almost anywhere there *may* be local talent to make possible a shorter series, or even a once-a-week permanent affair, in the lobby of a bank or other business institution which would carry some or all of the cost and benefit from both the live attendance and the on-air coverage. There would certainly be problems (musicians union? low performance quality?); but the use of local stars, with proper showcasing, gives the station a lot of leverage for "community identification."

WGSO, New Orleans — Attendance conditions for hit "show"

One of the all-time hits in traveling shows, the treasures from the tomb of Tutankh-amen, created tremendous traffic last September at the New Orleans Musuem of Art. WGSO, as a public service, gave an hourly report on traffic in the museum area, and twice an hour a report on availability of tickets and the number of people waiting in line. This one is easily generalized to any kind of public affair that interests a large sector of the community. A rock music festival? Maybe not — overcrowding seems to be a big part of all-out performance.

KNND, Cottage Grove, Oregon — The whys of total school board coverage

Putting local government on the air in small communities is a very old idea. Whether or not it works for a radio station seems to depend on a number of local factors. In Cottage Grove, Oregon, station owner David Pfleger has chosen, as a public service, to air in its entirety every formal meeting of the local school board. According to a news account, Pfleger says that about 25% of the cost is paid by advertisements, put in during breaks in the meeting: "You don't go into this sort of thing to make money out of it." And about the regular listenership he said, "I have to suspect that it is not enormous." However, it is clear that during the year the broadcasts have been on the air the community has come to accept them as regular and available; during certain crises (controversy over a new school tax levy, for example), listenership became extremely heavy.

The effects of the broadcasts on the school board itself should not be overlooked. Several members say the broadcasts make them speak more succinctly and directly, explain things more clearly, waste less time in non-essentials. That also comes under the head of "community service" by the radio management.

KCRW, Santa Monica, Calif. — What should a public radio station be?

In contrast to the foregoing, this non-profit station of Santa Monica College dropped regular coverage of the City Council — as part of a total program revamping in which the station management undertook to find its real purposes and "identity" as a public station. In the fall of last year, Ruth Hirschman came as acting manager, after seven years as program director at non-profit KPFK-FM, Los Angeles. She was to help the badly floundering station find new directions. Possibilities for non-profit radio stations have grown tremendously in recent years, she pointed out. As to the City

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Radio Programming

Council, the decision was to eliminate total coverage but to tape each meeting and later present the most significant portions, with informed comment. Some other elements of the plan to carry out the "public service" mandate of the station are: large time slots for jazz and classical music (volunteers bring records from their own collections), along with folk, rhythm and blues, and West Indies music, which are largely missing on the air in the city; "Newstand," a program in which news, columns and editorials from out-of-town papers are read on the air; film and book reviews, including interviews with authors and actors; programs on senior citizens, gardening, jobs, opportunities for volunteer service, cooking, etc. — all conducted by experts in the respective fields. "Public radio is passionately concerned about people with skills," Ms. Hirschman explained. "Featuring Santa Monica" is a 10-minute review of a week's local news, followed by features on youth, police, the environment, and other such topics. "Pacific Weekend" tells about events all over the West Coast. Also aired will be specials on literature, the theatre, the black community — and the weekly Santa Monica College football game during the fall season. Important, of course, will be the *quality* of each of these diverse elements, which will probably vary. What ties them together is the attempt to find material, valuable to the community and attractive to listeners, that would otherwise be missing from the local radio air.

WWIW, New Orleans—Swing back to Swing (plus Dixieland, etc.)

It's an idea that is cropping up in a number of places. WWIW, formerly WNPS, is another station that is proving its relevance — the return to Swing or the Big Band music of the 1930's-50's. Early last year Sun Broadcasting bought the former WNPS, which had been on country music. They called in program consultant Dick Oppenheimer, and he called in veteran programmer Bob Castle; both men had long thought a return to swing was a good radio idea. Castle had been trying to get a large commitment to swing by stations where he worked a number of years, without success. He assembled the large library of recordings needed for WWIW. Starting full force in early summer, WWIW is getting the best mail in its history, says Oppenheimer, now a managing partner, and a satisfying proportion of it is from teenagers; swing is not merely a nostalgia trip for the middle aged, he points out. In addition to marshaling the big-band galaxy, Oppenheimer and Castle are using the rich musical heritage of New Orleans by inviting into the studio local musicians who are fine artists but lately out of the limelight. Among them have been Alvin Alcorn, the Dukes of Dixieland, Blanche Thomas, Conrad Jones. They are interviewed and their recordings played. They do 30-second promo spots for themselves — and for the station. The audience loves that too. WWIW has created its own sector of the New Orleans radio airwaves.

KDAL, Duluth — Dreams of going on stage come true by phone

There is a large reservoir of frustrated stage talent in every community. KDAL tapped Duluth's stage-struck with a program called "Communication Line," a 50-minute morning call-in patterned after the "Gong Show." Listeners were invited to dial the station's number and those who got through during the show time could do anything on the air they wanted — well, nearly anything — with the gong at ready for the truly unbearable. On one typical morning a few months ago, 22 "acts" made it to the air. Among them were several poetry readers; a 70-plus-year-old harmonica player; a singer-composer whose song was "It's Colder By The Lake"; a teenage rock group (imitators of Fleetwood Mac); and a chorus of singing (or rather howling) dogs who got the "gong." The response to the first show, the idea of KDAL newsman Eric Eskola, was so overwhelming it is being repeated from time to time. Stage dreams flourish in thousands of souls and both KDAL and the Duluth telephone company are thankful.

KBMW, Wahpeton, N. Dakota — Doing it all on personal taste

No format name fits what Charley Parks and Kris Delaney, program director and music director, respectively, do for their station. But it makes the station No. 1 in the Wahpeton-Breckenridge area. They call it "mass appeal radio," but the "mass" is different at different times of day. In the morning they know they have an 18-and-up listenership, so the music runs more to the likes of Glen Campbell and Henry Mancini. At night, the audience is younger, so the music is more toward rock. But the programming team still doesn't choose the really hard rock. "The people [in this area] who listen to hard rock aren't listening to the radio anyway. They are listening to their stereos," says Delaney (as reported in a local news story). The choices come from around 70 new 45-rpm records added to the station's library each week. The mix is nearly all current tunes, with only an

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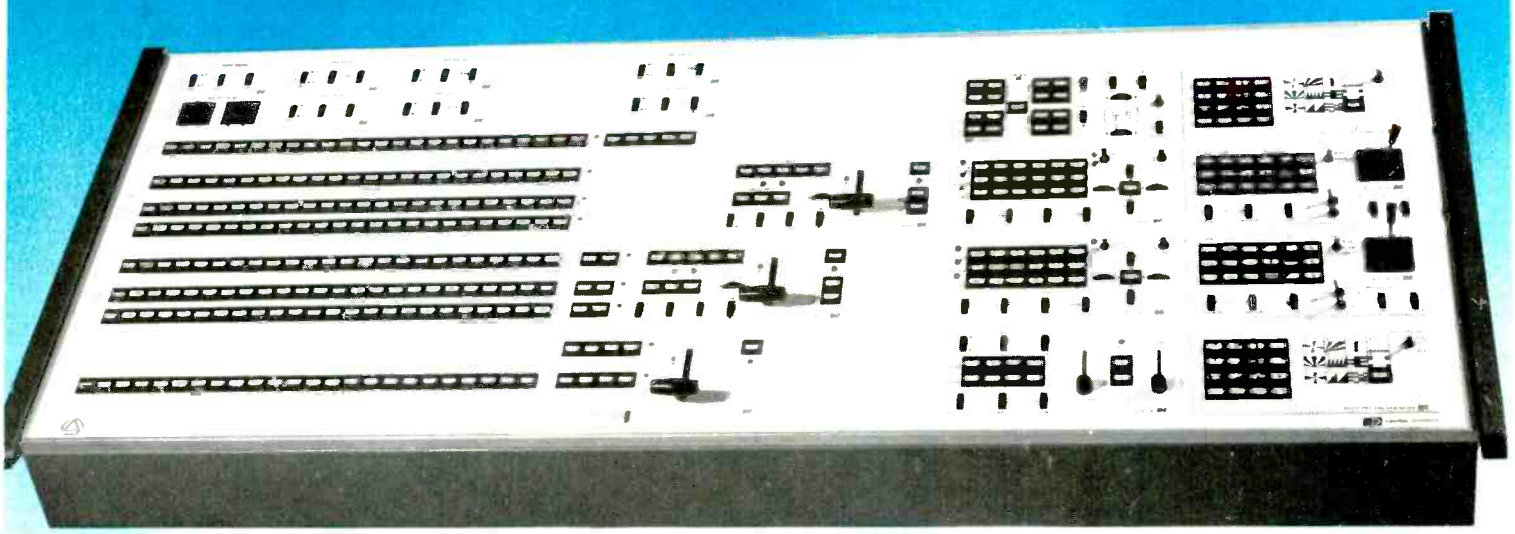

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occasional oldie. How are the choices made? Parks doesn't choose by "tagging" the music as "rock" or "country," but only as suitable to KBMW's need, or not suitable. "This is the hardest type of station to program, because we are trying to please everyone," he said. Clearly it comes down to what the two men like and what they know from instinct and experience their various audiences will like. Parks notes that popular music is constantly changing, so no long-lasting "formula" can be worked out for the choosing. It takes careful listening and a sensitive feel for the audience and the music. The success of the station means that the two men have that sensitivity.

BM/E's Program Marketplace

Syndicators For Radio

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Tel. 213-841-0225

PEOPLE OVER 20 (a rough and ready boundary between "young" and "adult") were by and large being served badly by the radio of the late 1960's and early '70's. It was the high tide of rock, the teenager was everybody's courted darling. For the upper end of the demographics say from 45-50 up, beautiful music was coming in to win its secure place on the scene.

That left a great empty middle. But the last two or three years have brought widespread recognition of the unbalance and a movement to correct it. Radio Arts, only about three years old itself, has been a major factor in this swing, and in the process has won a very large success as a program syndicator. From its zero start, Radio Arts has gone to about a hundred subscribing stations, to join the dozen or so national syndicators at the top of the heap.

This upsweep came in large part from having the right idea at the right time, but also from the experience and talents of the group of individuals who created the operation. Larry Vanderveen, now president, sensed the need for more MOR programming, and better MOR, around the country, in his position as national sales manager of KFI in Los Angeles. He was aware, as have been a number of other syndicators covered in this series, that as the rock generation grew up its taste in music would alter toward a quieter style. And there were all those 30+ people out there, never deep-dyed rock fans, who had a hard time finding anything they liked on their radio sets.

Vanderveen gathered a group of helpers and set out three years ago to sell his MOR idea around the country. One of the first moves was to engage Dimensions Unlimited, of Los Angeles, to do a national music preference study among adult listeners. The sales charts of records heavily slanted to rock, are seriously misleading for the adult group, says Radio Arts, because most record *buyers* are teenagers. But great MOR artists like Andy Williams, Steve Lawrence, Peggy Lee, and a score more, consistently sell out in concert and on television.

The study of the adult group confirmed the Radio Arts position overwhelmingly. From 12,000 questionnaires given to listeners 25 to 60 years old in 60 markets around the country, more than 5,000 were returned and carefully analysed for sex, age, geographic region, market size, etc. The artists chosen by the respondents for their "ideal radio station," from a list of 260, were heavily MOR.

Radio Arts named its format "The Entertainers," and set up a complete recording and duplication plant to produce it. Selections are made initially by Rudi Maugeri, music director, who has been himself a music professional, as leader of the "Crew Cuts"; later he was music director at WHN and KFI. This special sensitivity to the music is an important part of the success of the format. Vanderveen, in a *BM/E* interview, pointed out the MOR is hard to do since the music doesn't come with ready labels of "good" or "bad" established by the sales charts. That's why MOR is particularly susceptible to DJ inconsistency; and why many stations, says Vanderveen, mix big quantities of "soft rock" into their MOR in search for "popularity."

It was clear in the interview, and from much of the published material of Radio Arts, that Vanderveen himself is close to this kind of music, and has an important voice in the production of the format. The success of the format proves, once again, that experience with the music, a good understanding and feeling for it, are vital elements in syndicated programming.

Also vital, of course, is an understanding of the radio market, Vanderveen describes Radio Arts as prepared to help any subscriber who wants that kind of help with an analysis of his particular competitive position, followed by recommendations as to the most likely music for situation. In part to have programming available for a range of market situations, Radio Arts has more recently developed a second format, "Easy Country," which Vanderveen describes as "the middle of the country road." The new format, too, is doing well; of the 100 Radio Arts subscribers, about 20 are already using "Easy Country." *BM/E* listened to samples of the two formats, and found both to be, in a very short hearing, what Radio Arts calls them: pleasant, "foreground" music by highly expert artists.

Vanderveen says that even within one format, the programming can be "shaped" to fit particular competitive situations. Radio Arts is ready to make recommendations to this effect, but does not, says Vanderveen, dictate to the station management what it must or must not do. Stations want support, not dictation, he says, continuing that this stance of Radio Arts, plus their careful control of repetition and their habit of doing what they say they will do, are main factors in their success.

With this splendid start, Vanderveen and his associates are working on a third format, "Sound 10." He describes it as "adult contemporary," aimed at the 18-34 year old group. It will be built on current hits but not heavy rock. Radio Arts hopes to have it ready in a few months.

The care Radio Arts puts into technical quality deserves note here. (And for a slight digression — *BM/E's* "Audio For the '80's," in the October issue, should have included the high technical standards of a number of syndicators, including Radio Arts' as a strong influence for the upgrading of braodcast audio). Radio Arts' mastering and duplication equipment is "super hi-fi"; excellent quality was evident in the sample *BM/E* heard, from a 12-inch disc. Tapes for distribution are produced in a one-to-one playing-speed duplication. The units used for pickup from the discs are among the best on the market, including the Ortofon SL-15E moving coil pickup, Panasonic (Technics) direct drive turntable, Stanton and UREI amplifiers; and the program ends up on the MCI JH-110 tape machines, among the very best available. **BM/E**

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KSTP-TV's "Country Day": A New Approach To An Old Idea

A regional farm program succeeds and grows to a 22 market syndicated hit.

STATION KSTP-TV, the Hubbard Broadcasting Company's flagship TV station in Minneapolis-St. Paul, Minnesota, has found the key to an early morning problem, with a program which, although only a few months old, has already developed into a highly successful mini-network effort covering eight states and serving 22 TV stations.

The program, Country Day, is, in the words of its creator, Ralph Dolan, operations director for KSTP-TV, "Not your usual farm show, anymore than today's farmer is a country bumpkin." And herein lies a major factor in the success of this unique local television production which is now syndicated to 22 TV stations in the North Midwest starts at the normally unappealing hour of 6:30 am each weekday morning. Most of the 22-station mini-networks take the program live from KSTP-TV with a few airing it on a two-day delay basis.

KSTP-TV's "Country Day" travels throughout the midwest. Livestock judge Sunny Bartell is interviewed for "Country Day" at his Winconsin farm.

"Country Day" program host, Steve Edstrom pours the morning coffee for the program's creator, Ralph Dolan, operations director for KSTP-TV, Minneapolis—St. Paul, Minn.

The germ of the idea for an early morning agriculturally oriented program came from Ralph Dolan's intuition and his constant monitoring of KSTP-TV's market leading "News at 10:00 pm" program. "The more I watched our 10:00 pm news, the more aware I became of the large number of agricultural advertisers that were using our news show," said Dolan. "I felt that here was an area in which an extremely affluent and specialized segment of our audience could use some additional, quality, programming service at a time more appropriate for them than the 10:00 pm news. Although I know that the demographics for the news show indicated a large number of people were watching, there was also a large number of non-farm people which was wasted audience as far as agricultural advertisers were concerned. In addition, I was aware that there was a very large radio audience at 6:30 am, most of them engaged in various forms of farming. I had a real gut feeling that the right kind of quality programming specifically geared to this early morning audience, would not only attract viewers but also advertisers."

Dolan kept his ideas to himself and continued to study the overall programming situation. After deciding that an early morning show and mini network could, and would go, he took his idea to Stanley S. Hubbard, president and general manager for KSTP-TV. Young Stan, who is something of an innovator in broadcast matters in his own right, OK'd the idea and a decision was made to have the program on the air by late spring of this year.

The question of format for the show was of major importance to Ralph Dolan. "We didn't want another 'farm show'," he said. "Nearly every station with a rural audience has tried them at one time or another and usually after a brief stint they go off the air. What we wanted was a fresh, exciting and interesting approach to a segment of American industry which has been treated with what might be termed 'benign neglect' by the broadcast industry. Most farm programs are an amalgamation of weather reports, market prices, usually off a wire service ticker and government agricultural reports. There has been little effort, particularly by local TV stations, to personalize either the agricultural industry or the farmer. Our major goal was to bring modern broadcast techniques and concepts to the modern farmer; and believe me, the modern farmer is a far cry from the general image of Farmer Jones standing by the haystack with a pitchfork in his hand. Farming today is a complicated business. Your modern farmers are as aware of higher technological achievements as your bank managers. Many of them are graduates of leading agricultural schools, they are investors, they are interested in new scientific developments in their field, they are in short: "With it".

The key to making the introduction of the Country Day show a success was its syndication potential. Consequently, when the format was decided upon, Dolan had no qualms about spending money to insure that the program was presented in the best possible setting. KSTP-TV constructed a complete new set themed on a country kitchen locale. It also made available an action mini-cam remote truck for interviews with farmers daily on location and provided the program with its own meteorologist doing the latest weather from one of the most completely equipped and staffed weather centers in the country.

Dolan chose his program host with as much care as everything else connected with the show. Steve Edstrom, who was a familiar figure to both WCCO radio audiences and KSTP-TV viewers via two local TV shows, Ski Scene and CB Breaker, was named host for the Country Day show. A professional broadcaster for many years, with a gracious manner and a homey, down-to-earth approach, Edstrom has been a major reason for Country Day's unusual success.

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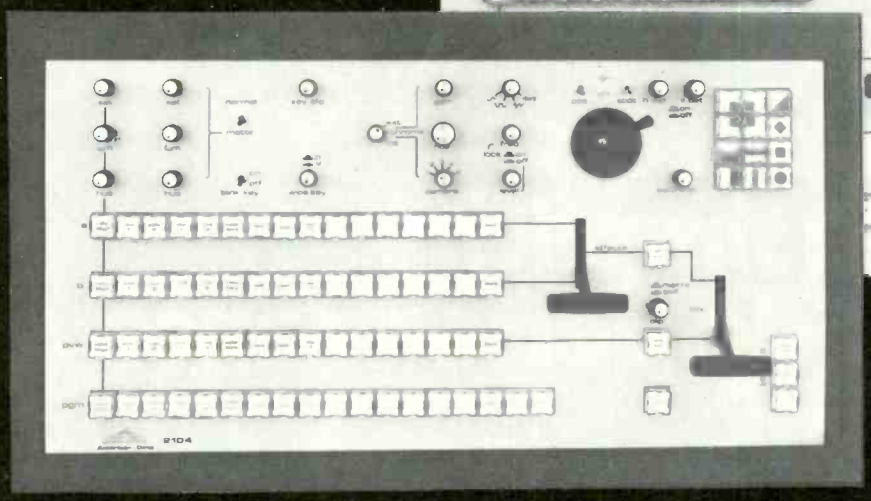

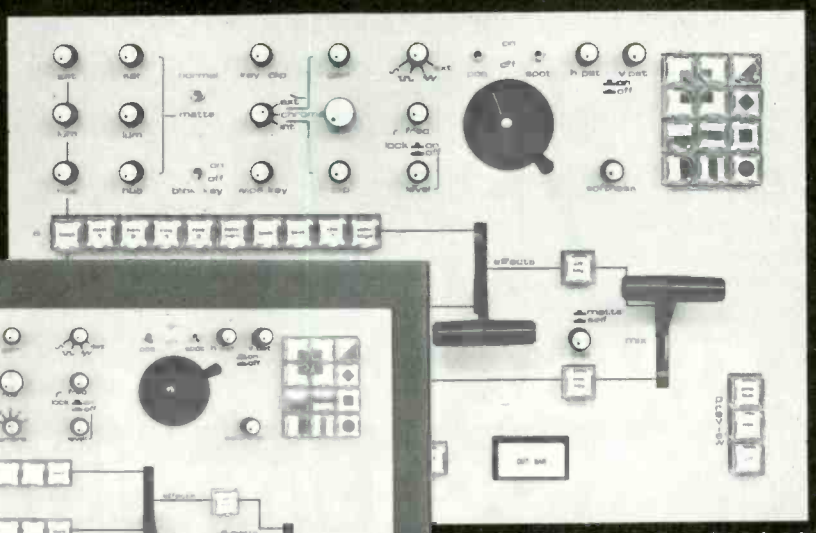

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TV Programming

With everything set for on-air time in April, 1977, came the most important part of Dolan's plans for Country Day's premiere; the syndication of the program to other stations in the area. By telephone, letter and personal visit, Dolan contacted every station he thought might be interested. The development of a syndicated network was a must, according to Dolan. "We wanted a quality show. It was an expensive proposition right from the start and we needed a line-up of stations which would be attractive to the kind of advertisers we wanted on the show; agricultural advertisers."

Dolan gave the potential station clients a proposition that, like the Godfather's, they couldn't afford to turn down. "We offered first of all, a quality program geared to a rural audience; at no charge. We supplied them with promotional material, also free. Each station received three one-minute spots for local commercials with the other three belonging to the Country Day network. Most stations don't make any money at 6:30 am, let alone program at that hour and they had nothing to lose and a lot to gain."

Shortly before the show went on the air in April, the Country Day Network consisted of 12 stations in Minnesota, Wisconsin, South Dakota, North Dakota and Montana and was on its way to becoming one of the most successful locally syndicated programs in the industry.

One of the major features of the half-hour program and one that has been an audience pleaser, based on letters sent to KSTP-TV, has been videotaped, on-the-scene reports and interviews from all over the midwest area by the Country Day remote crew. Utilizing both station remote mini-cam truck and airplane, the interviews with farm people in their kitchens, barns, fields and porches, have become one of the most successful segments of the show and has elicited up to 1000 letters a week from rural viewers.

Another important facet of the Country Day program is the rapport between the program's crew and the farm people. "We don't 'talk down' to the farm people," said Jerry Wasley, producer and director of the show. "We don't pretend to be farm experts. We let the experts talk to the people about things they're more familiar with than we are. After all it would be pretty silly for us to try and tell a farmer who's planning on spending $60-70,000 for some modern equipment whether it's good or bad for him. So we get the people that know and let them tell them." This kind of respect for the farmer, the program's obvious interest in his work, family and welfare, has proven to be a major attraction in the continued welcome the KSTP-TV remote crews receive while on the road.

However, those things the station does offer the farmer, such as its weather forecasts, are done with complete professionalism and with an eye towards the farmer's interests. Rob Dixon, a professional meteorologist, is permanently assigned to the Country Day program and he devotes much of his reports to specific areas of interest to the farmer, including analysis of soil conditions, current scientific trends in agronomy and other highly sophisticated data of importance to the modern farmer.

In the past few months requests for the program have come from all parts of the U.S. and Canada, including a request from Farmington, New Mexico. The syndicated network has grown to 22 stations in nine states and Canada according to Dolan.

With the rather amazing popularity of Country Day, however, have come additional problems for Dolan. "The main attraction of the Country Day show to date has been its spontaneity and live quality," said Dolan. "We don't want to dilute this attraction for the sake of adding more stations. Its regional favor has been its strong point and we don't intend to surrender that."

One solution, according to Dolan, is to design the Country Day format with the potential for live local inserts. "If we can solve this problem," said Dolan, "we'll have a program that won't be restricted by geographical limits."

Dolan's basic philosophy for building the syndicated network seems to be working out also as a number of agricultural advertisers have bought into the program. "The Grain Terminal Association bought a 52-week schedule," said Dolan, "and Ciba-Geigy, one of the major farm chemical manufacturers bought a 27-week campaign. So it looks as though my hunch was right."

Right or wrong, KSTP-TV and Dolan are fully committed for a continuation of the Country Day syndication. The network is two thirds sold out which makes it an attractive offering for other stations at a non-revenue producing hour and Dolan expects it to be SRO in 1978.

The show may also go to an hour-long format in January, 1978, with a number of new features being added including, believe it or not, a live audience—at 6:30 am in the morning.

And don't bet KSTP-TV won't bring it off. The innovative staff is loaded with surprises and right now, Ralph Dolan has sprung the surprise of the programming year in the Twin Cities. **BM/E**

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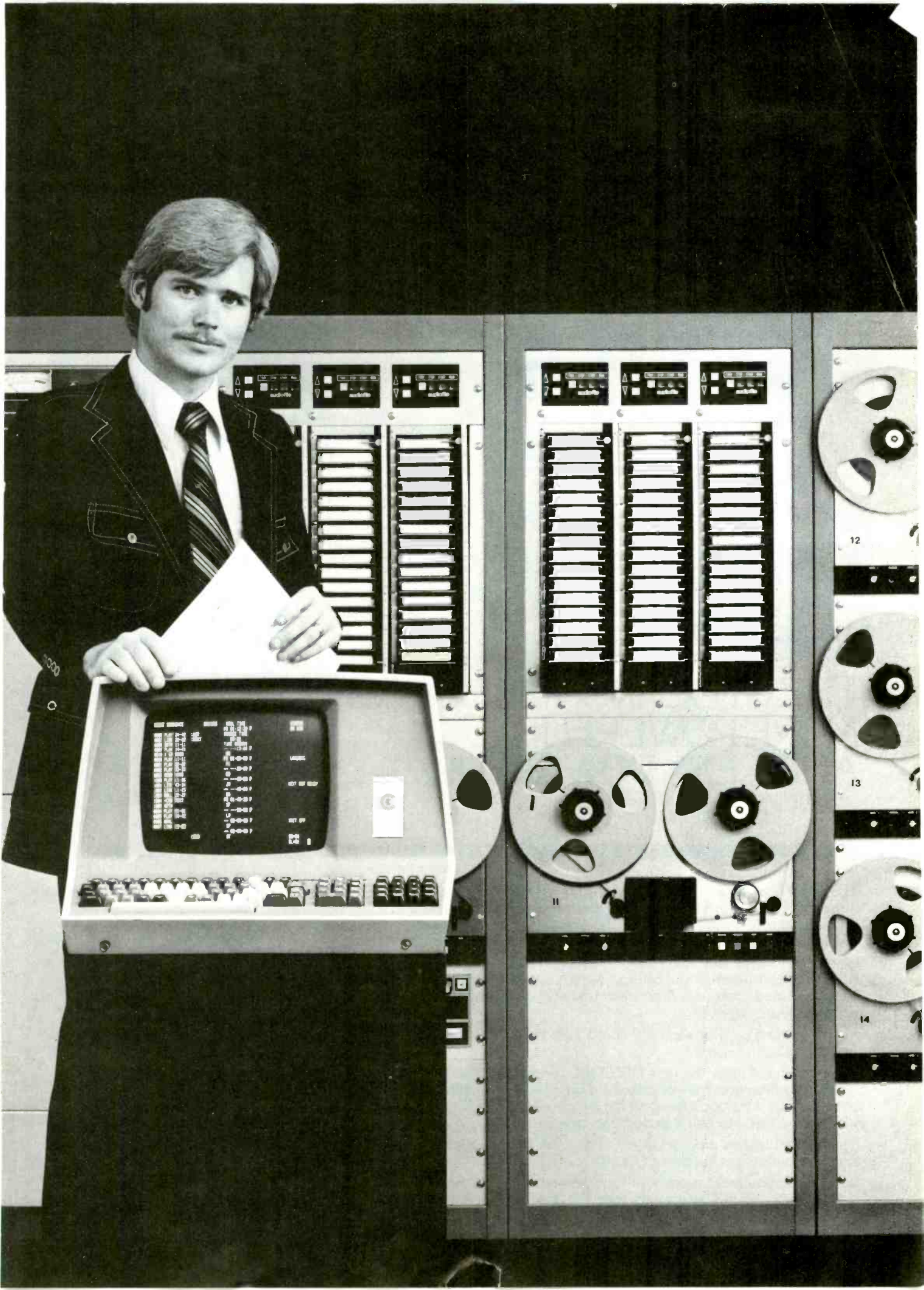

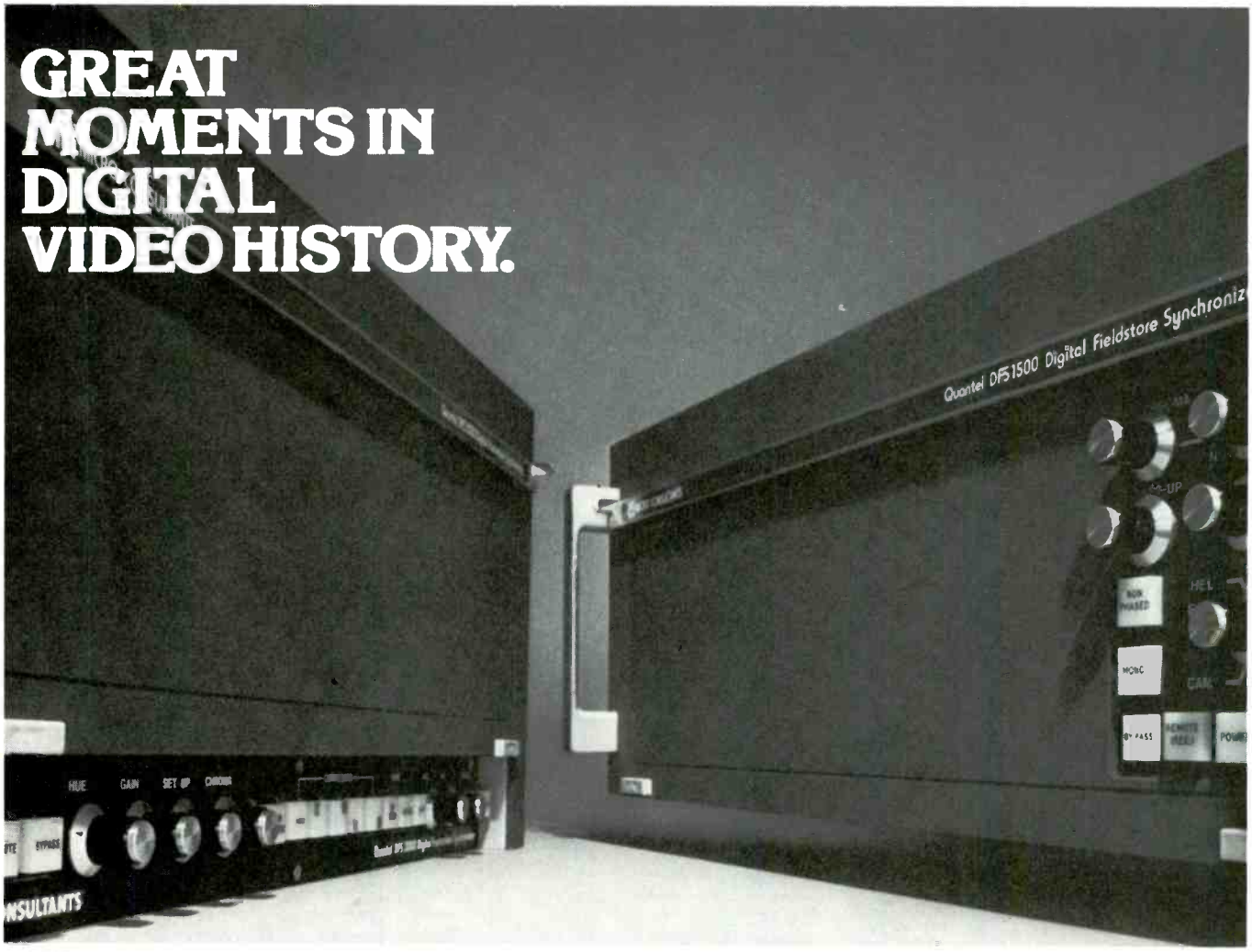

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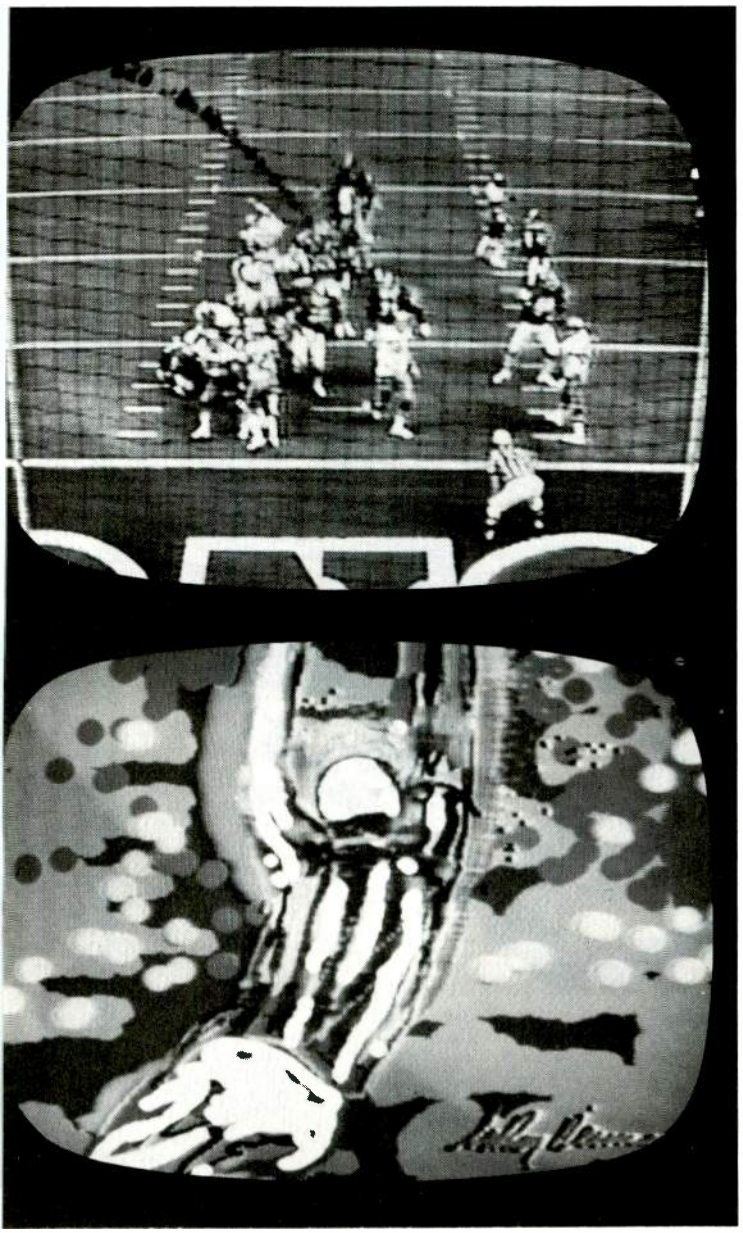
The digital video people

Circle 133 on Reader Service Card

Digital Technology For Broadcasters — Part IV

This series began one-year ago. Since then digital technology has taken off in both radio and television. This year's AES show witnessed the unveiling of digital audio records and a digital disc player with a 98 dB signal to noise ratio. Television has been adopting digital technology for processing and control at a rapid rate. What's next?



A YEAR AGO WE TERMED digital technology for broadcasting, ". . . a revolution underway." Since then there has been no slackening in its pace. If anything, it has gained momentum. At last year's NAB Convention in Washington, D.C., MCI brought Quantel's DPE-5000 (Digital Picture Effects) device and displayed it privately to invited broadcasters to gain feedback on its appropriateness. By October, ABC had the device on the air during the World Series. (See *BM/E*, August 1977). Last month, CBS used two spectacular new devices on its Superbowl XII broadcast, Ampex's (as yet, developmental) digital video graphics system, and CBS' own "Action Track." (see separate story this issue). Application of frame synchronizers for elaborate "Live" ENG activities is progressing at a spectacular rate (see *BM/E*'s special ENG report last month).

Thomson-CSF's Digital Noise Reducer introduced at last year's NAB is enjoying rapid acceptance by broadcasters according to company spokesmen and this year's Panels of 100 survey seems to support that notion (see *BM/E* Panels of 100 survey, this issue). In fact, by grouping the results of the survey along lines of just digital products and digital systems, broadcasters have cast an overwhelming vote of confidence in digital technology.

What's next? Scuttlebut around the industry is that we can expect to see refinements of the IBA prototype digital video recorder early this year. Design considerations for the digital VTR were discussed in a paper by J.L.E. Baldwin of the IBA at last year's International Broadcast Symposium in Montreux, Switzerland. Digital transmission of audio will be a fact shortly as PBS gets its satellite transmission system, DATE, operating in 1978. Digital video transmission is still down the road but its problems are actively being worked on (see "Digital Television Transmission," by Dr. Leonard Golding in this issue). But more immediately, the NAB show should present a dazzling array of new digital equipment. Vital Industries, for one, reports that it will exhibit a production model of its "Squeezoom" effects system which was shown in prototype form last year. MCI can be expected to show production models of its DPE 5000 this year, and The Grass Valley Group will no doubt be back with last year's NAB showstopper, its Digital Video Effects System.

Bosch-Fernseh has accomplished some marvelous

continued on page 45

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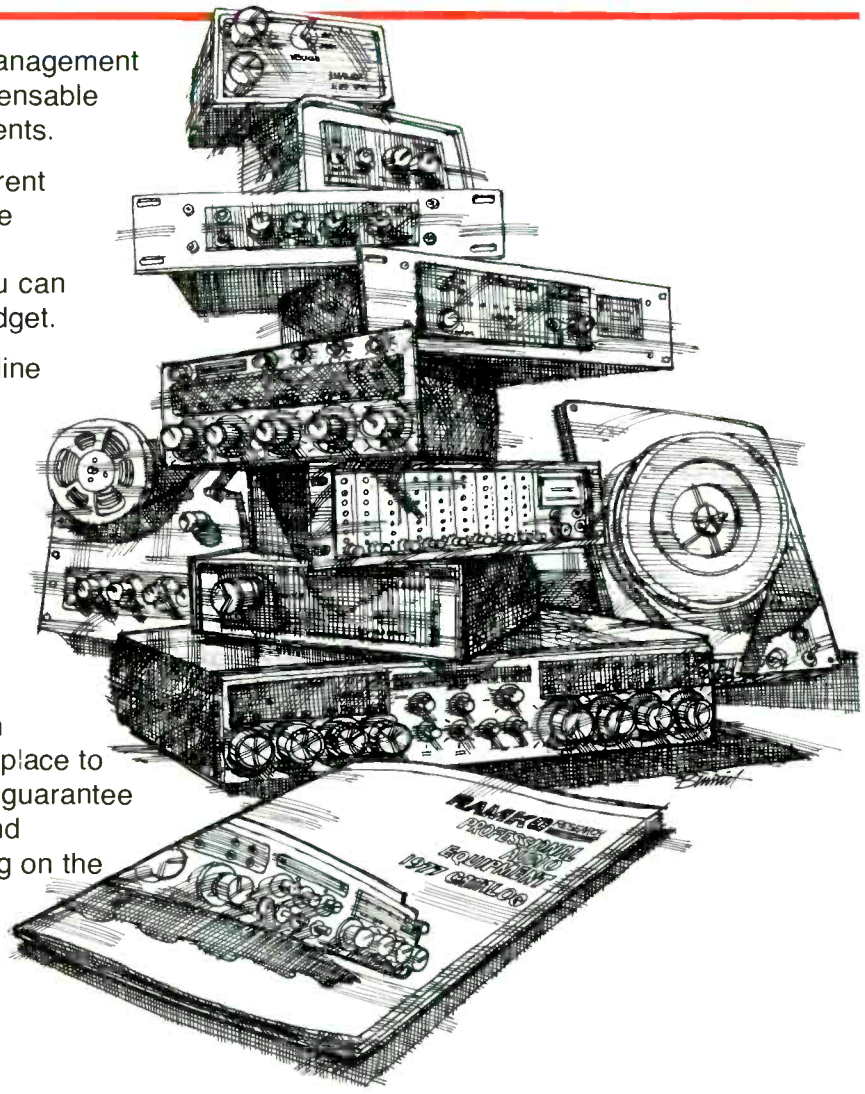

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Digital Technology—Part IV

things with its BCN Video Recording system utilizing its own Digital Store. In post-production, the BCN system should be remarkably powerful (see Robert Paulson's article, "Digital Technology's Impact on Post Production," this issue). In fact, the explosion of techniques now available through digital technology almost requires that most of the changes be wrought in post production rather than production. The possibilities for combination and permutation of the video signal are getting so great that it is increasingly too complex a series of alternatives for an operator to effect during the heat of production.

Implicit in all of this, and one of the major factors in the rapid development of digital technology, is that role that the microprocessor plays. John Davis of Vital Industries continues his primer on the microprocessor elsewhere in this issue.

The industry seems to be emerging from the "black box" stage of development that we spoke of in Part 1 of this series last year. This emergence, however, is more form than substance and stems from the interconnection of all these devices. As yet, there is still no industry wide standardization of digital technology. Sampling rates and bit rates are still inconsistent between many manufacturers and many devices (see William Miller's article, "Digital Video Bit Rates and Quantities—What's Best?", this issue).

One of the more interesting notions of what may be possible with digital techniques was broached by Eugene Leonard, president of Da Vinci Systems and a broadcast engineering consultant, at last October's SMPTE Conference in Los Angeles. Leonard states that, "With these advances in digital capability plus reasonable projections of what cost and performance may be expected from digital devices by 1984, the ability to create, store and retrieve digital information to replace "real" scenery and backgrounds bears examination."

The tools for accomplishing the generation of video backgrounds "(and, perhaps, foregrounds)" writes Leonard, come from the many digital devices already familiar to television engineers and from "the much larger universe of digital information processing. Leonard foresees that not only is the generation of backgrounds a solvable problem but also the generation of foregrounds and props. The problem is a complex one and one not to be solved for some time but Leonard's projections give an inkling of the myriad possibilities of digital technology.

It has been expressed many times by engineers in the industry that, outside the instance of final transmission of the broadcast signal from station to home, video information need not be in NTSC format. The fact that the signals are maintained much of the time in NTSC from the transmitter back to the camera may be a classic case of the tail wagging dog. No doubt, this format has been an essential bulwark of the industry from its early days but the advent of digital technology has opened the door to many advantages with many more yet to come.

The transition of the present state of broadcast engineering to an all-digital system is still many years down the road. This road will not be traveled overnight nor in any simple direct manner. Much remains to be done but the trip is well underway. **BM/E**

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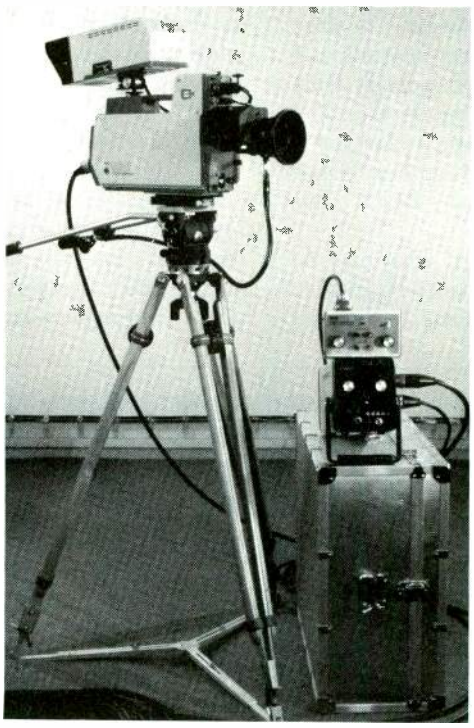

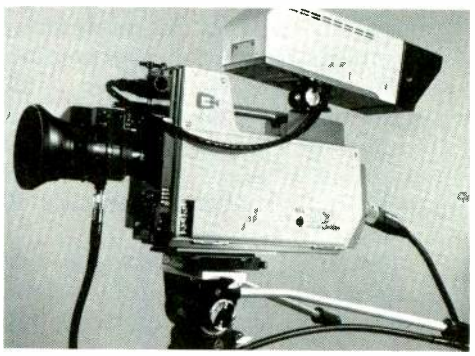

MNC-71CP with 5" viewfinder, mounted on Universal 2030 fluid head tripod (equipped with double handles). Also shown: Remote Production Control Unit and Remote Control Panel ("Paint Box"), camera case and related accessories.

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Extensive use of LSI micro circuits developed uniquely by NEC dramatically reduces the number of individual components in the camera. As a result, the MNC-71CP is significantly more stable in performance, 7 to 14 times more reliable in circuit operation, as well as considerably lower in its power consumption.

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Behind the MNC-71CP is Cinema Products' outstanding reputation for after-sales service. The same consistent and dependable backup we have always provided for our CP-16 line and Steadicam™ — an extensive dealer organization and full factory support.

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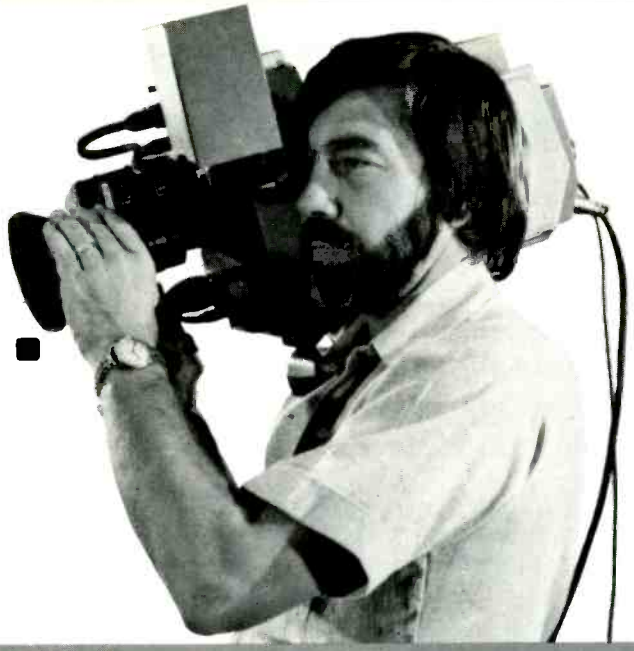

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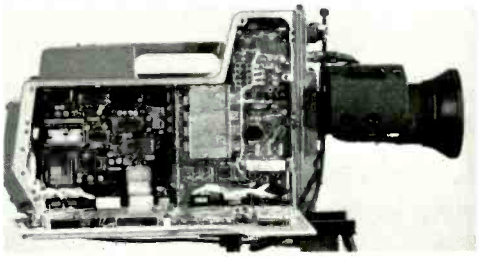
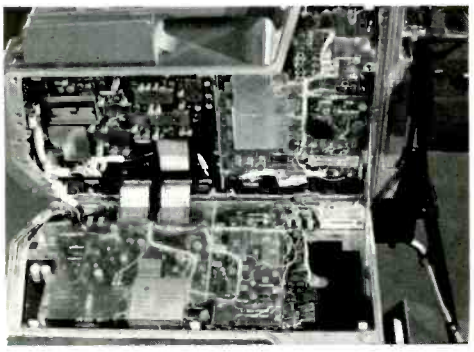
Steadicam (Universal Model) enhances MNC-71CP production capabilities in the field: providing utmost flexibility and fluidity as well as saving time and cutting costs. It is ideal for TV specials, documentaries, and commercials.





Merely opening the sideplates of the MNC-71CP permits checking all internal circuits without using a module extender.

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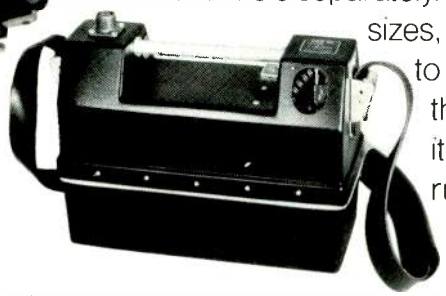

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Digital Audio: This Year An Industry Begins To Form

The technique is already in use with specially built equipment in a number of spots around the world. Here is an account of the regular hardware that will begin to appear later this year. Over the next few years it will create a whole industry devoted to the super-fidelity of digital recording.

"DIGITAL AUDIO IS UPON US" was the pronouncement in a leaflet inviting persons at the Audio Engineering Society Convention in New York last November to a special meeting at which standardization in digital audio would be discussed formally for the first time.

The AES Convention did indeed bring to view the first broadscale industry activity in digital recording. Seven major American and Japanese firms showed digital machines or related products, most of them prototypes of coming hardware. The demonstrations of several of those machines, as reported in this magazine's news department in December, were extremely effective: the digital technique came up to its advance billing as a leap forward in audio fidelity.

Digital recording has been used for audio for some time in a number of places. In England, the BBC has distributed radio programs around the country for a number of years in digital form, and has used home-built digital tape recorders for jobs requiring the highest fidelity. The new 3M machine described below was a joint effort with the BBC, who sought the expertise of a large electronics firm to help in improving their digital technology.

In Japan, Denon, one of the largest record manufacturers in the country, has for a couple of years made all original recordings on their own digital machines, for transfer to discs with almost no loss of fidelity. Their discs reportedly have the same special clarity that has been the stock in trade of the many "direct-to-disc" labels in this country, the generally small record companies that have made a virtue of bypassing tape in record production, putting the music "live" onto lacquer masters.

For a year or so, the National Broadcasting Company has used a digital system, built in their own labs, for carrying the audio tracks of television signals around headquarters in New York. There are more than 300 origination points and 100 delivery points, and NBC decided the only way to get the signals through the massive switching system with top fidelity was to digitize them. Four audio channels go into a bit stream on a subcarrier accompanying the video.

More recently, Soundstream Inc., who developed the digital tape recorder described in *BM/E* a year ago, February 1977, has been leasing the services of the machine to organizations wanting to make high-quality recordings; among the jobs has been a series of recordings of the Boston Pops Orchestra. And coming up in March, as now planned, will be the beginning of satellite distribution to affiliates of the Public Broadcasting System — about twenty public television stations will make up the first batch. Available will be the digitized audio transmission system, called DATE, described in earlier *BM/E* articles, which provides four super-quality audio channels encoded into a single bit stream, sent out on a subcarrier above the video, much like the NBC system noted above.

Digital tape recorder developed by the 3M Company handles in much the same way as standard professional recorders. All operating controls are on panel at right, which lifts out of cabinet and moves up to 20 feet away for remoting.

But the real beginnings of the digital audio industry naturally depend on the appearance on the market of digital machines in sufficient quantity so that anyone

with the money can have one. That may be a couple of years or more off, but we will start to move toward it about the middle of this year. That's when 3M has promised to bring out the first regular production models of their digital machine, introduced last November at the AES Convention. The quantity will be very small at the beginning. Other machines are due to follow over the next year and a half to two years.

In the following is a description of each of the prospective machines, with considerable technical detail. In some cases details of the special technology created for the machines are being kept under cover for the present; but a wealth of valuable information is in the open.

Soundstream Inc. *BM/E* published an early rundown on this machine in the February, 1977 issue. It uses longitudinal recording with stationary head. The PCM uses 15 bits. The tape is 1-inch, running at 30 ips. The main characteristics claimed are: harmonic distortion, unmeasurable (below noise floor) from DC to 5 kHz, typically -86 dB to 30 kHz; S/N ratio, better than 86 dB; wow and flutter, unmeasurable — time base re-established by crystal clock; frequency response, flat from DC to 15 kHz or 20 kHz, user's choice; modulation noise, unmeasurable; print-through, none; cross-talk, unmeasurable DC to 2 kHz, typically -85 dB or better to 13 kHz.

So far, the machine has been made in two-channel and four-channel versions; more channels are coming. One important distinction between it and the 3M and Mitsubishi machines (see descriptions that follow) is in the assignment of signals to tracks on the tape. In the Soundstream system, as formulated by Dr. Thomas Stockham, president, for *BM/E*, "each audio signal is on an independent portion of the tape" — further detail is withheld for the present. One significance of this technique is its effect on methods for editing the tape, and Soundstream claims that their system will allow editing in ways totally familiar to the recording industry. Beyond that, of course, is the sure prospect of automated editing of digital tapes, which will have far more facility, accuracy, convenience than the reel-rocking and razor-blade system we have all grown up with. Soundstream, in fact, has been emphasizing the great advantages that automated editing of digital recordings will have.

Another general factor in the Soundstream technique, emphasized by Dr. Stockham, is the error correction system. It is "fully error *correcting*," using three separate systems to detect errors — further details are promised for later.

As noted above, the Soundstream machine is now being actively used on a "leased service" basis — it is available to any organization wanting to make recordings of orchestra concerts or other musical events, or for studio use in recording production. Dr. Stockham told *BM/E* the machine will definitely be marketed by Soundstream, but at a later date he was not yet ready to specify — one and a half to two years seems a fair guess.

Mitsubishi Elec. Co. Shown first at the Audio Engineering Society convention in Los Angeles, in May, 1977, this machine appeared at the fall 1977 AES meeting with the transport altered from vertical to traditional horizontal form. There are two audio channels. It uses 1-inch tape running at 15 ips. The bit code uses 13 bits; the PCM sampling frequency is 48 kHz; bandwidth, DC to 20 kHz, ±0.5 dB; dynamic range better than 85 dB; distortion less than 0.1% at operating levels; cross-talk below noise level; wow and flutter (again) as low as a crystal oscillator will take them. Mitsubishi manages the relatively low tape speed by spreading the bits across nine parallel tracks. The technology of the machine was described in considerable detail in a Mitsubishi paper presented at the May, 1977 AES meeting. (AES preprint #1227; available from them at 60 E. 42nd St., NY, NY 10017 and recommended to everyone wanting to get oriented to digital techniques.) Mitsubishi says editing can be done in "virtually the same way as on conventional decks . . ." The error correction system is described fully in the paper noted above; the description emphasizes the design sophistication required for digital techniques, particularly error (mostly drop-out) correction. Whether or not any of the makers on this list have, in fact, worked out the problem fully satisfactorily won't be known until we get production models of the machines and use them for some time. In the demonstrations at the AES, all the machines were totally noise-free, which raises a strong presumption of success.

A Mitsubishi spokesman told *BM/E* that dates for marketing their machine had not yet been set. But marketing is definitely "in the plans."

3M Company. This machine, developed jointly with the British Broadcasting Company, as already noted, will apparently be the first digital tape recorder regularly offered for sale. As shown at the November AES Convention, it uses 1-inch tape running at 45 ips. That gives 30 minutes on a 12½-inch reel, which holds 7200 feet of the tape specially made by 3M for the purpose. The larger 14-inch reels can be used for 45-minute takes. 3M wanted a machine that would fit immediately into the normal routines of the professional recording industry. So they developed an elaborate control system (see photo) that any professional in recording can use with ease.

There are 32 tracks on the 1-inch tape, and that means 32 audio channels: there is one channel per track. A 16 bit PCM system, with 50 kHz sampling, gives claimed characteristics much like those of the two machines described already: frequency response, ±0.3 dB, 30 Hz-15 kHz; S/N radio, greater than 90 dB; harmonic and intermodulation distortion, both less than 0.03% over the whole range at +18 dBm input/output; cross-talk, more than 90 dB down, worst case; print-through, not measurable; flutter, not measurable; modulation noise, none.

The error correction system is based on a 50% bit redundancy, with the redundant signals laid along the tape in "blocks" in series with the signals to be corrected. Described in detail in a paper at the AES in New York (preprint #1298), the correction system uses parity words, each formed by comparing two separated words in the preceding "block"; and a cycle redundancy check, or CRC, which signals whether or not an error has occurred in recording that block. If one word in any pair used to form a parity word has been incorrectly recorded, the parity word allows it to be totally

continued on page 55

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And you can do it while the tape is threaded on the head. You don't have to stop to rethread.

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Accuracy is what the JVC CR-8300U is designed for.

The unique built-in Pre-Roll rewinds tape for about 4 seconds from the actual editing point, and puts the recorder in stand-by mode. When you push "Edit Start" the CR-8300U first plays back about 4 seconds of rewound program, then goes automatically into the recording mode at the edit point. You're assured of the highest accuracy.

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You want still frame and slow motion? You've got them. The forward speed can be adjusted from 0 to 1/15th normal speed. You'll always find the exact frame you want.

And the tape counter doesn't just count. It has a memory. When you know you'll want to find a particular point again you reset the counter to "000". Then when you rewind, it will automatically stop the CR-8300U right there.

No other moderately priced videocassette editor has this combination of features to give you the accuracy you're looking for.

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But speed and accuracy are nothing without quality. And quality is what the JVC CR-8300U has most of. It has everything you need for NTSC-type color video *built-in*.

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Black & white resolution is better than 320 lines; color, better than 240.

And if "flag-waving" turns you off, all you have to do is turn on the CR-8300U. The frame servo locks on the odd field, so every edit is smooth and clean.

JVC WORKS WITH YOU

JVC has worked with broadcasters and producers to give you what you want, what you say you really need. Speed, accuracy, quality. And the features you need to get them.

Features like an external sync input for V-locking other sources. A built-in capstan servo mechanism for jitter-free, stable tape speed. An internal time-lapse meter to make regular maintenance easier. And a new remote-control system you can learn about by reading the next page.

AND...TO TIE IT ALL TOGETHER... THE JVC RM-83U REMOTE AUTOMATIC EDITING CONTROL UNIT.

The RM-83U completely controls two JVC CR-8300U recorders for fast and accurate insert and assemble editing.

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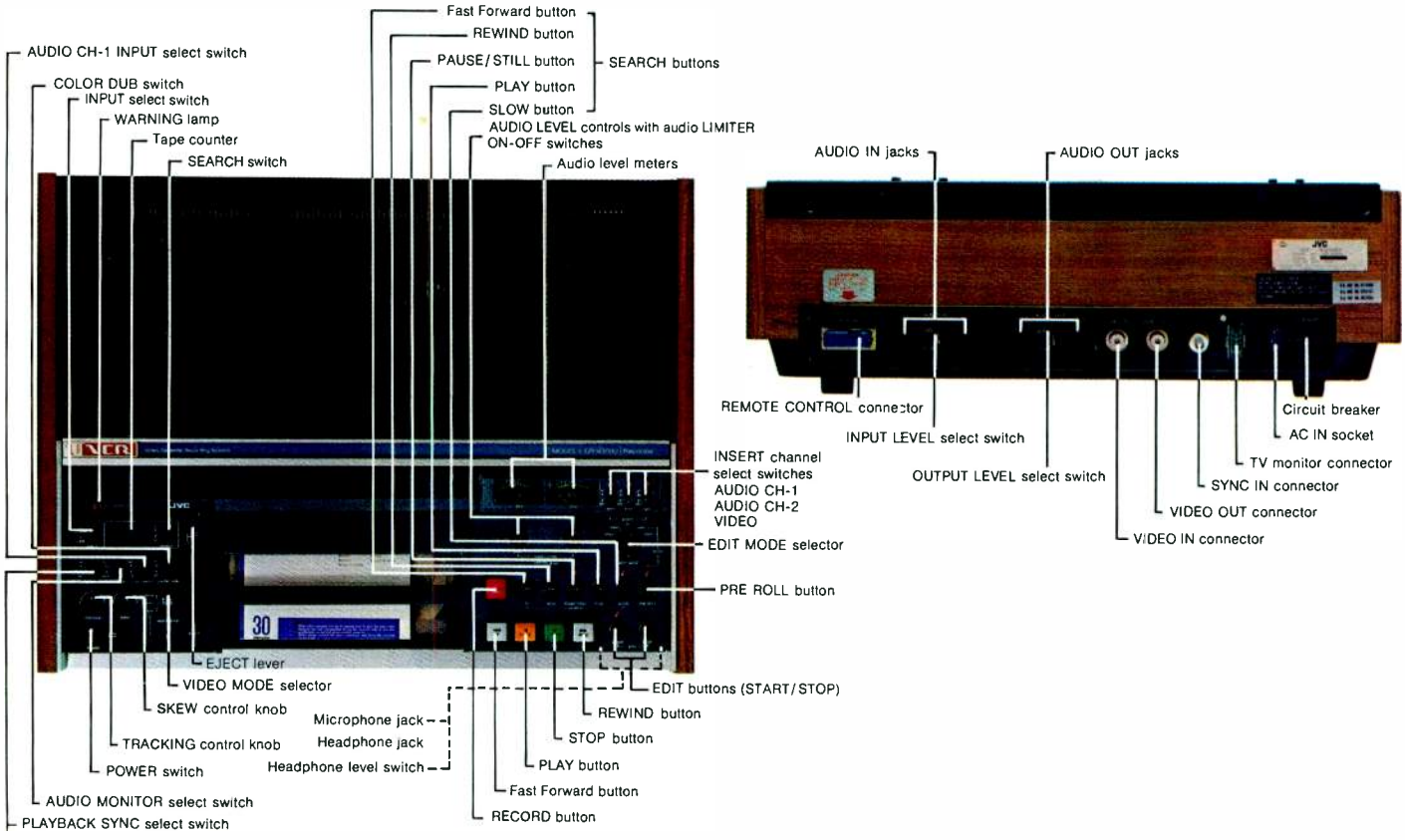
There are many more great features, such as the automatic safety device that shuts off both recorders if a tape is left in still-frame for 10 minutes. Get all the details on both the RM-83U and the CR-8300U by writing today to the address listed on the back page.

SPECIFICATIONS OF THE CR-8300U EDITING COLOR VIDEOCASSETTE RECORDER



GENERAL

Video Recording System	:	Rotary two-head, helical scan system
Luminance	:	FM recording
Color Signal	:	Converted subcarrier direct recording
Video Signal System	:	NTSC-type color signal
Power Requirement	:	120 V AC, 60 Hz 120 watts
Temperature Operating	:	41°F to 104°F (5°C to 40°C)
Storage	:	−4°F to 140°F (−20°C to 60°C)
Operating Position	:	Horizontal only
Weight	:	67.5 lbs. (30.6 kg)
Dimensions	:	24-1/16" (W) x 7-11/16" (H) x 17-3/4" (D) (610 mm x 195 mm x 450 mm)

Tape Transport

Tape Speed	:	3-3/4 ips (95.3 mm/s)
Fast Forward Time	:	Less than 6 min. for 60 min. tape
Rewind Time	:	Less than 5 min. for 60 min. tape
Wow & Flutter	:	Less than 0.2% RMS

Video Signals

Input	:	0.5 V to 2.0 Vp-p, 75 ohms unbalanced
Output	:	1 V p-p, 75 ohms unbalanced
Signal-to-Noise Ratio	:	More than 45 dBs (Rohde & Schwarz noise meter)
Horizontal Resolution	:	Color 240 lines Monochrome 320 lines

Audio Signals

Input	: Mic	−70 dBs, 600 ohms unbalanced
	: Line	−20/0 dBs, 10k ohms unbalanced
Line Output Level	:	−20/0 dBs (600 ohms unbalanced load)
Headphone Output	:	−28 dBs/−37 dBs, (8 ohms unbalanced)
Signal-to-Noise Ratio	:	More than 45 dBs (@ 3% distortion level)
Frequency Response	:	80 Hz to 15 kHz

Be sure to write today to JVC for more information on the CR-8300U Electronic Editing Color Videocassette Recorder and also for a copy of JVC's new Glossary of Video Terms.

JVC

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Circle 139 on Reader Service Card for a demonstration.

reconstituted. The statistics of drop-outs and other faults are heavily on the side of only one faulty word at a time in any pair.

3M says that recordings made on the machine, too, can be mixed down and edited in the traditional ways. They are making a "team" of two machines, one with the 32 tracks for the multi-track recording and one with two tracks to record the mixdown to stereo. The two-machine combination will cost "under $150,000."

In the demonstrations at the show, a piano recording made and played back on the 3M machine seemed to *BM/E* better than anything of the kind heard before.

Laser disc PCM player. This machine, developed jointly by TEAC, Mitsubishi, and Tokyo Denka Company, is aimed initially at the consumer market but has immense implications for the broadcaster. It is very closely like the Philips/MCA video disc machine, described in some detail in *BM/E*, May, 1975. A laser beam, aimed at the surface of a spinning glass disc with a micro-coating of metal, is turned on and off rapidly. It produces a series of tiny "pits" which are laid down in spiral tracks across the disc and can be coded in various ways to carry the information, audio or video. The ability to focus the laser spot down to about 1 micron makes possible an extremely high density of recording; in the video version, each revolution of the disc holds one complete video frame, and the audio version allows storage of a comparable amount of PCM information. At a rotation speed of 1800 rpm, one side of a disc holds about 30 minutes of recording, for either audio or video. Copies of the recording ace made by processes very like those used to produce phono records.

In playback, the laser beam is reflected from the series of "pits" and the variations converted to electrical signals. Keeping the playback spot in focus at the disc through all vertical irregularities of the disc surface, keeping it squarely in the right one-micron track, and moving the beam radially across the surface at the right speed are all accomplished with clever electronic servo systems — without them the whole technique would be impossible.

As a device developed for video recording, the laser disc system has more than the bandwidth needed for top-grade PCM audio recording, and the TEAC-Mitsubishi-Denka machine makes the most of that. Claimed characteristics are: dynamic range, better than 98 dB (!); frequency response, 10 Hz-20 kHz, ±0.1 dB; THD and noise, less than 0.1%; wow and flutter, set by quartz crystal accuracy (as in the other digital machines); two stereo channels; playing time, 30 minutes. TEAC says that the playing time is easily increased to two hours or more (presumably by reducing the rotation rate), and projects single discs holding all the symphonies of a composer or the 30 most popular rock tunes of the moment. Because the servo systems allow almost instant access to any part of the record surface, such a "carry-all" disc would be extremely attractive and easy to use.

The demonstration of this machine at the AES by Mr. Takasji Iwasawa of TEAC was a thriller for all those in the jam-packed audience. As described in the *BM/E* news column in December, a recording of distant bird calls interspersed with close-up train sounds took full advantage of the immense dynamic range of the system; and a recording of virtuoso drum playing, both very soft and very loud, showed the extraordinary handling of very high and very low notes, and transients.

Clearly the machine will at first be for playing professionally-recorded music in the home. But it could have a tremendous future in broadcast stations, as a means of putting professionally-recorded music on the air at a fidelity level well beyond anything we have now. And wouldn't it be easy to adapt to automation or semi-automation systems, with two hours or more of randomly-accessible music on one disc? A great plus for the system is the very low cost of duplication; individual discs could be sold for about the same prices as phono records.

TEAC says that marketing plans are not yet set, but projects a consumer price around $800. That should open a large consumer market. And it is worth noting that PCM for home audio is a very big idea in Japan. In addition to TEAC-Mitsubishi-Denka, several other firms showed prototype home digital systems at the most recent audio fair in Tokyo. The logic of this idea seems strong enough to make it a surety for the near future.

Mitsubishi PCM cassette tape deck. This machine uses another way to encompass the bandwidth of PCM audio; they put it through the helican-scan rotating-head recording of the video cassette machines. Recording is on standard, widely available video cassettes. There seems to be no basic reason that the fidelity should not be comparable to that of the other PCM audio systems; and Mitsubishi does, in fact, claim the following for their machine (brand-new at the November AES): frequency response, DC to 20 kHz, ±0.5 dB; dynamic range, 80 dB; distortion, less than 0.03%; wow and flutter, undetectable; recording time, two hours; digital code, 13 bits; sampling frequency, 47.52 kHz; full drop-out compensation.

Where will this brand of digital audio fit in? Its appeal to the consumer lies heavily on the fact that he will be able to make his own digital audio recordings and play them back immediately, as he does with video programs. The laser disc, for the foreseeable future, will not be a home recording technique. But the disc has a large cost advantage, with individual discs, fully recorded, costing in the $5-$10 range, as already noted. Digital audio on video cassettes will cost several times that. So it will be the consumer's choice: higher cost to be able to make your own, lower cost simply to listen to other people's recordings.

Ampex Corporation. Proper tape, of course, is essential for realizing the full potential of the digital tape recorders that are coming. Ampex stepped up to this need with the first regularly-marketed tape designed specifically for digital recording, the 460 Series. The lowest noise and harmonic distortion levels are not important on a tape for a digital recording, but surface integrity, the lowest possible drop-out rate, and the highest bit packing density *are* important. The 460 tape, according to Ampex, performs especially well on these counts. It can resolve signal wavelengths down to 60 microinches. It is end-to-end surface integrity tested, and production techniques are aimed to keep drop-outs to a minimum. These qualities have been emphaiszed for a number of years in instrumentation tapes, which are also generally "bit recorders." The 460 tape comes in a ½-inch width, 4600 feet on a precision reel, with list price of $71.50; and a 1-inch width, 4600 feet, for list price of $114.75. The base is 1.0 mil thick, and is back coated. Coercivity of the magnetic coating is 310 Oersteds, retentivity 1000 Gs. The tape is on the market. **BM/E**

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Super Spectacle At Super Bowl

Digital technology is used to break new ground in visual artistry offered on television. CBS also displays first great advance in sports televising since slow-motion instant replays.

MILLIONS OF VIEWERS last month enjoyed the results of new advances in digital technology while most of them probably thought they were watching a football game. AVA, the Ampex-built Video Art System (which has been referred to in other publications as "Electronic Palette") provided renown artist, Leroy Nieman, with an entirely new medium to work his wonderous impressions of Super Bowl activity. CBS Action Track gave viewers a unique new way to view important action, the first such innovation in sports televising in the last decade.

These two new developments are dramatic extensions of digital technology and the continuing marriage of television and computers. AVA is the result of more than five man-years of software development by Ampex engineers who have spent this past year constructing and experimenting with the system. AVA began as a joint project between CBS Television Network and Ampex Corporation. CBS provided the early concept and continuing input on how the system should develop.

AVA is not yet a fully developed product and Ampex vice president and general manager of Audio/Video Systems Division, Donald Kleffman has said: "It's an important and dramatic technical achievement, but as a commercially available practical product, it's probably several years away." According to Ampex project engineer, Ken Regnier, AVA utilizes considerable computer hardware common to other information processing systems.

Breakthroughs in semi-conductor components and general purpose computer components have made AVA possible from the hardware side, "...and therein lies the hope of cost control," said Regnier. But, he added, "the real breakthrough has been the extremely creative software."

Action Track was developed by CBS Television Network at its laboratory in Stamford, Conn. and takes advantage of many of the building blocks developed for the Digital Noise Reducer which was licensed to Thomson-CSF Laboratories by CBS last year. Some of these building blocks broadcasters are familiar with such as the frame store, motion detector, comb filter and chroma inverter.

Action Track got limited use during the game but CBS officials explained that its unique qualities are probably better suited to other sports where activity is restricted to fewer participants. Action Track functions in such a way that moving elements in a given TV field are sensed by a motion detector. When alternate fields are compared, those elements identified as exceeding a certain degree of change from the previous field are re-entered in both their former location and their new location. The result, as can be seen in the accompanying photos, is a string of "most active elements" such as a series of golf balls as the ball rolls towards the cup, or a series of baseballs tracing the dramatic trajectory of a pitch. The exact number of repeated elements is selectable. It is one thing to tell viewers that this pitcher has "a lot of stuff on the ball" and quite another to show it.

Used sparingly during Super Bowl XII, here CBS Action Track is applied to a baseball game. The arch of the curve is dramatically displayed as is the trajectory of the hit pitch (white streaks leading left down third base line).

Another function of Action Track allows the stationary portion of the picture (usually the background) to be colored black, or any other color for that matter. The results are dramatic, dynamic images suitable for bumpers or billboards.

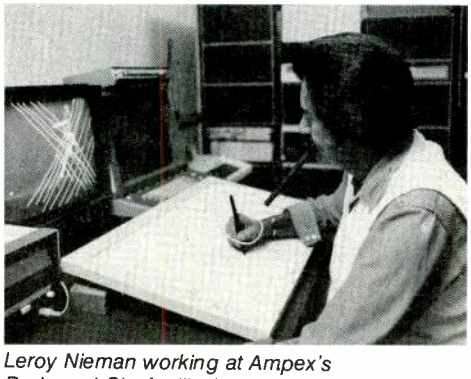
When CBS directors get more opportunity to explore the possibilities of Action Track with other sports, the American sports fan should find this device as important a part of spectating as slow-motion replay has become.

AVA, under the talented control of Leroy Nieman, provided some of the most beautiful graphics ever seen on national television. Nieman had spent some time at Ampex's Redwood City, California facility practicing with AVA. Later, Nieman went to New Orleans a few days preceeding the game to gain some additional time with

AVA and to prepare some material for uses in the pre-game and as bumpers. During the game itself, Nieman created topical impressions of the game, one of which appears on our cover and others accompany this article.

As indicated by Ken Regnier, most of the hardware associated with AVA has been in use in other areas of information processing and computers. AVA, however, contains about 96,000 16 bit words of software. "To do what we are doing," said Regnier, "we have to have a very fast computer and several thousand kilobytes of software."

Another action packed interpretation of Super Bowl XII by Leroy Nieman working on AVA.



Leroy Nieman working at Ampex's Redwood City facility in preparation for Super Bowl. Note that no marks appear on the tablet.

A Nieman rendering of CBS Sports commentator, Phyllis George is being replaced by another Neimen picture from the AVA frame buffer, line by line. An alternative display method is to read-out sequentially, which would allow the viewer to see the artwork recreated in the same sequence in which it was drawn.

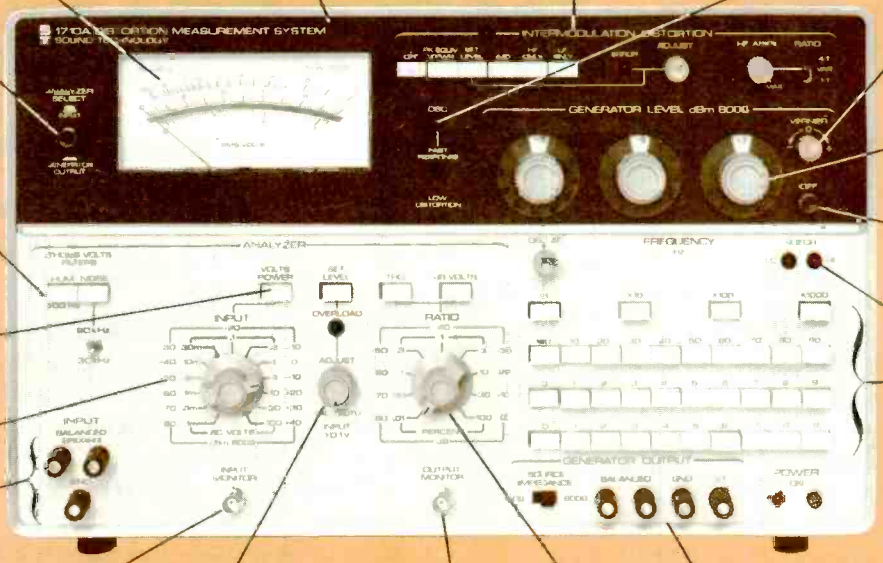
What AVA does is this: the main interface between the artist and the computer is the "tablet". The tablet is essentially, thousands of tightly wound wires running vertically and horizontally in a matrix just under the surface of the tablet. A 200 Hz field pulses along these wires. The implement used by the artist is in the form of a "pen" but functions as a transducer, which, when pressed to the tablet, senses this pulse and starts a timing function in the computer. The software of the computer describes the tablet as a matrix of 512 pixels by 512 pixels, and each pixel is described by an 8 bit word. The timing function permits the path of the pen across the tablet to be accurately tracked in all directions.

What is astounding about AVA, however, is not so much the ability to accurately track the movements of the pen on the tablet but rather the enormous number of functions available to the artist. These functions are available through what is called the "menu" side of AVA. At any one time, the artist can choose any one of 256 distinct colors. Which colors make up the palette is determined by the artist and can be changed. Moreover, different modes allow the color selected to be described as opaque or translucent, or allows the colors to be mixed with other colors. The initial selection of the colors is done in the "color map mode", which, when initiated, causes the available colors to be displayed on the color monitor. The artist moves the pen over the surface of the tablet and a cursor moves correspondingly over the monitor screen. When the cursor is over the desired color, the pen is pressed to the tablet and that color is assigned to subsequent movements of the pen. In addition to colors, the artist can also select a variety of brushes from thick to "air brush". The artist draws the pen across the tablet. No marks are made on the tablet itself. The results of the pen's movement are registered instantly on a color monitor in front of the artist. According to Regnier, it takes just a short time for the artist to develop the necessary hand to eye coordination required to work in this way.

All of the information required for the interactive character of the machine is either stored in RAM core, or buffered in such a way as to maintain the interactive character of the machine. The output created by the artist, however, is stored serially so that when a painting is read out, it may take several seconds. Once read out through a frame buffer to the monitor, it is in NTSC format and can be output to a still store or other medium utilizing NTSC.

Though AVA is not yet a "product" per se, it offers enormous possibilities. One suggestion made has been the possibility of a centralized graphics arts system for television stations that would allow them to tap top artists for a fraction of what exclusive access or maintaining their own art department might cost. Joe Flaherty, vice president of engineering for the CBS Television Network, sees AVA as another important step towards bringing the creative artist and the technology closer together. Said Flaherty, "This system offers unparalleled opportunity for creativity. Traditional television graphics systems limit the artist's images to fairly simple geometric shapes while (AVA) actually expands the artist's horizon." Leroy Nieman agrees. Said Nieman, "To apply strokes to the electronic surface and leave no marks — almost painting blind — allows me to become a real part of the painting and makes the television viewer a participant in the excitement of the creation of a work of art." **BM/E**

Here's how useful a distortion analyzer can be



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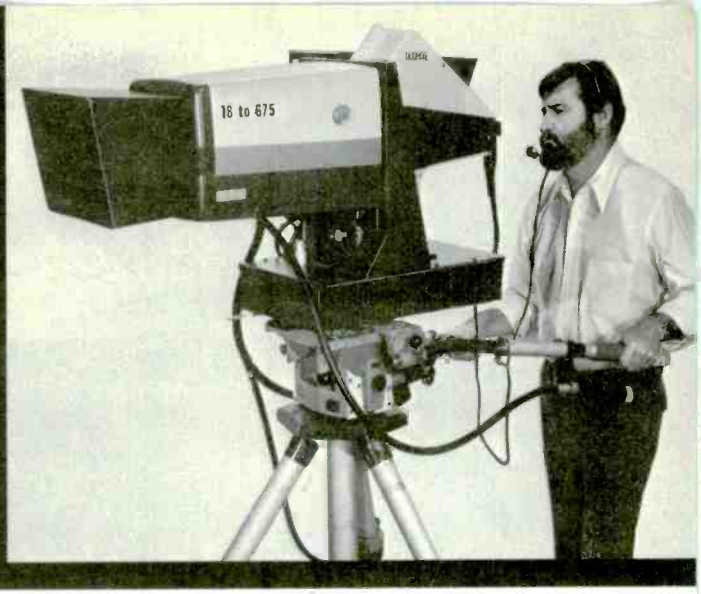
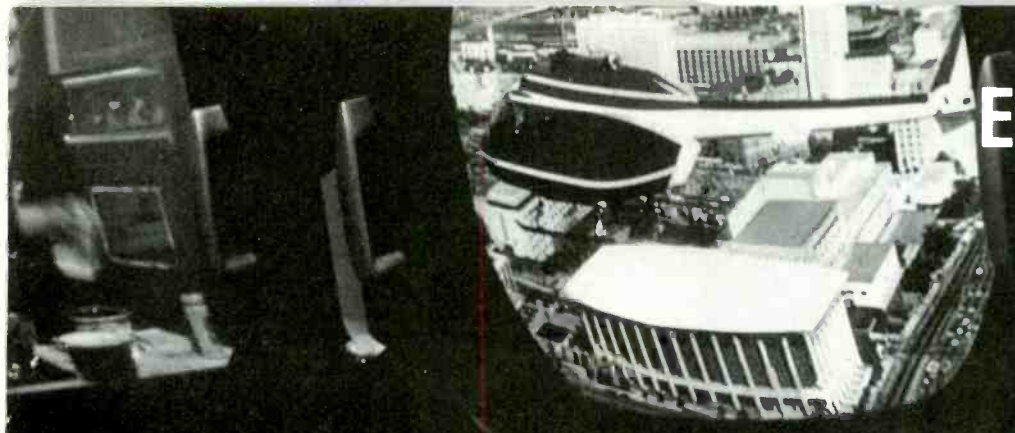


TKP-46. Part of the new video freedom.



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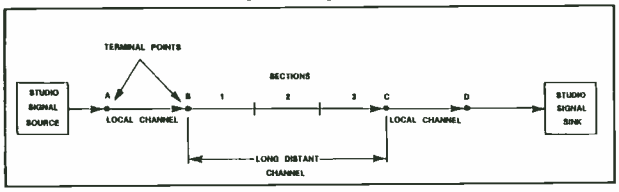
Digital Television Transmission

By Leonard S. Golding

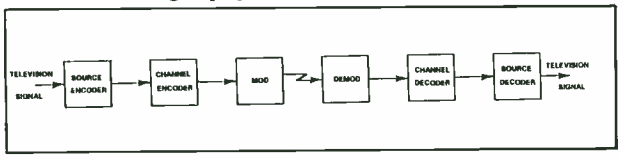
By March of 1978, some 20 PBS affiliates will be receiving four discrete audio channels along with video through the DATE (Digital Audio For Television) system designed by PBS and Digital Communications Corp. By the end of '78, the majority of PBS affiliates are expected to be on the DATE system. The next big jump will be to develop a digital transmission system for the video signal. Dr. Golding outlines below many of the techniques and considerations going into this next great step in broadcast technology.

A TYPICAL LONG DISTANCE television transmission link is depicted in Fig. 1. As one can see, it is comprised of some local sections plus a number of sections which make up the long distance portion of the transmission link. In the case of digital transmission, one or more of these sections will be transmitting the television signal in digital form. If the transmission link is totally digital, then all sections will be handling the digital television signal. In the near future it is very possible that some sections may be analog and some sections may be digital.



Television long distance transmission link.

A signal usually starts at some studio location and travels through the local channel, which could be either a coaxial cable or a radio link, to a television operating center or international television exchange. The signal then travels over a long distance channel which may be made up of several radio relay hops, several sections of coaxial cable, or possibly a satellite link. The television signal arrives at some distant point and then goes over a local channel from a receive television operating center or international exchange to a studio location, usually for re-broadcast or further editing. In the long distance transmission link there are several terminal points as noted in Fig. 1. These points are labeled A, B, C and D in this figure. Each terminal point contains television receiving and transmitting equipment as shown in Fig. 2.



Terminal point configuration.

At each terminal point there are three key signal processing operations that are generally carried out, which affect the television signal quality and which should be considered in more detail.

The first operation is called source coding, involving a source encoder on the transmit side and a source decoder on the receive side. The main function of the source coder is to take the analog or digital television signal and process it to remove redundancy in the signal so that it may be transmitted with a given picture quality at a minimum bit rate. This operation is very significant for transmission systems since it is costly to transmit bits over long distance links and the greater reduction in bit rate possible, the lower the potential cost for the transmission link.

The second type of processing that is carried out at the terminal point is called channel coding or very frequently called error coding. In this operation, the properties of the channel or transmission link such as the additive noise in the channel and other sources of impairments, are used to encode the bit stream so as to offer maximum protection against these impairments. Generally, this operation involves the insertion of additional bits into the data stream which can be used at the receiver to detect and locate bit errors that have occurred in the data stream as a result of transmission over the link.

Error coding is important for it permits operation at lower carrier-to-noise ratios, which in turn means a requirement for less transmit power. This directly affects the cost of the transmission link and for some links, such as satellite links, may be a limiting factor in realizing a given picture quality irrespective of cost.

The third operation carried out at the terminal involves modulation and demodulation of the digital information on a sinusoidal carrier. One example of this is the use of Phase Shift Keying, where the phase of the carrier is modulated by the digital television bit stream. The modulation method used is important in determining the required RF bandwidth and power needed in the transmission link and is an operation which is given a very careful consideration in the design of the overall transmission system.

Each of the three signal processing operations effects the type of impairments which will result in the reconstructed television signal that is delivered to the user. Furthermore, these operations can not be considered completely separately as each operation effects the performance of the other operations. For example, if differential phase-shift-keying (DPSK) where to be used as the modulation technique, when bit errors occurred in the transmission system, they would occur in pairs due to the differential method of extracting the data. These pair-wise errors would cause a particular noise pattern to appear in the reconstructed television signal or in turn, would effect the type of error coding which might be used in the link.

continued on page 64

Dr. Golding is vice president of Digital Communications Corporation, Gaithersburg, Maryland.

Digital Television Transmission

In this article several of the questions which must be answered when considering a television transmission link that involves digital sections, are addressed, as well as a discussion of the directions currently being taken to answer these questions.

Source coding considerations

The following is a list of considerations that have to be made when considering the coding of the television signals for minimum bit rate with a given required quality:

- Passbands and exact frequency spectral characteristics of luminance and chrominance signals
- Quality objectives and methods of measurement
- Bit rate objectives
- Composite or component analog-to-digital conversion
- Intra or inter frame coding
- Adaptive or non-adaptive coding
- Performance as a function of input signal-to-noise ratio
- Performance as a function of channel bit error rate and bit error distribution
- Equipment complexity

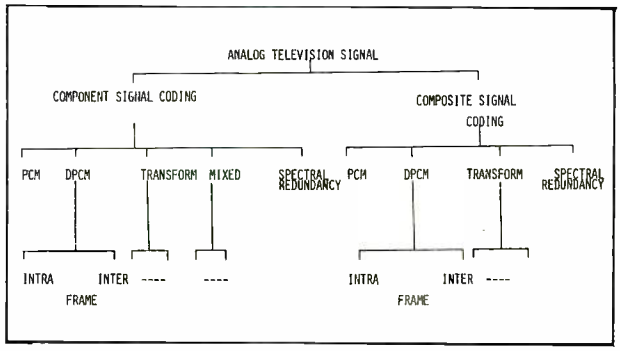
Several of the above items relate to general requirements on the source coder while several other items relate to the type of source coding selected. In the area of requirements, one must define the exact spectral characteristics of the luminace and chrominance signals, such as the exact amplitude-frequency response of these signals in order to be able to select the most appropriate filtering and the lowest possible sampling rates that should be used in the analog to digital conversion process. Current definitions of the NTSC signal do not specify the spectral characteristics of these signals in sufficient detail for determining the correct pre and post filters and sampling rates. One must also specify the quality objectives that the source coders must meet and the methods of measurement. The most meaningful specification of quality is in terms of subjective quality, relating picture impairments to a subjective rating of picture quality. All the objective analog specifications were originally based on subjective quality and in the case of this new area of digital television, I believe the same will hold true. In defining the source coding technique which is appropriate, one must also identify the bit rate objectives, that is the output bit rate at which one wishes the source coder to operate, and the allowable equipment complexity.

Related to the quality objectives is the sensivity of the source coding technique to bit errors made in the channel and the nature of the bit error rate distribution with time. In order to meet given quality objectives different source coding techniques may require different bit error rates in the communications channel as a function of the nature of the bit error distribution with time. Clearly, source coding techniques which are more sensitive to bit error, will place more stringent demands in both power and bandwidth on the digital communications system. This must be considered in selecting the source coding technique.

In Fig. 1 the various terminal points where source coding is carried out may have as an input a television signal with different signal to noise ratios at each of the terminal points. Therefore, another important consideration is the performance of the source coding technique as a function of input video signal to noise ratio.

SOURCE	SAMPLING FREQUENCY (MHz)	DIGITS PER SAMPLE	TYPE OF DIGITAL CODING	QUANTIZING DISTORTION S/N (dB)	SUFFICIENT GROSS BIT RATE (MBPS)	REQUIRED ERROR RATE
A.T. & T.	10.290	9	PCM LINEAR	--	92.61	10^{-6}
NTT (JAPAN)	10.7	4.3 (AVERAGE)	2 DIMENSIONAL DPCM VARIABLE LENGTH CODING	51 to 55	44.0	--
COMSAT	10.7	5	HIGHER ORDER DPCM	--	44.7	--
NTT (JAPAN)	Y - 7.6 I - 2.5 Q - 1.3	Y - 4.9 (AVERAGE) I,Q - 3.7 (AVERAGE)	COMPONENT CODING 2 DIMENSIONAL DPCM VARIABLE LENGTH CODING	--	32.064	10^{-7}
COMSAT	Y - 6.02 I - 1.77 Q - 0.78	Y - 5 I 4 Q	NON-LINEAR DPCM SUB-NYQUIST SAMPLING	--	33.6	10^{-4}
OKI (JAPAN)	10.7	3.2 (AVERAGE)	TRANSFORM	--	34.0	10^{-6}
NEC (JAPAN)	10.7 (7.2)	8	NON-LINEAR DPCM INTRAFRAME	--	20 to 25	10^{-4}

Some proposed digital TV coding techniques for 525/60 NTSC color television signal.



Source coding

In selecting the source coding technique, there are a number of basic options open to the designer. These are listed above and are also shown in Fig. 3. One of the basic decisions which must be made by the designer is whether or not to directly encode the NTSC composite signal, or to first separate the composite signal into its luminance and chrominance components and separately encode each of these components from analog to digital form. Coding the luminance and chrominance signals separately permits easier access to the properties of each of these signals and allows the designer to more effectively use these properties to obtain lower bit rates in the source coding operation. Therefore, for greater bit rate reductions, component signal coding is a more desirable approach. However, component signal coding generally involves greater equipment complexity as well as having to contend with possible degradation associated with separating the luminance and chrominance components from the composite signal.

In transmission links, which require standards conversion, the signal format to be provided at the receive site is different than the input signal format at the transmit site. Component signal coding is very attractive, for these transmission links since the composite signal must be separated into its component parts in any case, in order to provide the standards conversion. It would therefore seem desirable to take advantage of the separation of a signal

continued on page 66

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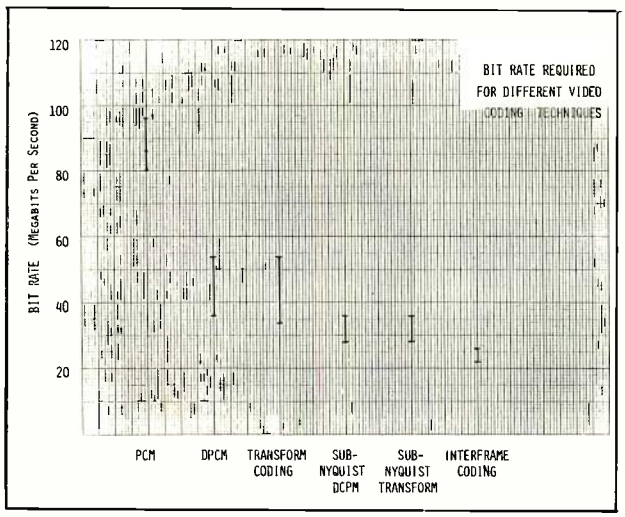
into its component parts for source coding as well.

Another basic choice in selecting a source code is whether or not information from more than one frame of the television signal would be used. Intraframe source coders only process the information within a single frame in order to obtain a bit rate reduction. On the other hand, inter-frame coders also use the information from successive frames to take advantage of the frame to frame redundancy in their signal processing operations. As one might expect, the inter-frame coders generally can provide lower bit rates or greater bit rate reductions, because of using the frame to frame redundancy that exists. However, they are usually more complex because they require large amounts of memory in order to take advantage of this type of redundancy.

Many properties of a television signal are difficult to define because they vary so greatly from one program to the next in the commercial broadcast application. For example, in one case there may be coverage of a sporting event such as a football game involving a great deal of rapid motion, and a great deal of scene detail associated with the background crowd. In another case, a commentator may be talking in front of a television camera involving scenes with very little motion and very little detail. These large variations in scene content lead to another basic selection which has to be made by the source coding designer; that is, should his source coding be adaptive, monitoring the television signal characteristics and then using them to adjust the coding technique, or should the source coding technique be non-adaptive; that is a fixed coding technique based on long term properties of the signal. Both types of source coding techniques have been developed.

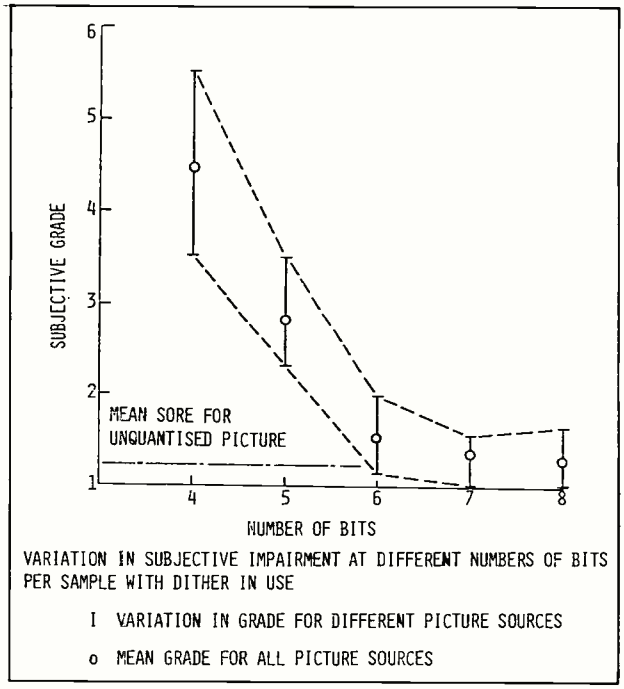
The basic method for converting the analog television signal into digital form is the use of pulse code modulation. This conversion process does not attempt to take advantage of any of the redundancy in the television signal and generally requires a sampling rate of approximately 3 times the color subcarrier or 10.7 MHz and 8 bits per sample for a bit rate of approximately 86 Mbps to provide a digital television signal that will meet commercial broadcast quality.

As shown in Fig. 3, pulse code modulation can be applied either to directly encoding the composite signal or



Bit rate required for different video coding techniques.

to converting eash of the luminance and chrominance signals separately into digital form. As indicated in Fig. 4, the bit rate required with pulse code modulation ranges anywhere from 80 to 96 Mbps. The need for such a high bit rate is emphasized by the subjective results shown in Fig. 5. These results, obtained by the BBC Research Labs, show that 7 to 8 bits per sample are needed in order to obtain a subjective rating of between 1 and 2. The subjective rating scale shown is a six grade impairment scale where grade 1 corresponds to "imperceptible degradation" in the picture; grade 2 corresponds to "just perceptible degradation" in the picture, up to grade 6, which is objectionable degradation in the picture. The typical objective for commercial broadcast service is a subjective grade of 1.5 to 2.



Example of measured results for PCM coding.

Subjective results, such as shown in Fig. 5 for PCM coding, is the primary method for evaluating the performance of digital television processing techniques and serves as the basis for comparison of different types of processing methods.

As shown in Figs. 3 and 4 there are a number of other signal processing techniques that can be applied to coding television signals which are capable or reducing the needed transmission bit rate by a factor of from 2 to 4 over pulse code modulation. These techniques in some way use the redundancy in the television signal, either within a single frame or from frame to frame.

Differential pulse code modulation (DPCM) as discussed in detail in reference 1, attempts to estimate the next sample value from a predicted value determined in some way from previous samples, either previous samples along the same scan line or from previous scan lines, as well as the same scan line within single frame are used. DPCM can also be applied on an inter-frame basis using samples from the preceding frame as well as the present frame.

The difference between the predictive sample value and the actual sample value is the signal which is actually encoded into digital form and transmitted. If the prediction is accurate, as will be the case if the samples are

highly correlated, then this difference signal will have a small dynamic range and will require fewer bits per sample to encode it than the original sample value. Furthermore, the difference signal will have a well-defined amplitude distribution with a maximum value around zero. Since DPCM encodes the derivative information in the signal, most of the noise which does occur when using this technique, will occur around the edges of the image. Subjective tests at Bell Laboratories, have indicated that subjectively edge noise is more tolerable than the equivalent amounts of noise in flat areas of the image. Therefore, by employing both the statistical properties of the signal as well as subjective properties of the viewer, DPCM permits a reduction by a factor of approximately 2 in required transmission rate with the same subjective quality.

Another source coding technique for television is called transform coding which is discussed in detail in reference 2. This type of source coding offers approximately the same bit rate reduction as DPCM and also uses both the subjective quality of the viewer and the statistical properties of the signal to acheive a bit rate reduction. In the transform coding method the video signal is converted by means of a Fourier transform or a Hadamard transform into the frequency or sequency (zero crossing) domain. As a result of this transformation, the image is now described in terms of its content in different frequency bands. Due to the redundancy in the signal, most of the energy content will be at the lower frequencies with only small amounts of energy at the higher frequencies. Furthermore, subjectively it has been shown that more noise can be tolerated at the higher frequencies than at the lower frequencies as was indicated previously for the case of DPCM.

Taking these facts into account, the transform signal is split into a number of frequency (or sequency) bands and each band is encoded separately using a different number of bits per sample for each band. In this manner the quantization noise spectrum can be shaped to provide more noise at higher frequencies in keeping with the subjective properties of the observer. Also frequency bands which do not contain any signal energy can be identified and zero bits per sample can be assigned to these frequency regions. This signal representation also permits easy determination of minimum filter bandwidths allowing one to suppress unimportant frequency regions by means of two dimensional low pass filtering.

Transform coding is closely related to DPCM. As a matter of fact, it has been shown by Habib that DPCM is a special case of transform coding. As can be seen in Fig. 4 both DPCM and transform coding achieve about the same bit rate reduction. One difference between coding the signal in composite form and separating luminance and chrominance components and coding them in individual form, is that in the case of component signal coding, it is easy to encode the luminance and each chrominance signal using different source coding techniques or the same source coding technique with different parameters optimized for each signal. It is more difficult to optimize a coding technique for each signal when the television signal is in its composite form.

Another source coding technique which takes advantage of the characteristics of the video signal in the frequency domain is a technique called sub-Nyquist sampling, identified in Fig. 3 as a spectral redundancy technique. Reference 3 provides an expanded discussion of this technique. In this technique, advantage is taken of the fact that the energy of the television signal is clustered at multiples of the line harmonics across the frequency band rather than being totally continuous with frequency. This clustering of energy permits one to interleave the sampling error as a result of sampling the signal at a rate lower than 8.4 MHz so that this sampling error or aliasing energy can be removed by means of a comb filter at the receive point. This technique then permits one to use sampling rates lower than 8.4 MHz and still not suffer degradation due to sampling error such as the generation of moire patterns that would normally be generated when sampling at too low a rate. This method not only takes advantage of the statistical properties of the signal which result in a clustering of energy at multiples of the line harmonic, but also takes advantage of the subjective property of the observer that if the difference frequency exceeds 100 Hertz the energy inserted in the original video spectrum becomes very difficult to see in the image. This sub-Nyquist sampling technique has been combined with DPCM or transform coding to achieve bit rate reductions of approximately 3 to 1 over PCM coding.

The lowest bit rate achievable of approximately 25 Mbps with commercial broadcast quality requires the use of inter-frame coding and the redundancy that exists in the signal not only within a single frame but from frame to frame. References 4 and 5 discuss specific inter-frame coders. Generally, the inter-frame coder requires a full frame memory so that the new frame of information can be compared with the old frame to determine how many significant changes have occurred. Typically only the significant changes are transmitted as new information. The inter-frame coder employing both frame to frame redundancy and spatial redundancy within the frame is capable of the lowest required transmission bit rate, however, it is also the most complicated codec of the various ones discussed.

Each of the above source coding techniques that have been described have already been implemented and been tested in real time with television signals.

Error coding considerations

The following is a list of considerations that should be made to protect the digital television bit stream when transmitting the signal over digital communication links.

- Link error rate and error distributions
- Error rate objectives
- Forward error correction or automatic repeat request (ARQ)
- Error detection and concealment or error correction
- Bandwidth constraints — coding rates permissible
- Impairments in reconstructed video signal — relationship to source coding
- Soft or hard decision error decoding
- Error protection for synchronization signals for data
- Equipment complexity

As in the case of source coding, error coding has some fundamental areas in which error coding techniques can be grouped. The first such area is whether the error code is used for error detection only, or both detection and correction of errors. In the case of the television signal, one method of using error coding is to simply detect the errors at the receive point and conceal them using the inherent

continued on page 70

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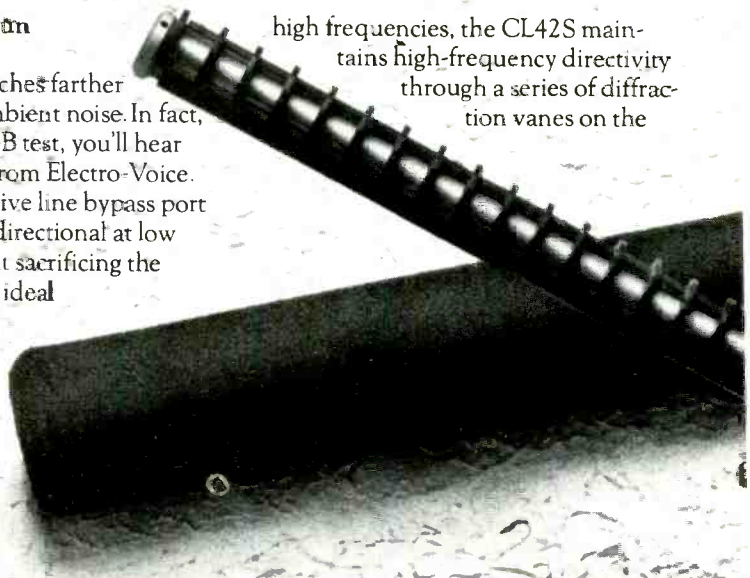

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Hypercardicid System
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CH15E
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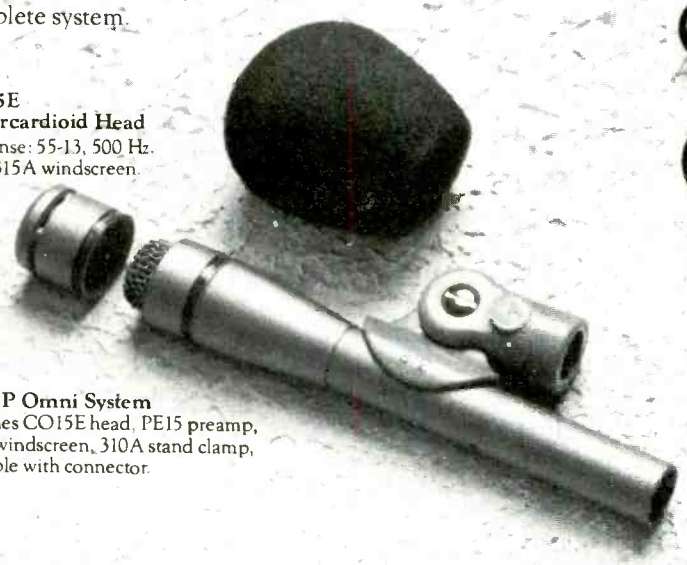

CO15P Omni System
Includes CO15E head, PE15 preamp, 315A windscreen, 310A stand clamp, 15' cable with connector.

CS15P Cardioid System
Includes CS15E head, PE15 preamp, 315A windscreen, 312A stand clamp, 15' cable with connector.

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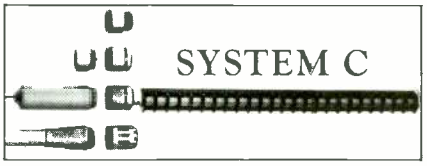

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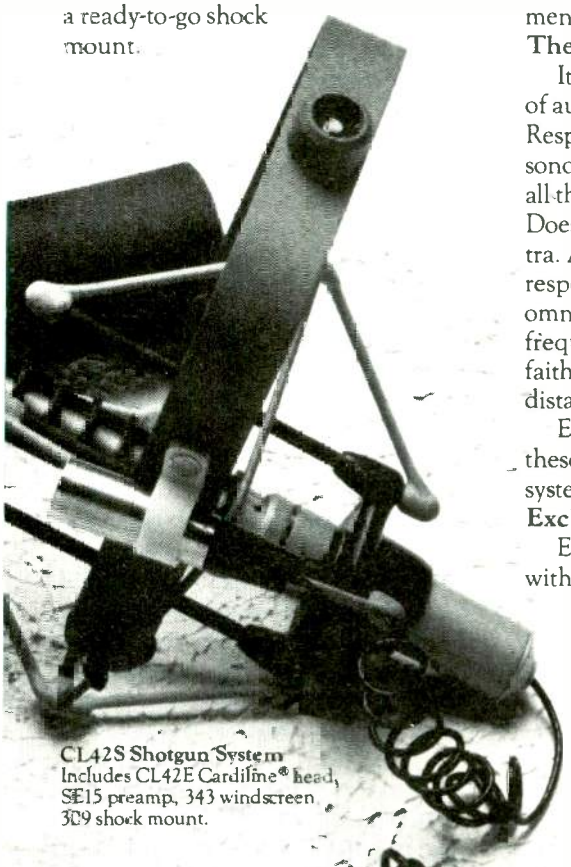

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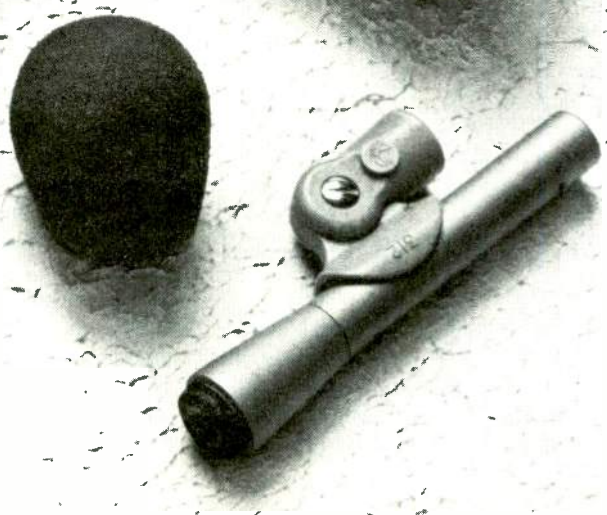

PE15 Preamplifier
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redundancy in the television signal. For example, if one sample has errors associated with it, and this is detected at the receiver, that picture element can be replaced by the previous picture element. Since the adjacent picture elements are highly correlated this replacement would not be noticed within the picture provided the frequency of occurrance was not too high for this replacement procedure.

If error correction is to be used, there are two basic methods for carrying out such error correction. The first is called automatic repeat request (ARQ) in which errors are detected at the receive point and the transmit point is requested to retransmit those bits which are in error. This type of coding requires a return communications link and storage facilities at the transmit and receive points to store the message until it is verified that the message has gotten through correctly.

The other method for error correction is forward error correction where enough structure is built into the code to identify the specific location of the bits in error. Within the area of forward error correction there are two fundamental error correction techniques, one of which uses the amplitude information in the receive pulses to assist the error decoding process. This is generally called soft decision error decoding.

The other involves first reconstituting the binary pulses from the received digital signal and then using these binary pulses in the error decoding process. This is typically called a hard decision error decoding process.

The soft decision error decoding process generally is more complex, but is capable of providing on the order of 2 dB additional coding gain as compared to hard decision decoding. In selecting the error code one must first decide what are the error rate objectives. For a PCM coded digital television signal, based on subjective tests, a bit error rate objective of 10^{-8} or better is required to have imperceptible errors in the picture. This is illustrated in Fig. 6 which

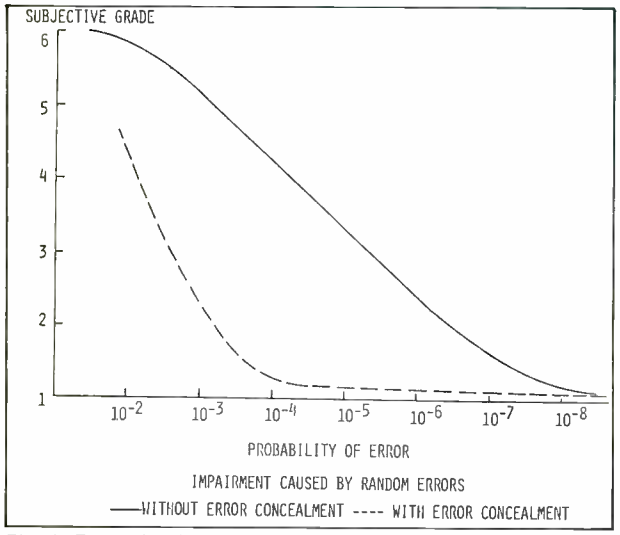

Fig. 6. Example of measured results for bit error rate sensitivity with PCM coding.

shows results of measurements made at the British Broadcasting Corporation Research Labs. The solid curve in the figure corresponds to subjective tests on acceptable bit error rate with no error coding employed. The subjective grading scale is the same impairment scale that was shown in Fig. 5. The objective for commercial broadcast television being between 1.5 and 2 on this grading scale which would correspond to imperceptible impairment.

Other items which must be considered when selecting an error code are the link error rate and the distribution of errors with time in the link. In the case of random additive noise in the link the bit errors generally are randomly distributed with time. However, some links exhibit clusters of errors due to fading conditions in the link or impulse noise which is generated by various mechanisms. The distribution of errors in the link determine the type of error code which is to be selected. The error code must effectively use the characteristics of noise in the channel to suppress the errors that do occur, just as in the case of source coding where the statistics of the source are used to effectively obtain bit rate reductions.

A very important consideration for many communication links, particularly terrestrial communication links, is the limitation on bandwidth available in the communications link. Error coding generally involves the insertion of additional parity check bits into the data stream in order to provide the protection against bit errors made in transmission. This generally involves an expansion of bandwidth in the communications link needed to accommodate the higher bit rate associated with the error protected data stream. If bandwidth is an important constraint then the error code that is selected must be very efficient, that is, use very few additional check bits in order to provide the error protection. Such codes do exist, however, they generally involve greater complexity in order to achieve the same degree of error protection as ones which permit a greater number of check bits to be entered in order to obtain the error protection. In the case of the television signal, where error rates of 10^{-8} or better are generally required error codes that add only one additional check bit for every ten information bits or one additional check bit for every seven information bits have been built and are capable of permitting operation over transmission links which have a 10^{-4} bit error rate providing a four order of magnitude improvement in permissible bit error rate over the uncoded case.

In Fig. 6 a dashed curve is shown representing the performance where error detection is employed and error concealment used for masking the errors. Only one additional check bit is added for every eight information bits to achieve this error detection capability. As one can see from Fig. 6, a four order of magnitude improvement is achieved through the use of error detection plus error concealment.

One important aspect of error coding which also must be considered is the impairment introduced int he reconstructed video signal and the effect of the source coding technique on the impairment introduced in the video signal. For example, if we consider DPCM we have a source coding technique which encodes the derivative of the video signal. Therefore, in the differential PCM decoder an integrater must be included to recover the video signal. When a bit error occurs in the transmission link the integrator in the source decoder causes the error to be propagated over many samples. In this particular case, one has increased sensitivity to bit errors which must be considered in determining the bit error rate objectives and in turn impacts the error code selected. Bit errors in a pulse code modulated system on the other hand, result in isolated

continued on page 72

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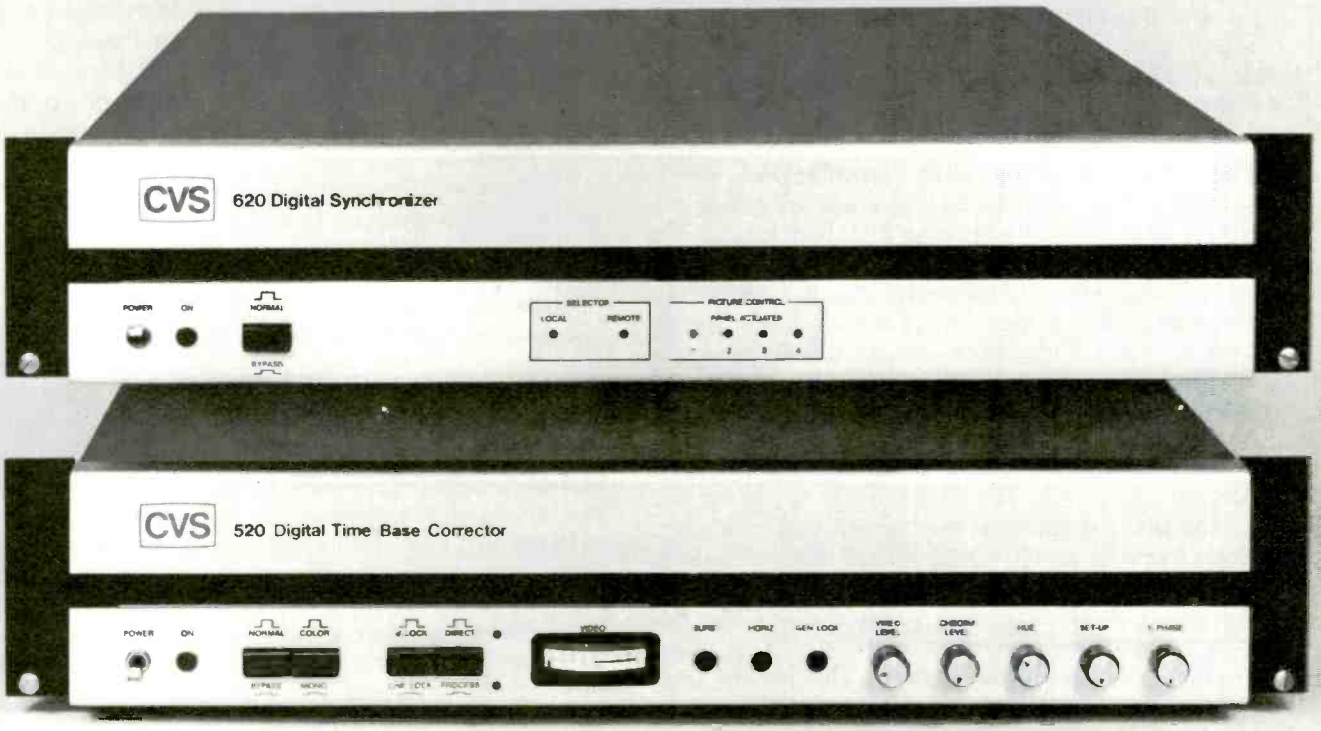

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errors in the reconstructed luminance or in chrominance signals. In this particular case error detection with error concealment is an effective means of eliminating the impairment in the reconstructed video signal due to bit errors in transmission.

These examples indicate the inter-relationship between the source coding technique, the error coding technique, and the resulting impairments in the reconstructed video signal which must be considered when selecting both coding techniques.

Examples of digital television transmission systems

A number of experimental digital television transmission systems have been developed for both satellite and terrestrial communication links and have undergone testing over such links. The following tables lists some of the systems that have been developed in the U.S. and in other parts of the world. As can be seen from the table, most of the systems that have been developed use differential Pulse Code Modulation as the primary means of reducing the bit rate below that of PCM encoding and use sub-Nyquist sampling as the other means for reducing this bit rate.

Most of the systems use only the information within a single frame for source coding (intra-frame coding techniques) and use some sort of error coding to permit operation over communication links which have a bit error rate of approximately 10^{-4} which is a rate typically provided for digital speech communications. This permits compatibility between digital television and digital speech transmission.

One system listed in the table is of the inter-frame coding type, which is capable of operating as low as 25 Mbps and providing commercial broadcast quality. It should be pointed out however, that extensive subjective testing of most of the systems listed in this table has not been carried out. Therefore, one can at best say that these systems appear to provide acceptable commercial broadcast quality. However, more testing must be carried out before this can be stated as a proven fact.

In reviewing the information in the table one of the points that is evident is that these systems are intended to be compatible with digital terrestrial networks that are in planning which are intended primarily to carry voice communications. Most of the transmission rates for the European systems listed are aimed at 34.7 Mbps which corresponds to the third level in the digital transmission hierarchy. In the case of North America and Hapan, the transmission levels are aimed at 34.7 Mbps, or half that rate, which is the third level in the digital hierarchy in these countries.

Digital television transmission is a new area where transmission systems are first beginning to emerge from the research and development laboratories into working or operational systems. Very little has been done in the way of standardization of digital television transmission systems and very little has been done in the way of developing standardized test procedures for evaluating digital television systems. However, the potential which has already emerged for digital television transmission indicates that digital handling of the video signal offers a great deal of promise for providing long distance transmission systems which can provide very high video quality.

In the next five to ten years it is expected that digital television transmission will become very important from an operational standpoint and standardization will have been able to determine specific source and error coding techniques that become widely accepted for transmission of video signals throughout the world. **BM/E**

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Digital Video Bit Rates And Quantities — What's Best?

By William Miller

Increasingly, digital equipment for broadcasters is utilizing the 4 times subcarrier sampling rate. Though more expensive than the 3 times subcarrier design, there are significant advantages to the higher frequency sample.

William Miller is product manager for Consolidated Video Systems, Sunnyvale, Calif.

IN RECENT MONTHS, there has been a high degree of controversy over 3 times subcarrier (3fsc) vs 4 times subcarrier (4fsc) and 8 bit vs 9 bit digital systems. Numerous technical articles and discussions have appeared. Perhaps of greater importance is that various manufacturers have adopted different digital formats for their products. Thus, an understanding of the differences between the two approaches is of more than academic interest to many potential digital video product users. The purpose of this article is to compare the two approaches from both theoretical and practical viewpoints. Although the bit rate and number of bits both affect signal quality, they are essentially unrelated. So, they are treated separately in this article.

How many bits how often?

Before considering the differences between systems, it is worthwhile to review some of the basics of television signal sampling. Sampling involves measuring a signal at discrete points, usually with a chain of periodic, high frequency, short duration pulses. Fig. 1 shows a simplified spectrum of some of the signals derived from the sampling process. In this sampling process, sidebands are generated. From Fig. 1, it can be seen that, as the sampling frequency is changed, the separation between the sidebands and the baseband signal will change. This change potentially causes interference between the signals.

To keep the lower sideband signal from interfering with the TV signal, the sampling frequency must be at least *twice as high* (8.4 MHz) as the highest frequency (4.2 MHz) of the video signal. This rule is known as the "Nyquist Criteria". It is named after Mr. H. Nyquist of the Bell Telephone Laboratories, a pioneer in sampling technology.

It should be noted here that work *has* been done on digital television using sampling frequencies below 8.4 MHz. This "Sub Nyquist Encoding" uses special comb filtering techniques and has not yet found commercial application.

In subjective testing of digital television techniques, Mr. A.A. Goldberg of CBS Laboratories found that, unless the sampling frequency was locked to the color subcarrier, objectionable "beats" could occur in the picture. Thus, multiples of the subcarrier frequency produce a minimum of problems. To ease filtering requirements, the common practice with early NTSC digital products was to use 3fsc (10.7 MHz) synchronous sampling. Those who own, or have used, a time base corrector or other product with this sampling rate know that a 3fsc system, when properly designed, can produce good results.

If a 3fsc system provides satisfactory performance, why, then, consider a change to a 4fsc (14.3 MHz) system which requires more expensive memory and more sophisticated A/D conversion? The answer is that a 4fsc system significantly improves performance and is easier to work with for future expansion of digital video applications.

Four times is better than three

The improved performance of a 4fsc system can be measured, principally, in three areas: reduced distortion, better "K" factor, and improved frequency response. Let us consider why this is so.

Referring again to Fig. 1, it can be seen that, unless the

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Introduction To Microprocessors—Part II

By John Davis

The 6800 microprocessor serves as an example for discussing some basic applications of microprocessor technology in broadcast operations. Microprocessors are the key to "staged" automation.

IN THE FIRST ARTICLE, it was noted that a microcomputer consisted of four distinct elements: microprocessor, input element, output element, and a storage element. These elements were interconnected by three buses: the address bus, the data bus, and the control bus. The address bus, a typically 16-bit wide bus, allows the microprocessor to access the storage elements; the data bus permits information to be transferred between the input and output sections in the microprocessor, as well as between the storage element and the microprocessor; the control bus controls timing of the microprocessor system, as well as read/write and transfer control. For example, reading from memory, the read line would have to be asserted and a particular phase of the clock would cause data to be placed on a data bus.

The configuration for a 6800 microprocessor is shown in Fig. 2. Initially, this diagram will look complex; however, if this diagram is analyzed, using the buses and the electrical elements previously defined, its operation is found to be very straightforward. The microprocessor element can readily be identified as being the MC 6800 MPU, located in the center of the figure. From this it is known that three buses must emanate: the address bus, the data bus, and the control bus. These buses will connect with peripherals (input/output devices) and memory. Note in the diagram that there are two random access memories on the right hand side of the figure, labeled RAM 1 and RAM 2. There are also two read only memories on the left hand side of the figure, labeled ROM 1 and ROM 2. These ROM's and RAM's are the storage element. There are two input/output chips; one is a parallel interface adaptor (PIA, MC 6820). It permits parallel communication with outside devices. The other is an asynchronous communications interface adaptor (ACIA, MC 6850). Notice that there is something peculiar about the 6800. While a data bus and the address lines are readily discernible, a distinct control bus is not. The 6800 uses part of the address bus to control peripheral devices so that input/output to 6800 looks like an extension of memory.

If a terminal were connected to the ACIA shown in Fig. 2, an operator could communicate with the microprocessor. Data would come in serially from the terminal to the ACIA. It would be transformed to a parallel form which could be placed on the data bus shown as D0 through D7. When data has been received by the ACIA, it causes an interrupt (this is simply a bit or line that indicates an action has taken place). The IRQ line acts as an interrupt, since it interconnects the ACIA and PIA to the 6800 MPU. The microprocessor unit recognizes that an interrupt has occurred. It then "services" the interrupt by finding the device that has caused the interrupt and accessing the data from that device. In the case of the ACIA, the data would probably be accepted by the MPU and transferred to RAM storage for future use. If the character that was typed on the terminal were to be echoed back to the CRT terminal, the MPU would place the data back on the data bus and then assert the write line to the ACIA. This then would cause the character to be displayed on the CRT.

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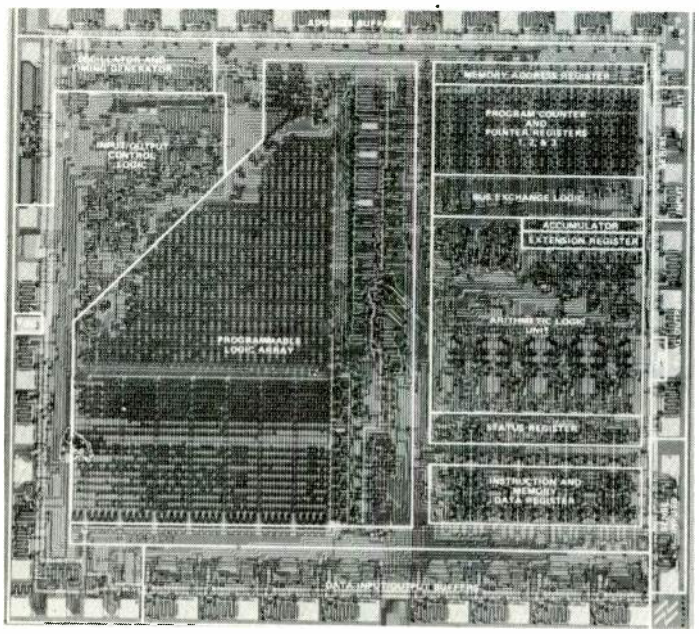
Mr. Davis is director of Data Systems, Vital Industries, Gainesville, FL.



A typical microprocessor. Devices such as these will be taking on increasing importance in broadcast engineering.

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Fig. 1 shows a typical 8080 microcomputer system which illustrates the data bus, address bus, and control bus.

Fig. 3 shows the interface of these buses with the MPU in more detail. The contrasting difference with the previously described microcomputer system is the I/OR and I/OW signals which are used to control the input/output devices and are distinct from the memory control signals (MEMR and MEMW). Special input/output instructions are provided for the 8080 system, since these input/output devices are distinct from memory.

The memory devices (RAM and ROM) are addressed by the address lines and normally, the most significant bits are decoded for chip selections, along with the MEMR and MEMW signals. The input/output stucture does not affect the memory address space. Special instructions transfer data betwen the accumulator and the input/output addressed "ports'." The normal mode of addressing the input/output devices is the use of a decoder for decoding the address bus into exclusive chip selects that enable the input/output device. The 8080 then can support 256 input and output ports with appropriate decoding. The 8255 is a programmable parallel interface with The 8251 bi-directional data buses. The 8251 provides a serial data communication interface so that the system can communicate asynchronously or synchronously. To summarize, this system utilizes a separate input/output structure from the memory address space, which then requires special input/output in-

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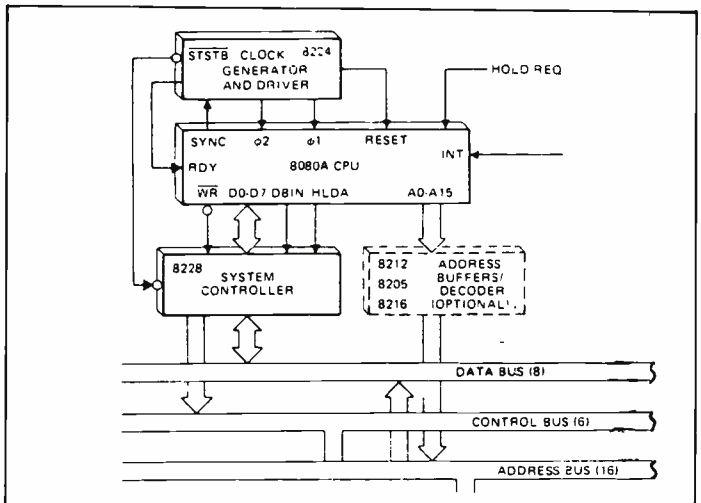
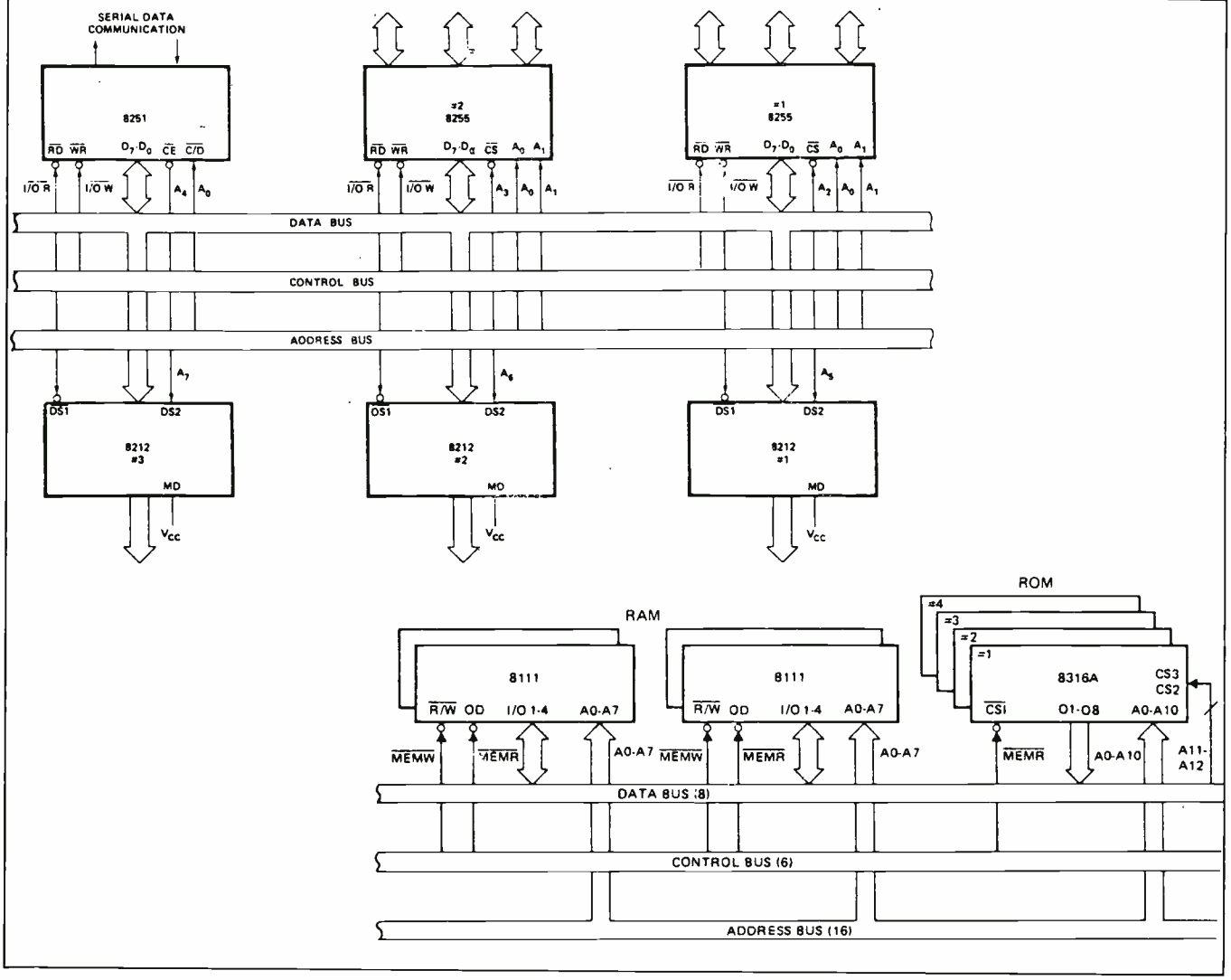


Microcomputer system typical interface.



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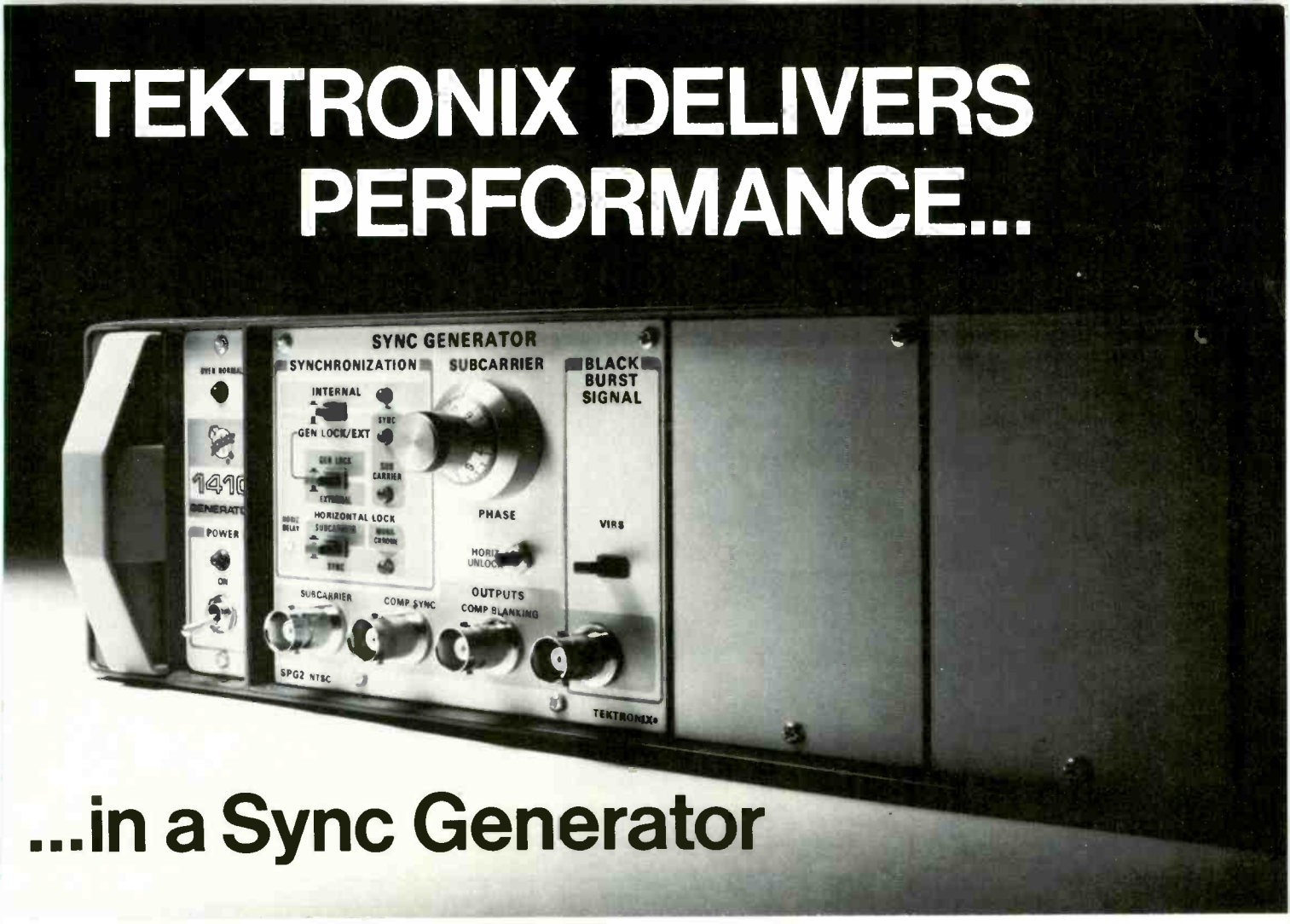

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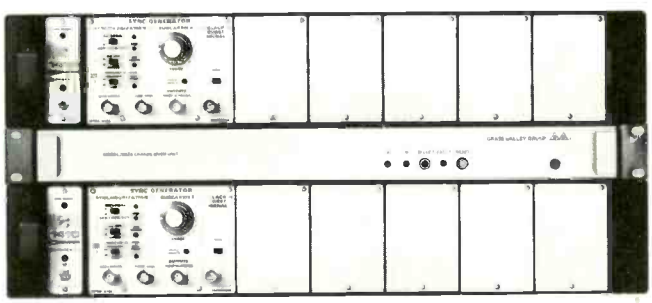

Typical NTSC sync generator system comprised of two 1410R Option 01 mainframes with SPG2 sync generator modules, and one GVG 3257A Automatic Changeover Unit.

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structions and input/output decoding chips for a number of devices (or ports) that are addressed by the appropriate decoder.

An example of an application of the 6800 microprocessor system would be to control a dimmer panel for a TV studio. The ACIA could be connected to a terminal to permit operator communication with the microcomputer and the PIA would provide parallel controls to the dimmer panel itself. The ROM would then contain the programs which we would be running to control the panel. The RAM would be a scratch pad area. The PIA, being the parallel interface device, could be used to transmit information to the dimmer panel through Port A or Port B. Information could also be verified by reading on one or both of those ports. Since these ports are really just 8-bit wide parallel buses, these bits themselves could be decoded to provide control over the dimmer panel itself. The operator could then enter commands through the terminal, which would be transmitted to the MPU causing programs to be acted on that are stored in the ROM memory. Temporary data that would be entered on the terminal could determine rate at which the dimmer panel could dim or increase intensity of the lighting. The MPU would then send out the appropriate controls through the PIA, causing the panel to operate. The end result would be that an operator could enter commands on a terminal and cause a light dimmer panel to dim at a pre-determined rate and increase intensity on various sections of the lighting panel at a rate determined by the operator at a CRT.

Another application would be control of an auto cart machine, using the same building blocks. Again, a terminal would be connected to ACIA. The PIA would be connected to the auto cart machine itself. A different program or firmware would be stored in the ROM's and the RAM's would again provide a scratch pad area. The operator could enter through the CRT the programming sequence of events. These programmed events would be stored in RAM. The RAM would contain a program which would control how these events could be aired. The PIA would then be instructed by the MPU to put out a BCD code (binary code decimal) which would cause the audio cart machine to play the desired cart. By providing additional programming in the ROM, the MPU could automatically sequence between events; that is, playing one cassette after another, in accordance with the program entered in the terminal. It could also cause a mic to be cued or various other devices to be switched on-air at a pre-determined time.

It should be noted that the above two applications of the 6800 micropro-cessor involve control functions. These applications do not access large data bases nor do they perform data base manipulation. It should be recognized that this is one of the limitations of a microprocessor or minicomputer at this time. Searching a large data base (that is, a large storage area of data) or manipulation of data bases are better suited for minicomputers or large scale computers with more sophisticated higher level languages. In the next article an investigation of programming of microcomputers and the associated software support will be made. This will point out some limitations of the microcomputers as compared to a large main frame computer or minicomputer. **BM/E**

Digital Technology's Impact On Television Post-Production

By C. Robert Paulson

Digital technology has been applied to post-production to improve control, simplify operations, and to greatly expand the creative flexibility of videotape editing

FILM INDUSTRY PEOPLE HAVE BEEN QUOTED as saying that film will remain the master recording and editing medium for single-camera television production, "for the foreseeable future." (See *BM/E* Television Production and Programming, December, 1977.) Because they are film people, it is understandably difficult, if not impossible, for them to be aware of the great changes that digital technology is currently creating in the areas of television production and post-production. I believe, however, that the "foreseeable future" will have moved much closer in 1978 as a result of advances in digital technology.

Two deficiencies in television post-production hardware capabilities have, up until recently, been formidable barriers to the use of video in the production of what is termed, single-camera technique. The primary deficiency has been the lack of a random-access editing system matching the film system of randomly reaching for film clips hanging from nails on the editing room shelf. Second is the lack of a reasonably priced, simple to operate signal processing system to provide with-in-the-scene and transitional picture effects routinely available from the optical film laboratory.

Two applications of digital technology in television post-production are rapidly eliminating those defciencies. It is not illogical to predict that the 1978-1979 network programming season will have one or more single-camera series formerly shot on film being shot and edited entirely on one-inch videotape.

How is digital technology precipitating this change? The question has a two-part answer. First, constant dizzying breakthroughs and constantly plummeting prices for digital components such as microprocessors and semiconductor memories are revolutionizing both editing system architecture and editing techniques. Second, the same digital components used in the video signal processing circuitry of an editing system are providing mind-boggling new picture manipulation techniques at a rate impossible to keep up with.

Digital technology offers simplication

SIMPLIFICATION is the one word describing the impact of digital technology on editing system architecture and editing techniques. And the principal victim of the simplification move in post-production editing may be the digital SMPTE time code standard, which in the early 1970s made precise editing of videotape possible and practical. For all of its elegant simplicity to the television engineer, the SMPTE time code can be a mathematical nightmare to a film-oriented editor. Not only is the code's concept entirely foreign to editors used to thinking in terms of feet and frames of film, to most film editors, the control keyboard of a typical computer controlled editing system has all the overwhelming complexity of a "Star Wars" spaceship navigation console.

Fig. 1. Bosch-Fernseh EES-9 Editing System provides control of Search, Assemble and Video/Audio 1/Audio 2/Audio 3 editing functions for two units from either console. Controller reads either SMPTE time code or longitudinal tape time at flip of internal switch. Insert shows right hand control panel details.

Digital technology, for one thing, has allowed many of the operations required for editing to be made transparent. That is, the controls for operating editors can be made simple so that a non-technical operator can work with equipment in a straightforward way. The EES-9 digital-based editing system as a built in option to the Bosch-Fernseh BCN-50 studio VTR is one such example of a control-simplified editor. This versatile editing accessory, consisting of the right-hand control panel (Fig. 1) and two plug-in PC boards, allows a non-technical machine operator or film editor to make editing decisions and execute edits using *either* previously recorded SMPTE time code, *or* picture or sound editing point locations on the tape arbitrarily designated by digitally expressed longitudinal tape time.

Microprocessor based logic enables the operator to select Edit In and Edit Out points on both tapes by viewing their playbacks at the standard thirty frames per second playback speed. Punching the IN and OUT buttons stores the SMPTE or tape time digital code to representing those

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Mr. Paulson is managing partner, AVP Communications of Westborough, Mass. and consultant to Bosch Fernseh.

points in the Editor's memory. The initially selected edit is previewed or "rehearsed" by pushing two more buttons, after switches have been thrown to set up the recording machine for the desired edit — Assemble (record both audio, video and control track) or Insert (record any mix of Video, Audio 1 and Audio 2 inputs, synchronized to control track already laid down on the slave tape).*

If the first or repeated previewing of the initially selected edits indicates a need for a change in timing of any or all transition points, making the change on the EES-9 is not a mathematical procedure. Designating the video or audio/Edit In or Edit Out/ master or slave machine, edit cue which is to be changed by making appropriate switch settings, the selected transition point is moved forward or backward in time by punching the "+" or "−" buttons on the front panel. Even though SMPTE time code may have been used to select the edit point initially, thereafter all editing decisions are made in terms of numbers of frames. When all edit transition locations have been set to the editor's satisfaction, making each edit is a simple matter of pushing two more buttons on the VTR control panel in sequence.

*Slow-motion and stop-motion (freeze-frame) viewing of viedo are also possible on BCN-50s equipped with the master tape protecting BCN Digital Store. This VTR accessory is described later in the digital video signal processing section of the article.

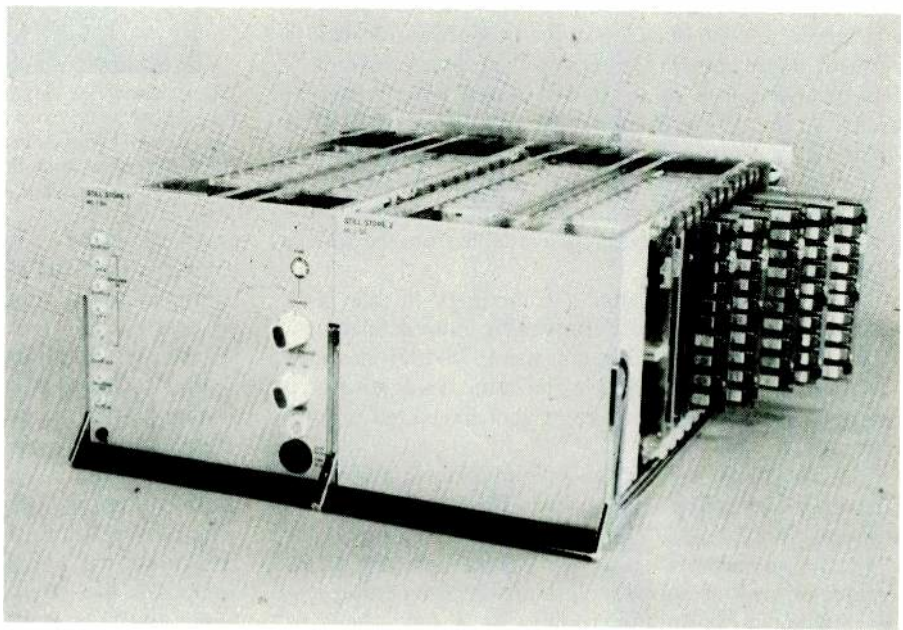
During edit previewing and rehearsals, shuttling the tape on either or both machines at variable speeds in forward and reverse directions is obtained by rotating a control knob with a feel quite familiar to film editors.

Another digital-oriented feature of the BCN-50 design is its three-position selector switch which delegates operating control of the VTR either to the internal or adjacent EES-9 editing controller, a second remote computer or manually-operated editing or automation controller, or the control push buttons on the VTR. Interfaced to a computer-based editing controller like the CMX-340, the BCN-50 can become part of a mixed-format editing system whose input can be quad, any 1-inch helical VTR and video disc playbacks, and whose output may be either a quad or 1-inch helical edited master tape.

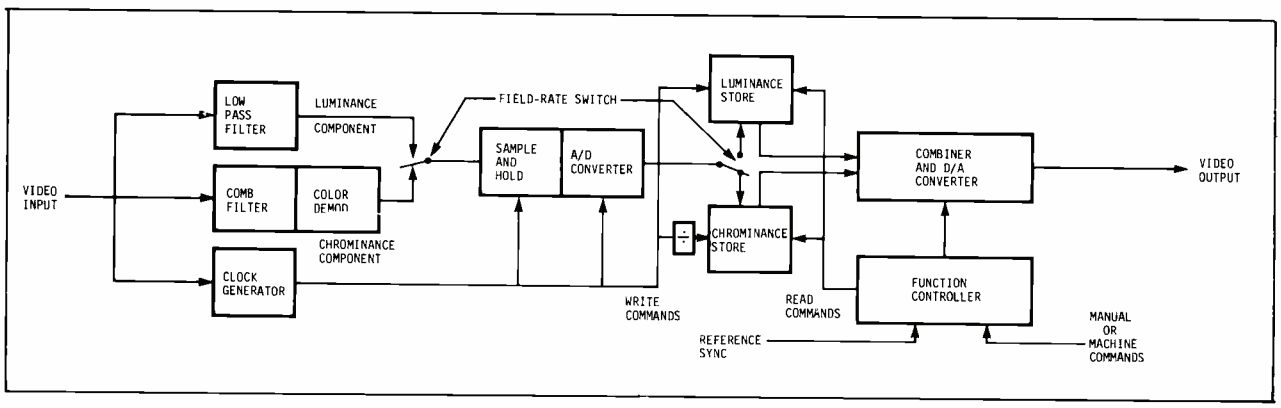
Understanding these new digital technology created editing techniques will not be too much of a challenge to a non-technical film editor who has had some exposure to the popular pulse-counting editing controllers developed for the ¾-U VTR equipment used in ENG. Trying to understand what digital technology offers as new capabilities in the processing of video and audio signals in production and post-production is quite another matter, however.

Digital processing in post-production

First, a quick look at digital audio. Prototype digital audio recorders were described and demonstrated at the



BCN Digital Store block diagram. Compact unit uses component signal rather than composite signal digitizing principle, to offer both price economics and applications versatility as either standalone processor or integral VTR component.



November 1977 Audio Engineering Society Technical Conference in New York. They were conceived by their developers to eliminate the audio tape and record post-production constraints created by the tape noise resultants of multiple generation audio dubbing and sound sweetening. Availability of a 98 dB signal to noise ratio using digital audio recording will certainly also have an impact on television program audio recording and post-production processing, as soon as television systems have compatible hardward developed. The demonstration which was most relevant to television production/post-production needs was the playback of a recording of the quiet sounds of birds in a natural setting without tape hiss, immediately followed by the undistorted reproduction of the terrifying sounds of a passing train.

Attractive though digital audio may appear to be, its introduction into television production and post-production operations may take years, however. Television product and systems designers generally cannot be coerced into thinking about audio until after a product's video parameters are cast in PC Board plastic. In fact, unbelievably, many "broad-band" video engineering experts don't really understand "narow-band" audio problems at all. Further, digital audio recorder engineers are going to have their hands and brains and laps full of challenges in trying to bring their prototype products to the audio products marketplace, as *user-oriented* digital audio production and post-production systems. Once they begin to hear how digital audio has opened up the window to the sound universe without letting in the noise, creative audio producers will begin demanding audio post-production signal processing capabilities analagous to the video post-production signal processing capabilities offered by the new digital-based products which are the subject of the remainder of this article.

All of the digital video signal processing products to be discussed grew out of major network operating needs for a means of eliminating non-synchronous switches among geographically dispersed or autonomously synchronized and controlled signal sources. The original techniques were non-digital, expensive, and often not precise or reliable. Transmitting a back-timed sync reference to all remote locations requires a dedicated network of sync distribution lines. The second developed alternative of slaving remote location sync generators to individual highly stable Rubidium standard oscillators substituted expensive hardware for line costs, and the oscillators eventually drifted out of dead sync in any event.

Digital technology's initial response to the challenge of permanently eliminating non-synchronous switches as a problem under any circumstances was the field synchronizer. Within months of their introduction at the 1974 NAB by Nippon Electric Corporation and CVS, they were joined by Frame Synchronizers offered by Micro Consultants Inc. and others. As the names imply, the units had memory capacity for storing either a field (1/60 second) or frame (1/30 second). Both types of units operate on the same concepts. A high-speed Analog-to-Digital converter locked to the incomine composite video signal samples it at a rate of either three times or four times the subcarrier frequency, digitizes each sample into eight bits of resolution, and stores the digitized signal serially in a semiconductor memory. The stored samples are clocked out at

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a rate which establishes the re-constituted analog signal in vertical, horizontal and subcarrier phase with a local reference sync generator.

Providing the synchronizer with a frame's worth of storage capacity guarantees that the output signal will never have a glitch, regardless of the phase disparity of two incoming signals between which the synchronizer is being switched.

The first digital technology breakthrough relevant to the topic of digital video in post-production was the development in the early 1970s of high-speed A/D converters which could operate reliably at the better than 80 MHz bit rates required for the creation of a digital time base corrector. The second was the development of a random-access digital memory with a capacity of a frame's worth of bits — approximately three million — with write and read access speeds substantially higher than the A/D sampling rates.

Continuing rapid advances in both component designs, circuit functioning and manufacturing technology all contributed to the most recent breakthrough which has resulted in frame synchronizer products' spawning of new families of digital video signal processing products.

Even if you're a top-notch engineer who can spend all your time reading advertisements and literature, you're going to have trouble keeping up with both the capabilities and costs of these new families of digital signal processing products in 1978. Both are directly influenced by new technology developments in the computer industry. Quantum improvements in microprocessor and semiconductor memory operating versatility and speed mean that most television products using these components stand to be obsoleted in not much more than a year after introduction. Further, competition among computer industry device suppliers constantly yields the beneficial effects of lower component prices even as capabilities and applications are improved.

During the next two years, therefore, digital video signal processing product capabilities will stay well ahead of the abilities of even the most creative writers, directors and editors to plan for their utilization in post-production assembly of a program. Designing editing systems so that the capabilities will be available in the most logical way to a non-technical editor will be the second greatest challenge to their inventors and manufacturers. (The first challenge will continue to be deciding when to freeze a product design and specify components with a high probability of being available from production when they are needed. To freeze too soon on the wrong components is to invite obsolescence by a competitor in even less than a year. Waiting carries with it the danger of missing a market opportunity.)

The fundamental circuit design breakthrough which makes possible such exciting processing techniques as zoom, expansion, reduction, multiple images in unlimited arrays and similarly virtually unlimited picture mixing and transitional techniques, is the combination of high speed circuit operation and random-access write and read, with each function independent of the other. This means that specific memory addresses can be assigned to store

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information from specific picture locations. Picture data entry can be commanded at any rate and in parallel to multiple addresses.

Once an image is in the store, it can be left there indefinitely. Readout can then be time- and dimensionally-varied to provide the special effect. If input and output operations are both varied according to a predetermined plan, picture montages combining still, slow and standard speed pictures are created.

Two different methods of television signal digitizing are used in the currently available products. The first and original approach is called composite signal digitizing. A sample and hold circuit operating locked to and at 3 or 4 times the frequency of the incoming signal burst frequency measures the instantaneous voltage amplitude of the signal above the tip of sync zero reference. An eight-bit digitizer translates this measurement into a digital word representing one of 255 levels above zero. The eight bits then representing each word are then stored in parallel in eight memories at the addresses representing the picture elements.

Obviously, each stored measurement which represents an element in the visible picture contains information about both the luminance of the image point and its colorimetry. If, when the image point is recalled, it is then located at another part of the raster and/or in another color field, its color subcarrier phase must be adjusted to maintain original scene colorimetry.

While the composite video signal digitizing technique is straightforward, it has dual disadvantages of high cost, because of the amount of memory required, and limited versatility, because the luminance and chrominance components of the incoming signal are not directly available for separate processing after readout.

The well-known but not so widely used techniques known as component signal digitizing eliminates both these disadvantages. In the Bosch-Fernseh BCN-50 Digital Store (Fig. 2), the first digital signal processor which uses this principle, the video signal is first separated into its luminance and chrominance components by filtering. In succeeding 1/60 second increments of time (field rate) a Sample Hold circuit is switched between teh luminance and chrominance signal inputs. Both the sampling rate and the digitizing resolution (number of bits) are substantially reduced from the requirement for composite video signal digitizing. This is possible because of well understood inabilities of the human eye to detect improved color fidelity or picture details when luminance and chrominance signal sampling rates and digitizing resolutions are increased above empirically determined values.

Technical purists may claim that this approach is "narrow band signal processing," and therefore picture degrading. During one field only luminance information is put into storage, and during the other field only chrominance information is stored. Theoretically half the picture vertical resolution is lost. However, a principal application of digital video signal processors is manipulation of single frames taken from a thirty frame per second "moving picture." If the picture to be processed has any motion in it, only one field can be used in any event, to prevent horizontal jitter of vertical lines in the picture. Further, phasing of the chrominance information to the burst phase of each of these four succeeding color fields is much easier

A "quad split" picture display processed in the BCN Digital Store from a single input. Alternatively, each of the quadrants can be filled with a different image, one of them a "moving picture."

to accomplish operating on the chrominance signal by itself. The final proof of the validity of the component signal digitizing approach is viewing programming material which has been processed by both component and composite signal digitizing techniques. There is no discernible impairment of either picture details or colorimetry.

The BCN Digital Store is a standalone digital video signal processor. Its price including an array of controllers providing interfaces both to human operators and VTRs and other picture sources has been set at substantially

under $25,000. This compares with composite signal frame store products which costs upwards of $50,000.

In its standalone integration in a post-production system, the Digital Store is a multiple-image signal processor which can create individual pictures in its output, ranging from a single picture full frame to an unlimited duo binary matrix of images (2, 4, 8, 16, 32, . . . pictures in either or both horizontal and vertical raster dimensions, see Fig. 3). Because all parameters of both the writing and reading processes for each picture element location are independently variable, in addition to multiple image displays, the BCN Digital Store display can include multiple source still plus one moving picture image in each of the picture segments. Picture orientation within each segment can be a mirror image or inversion of the original picture.

Picture inputs can be any input to a production switcher — VTR playbacks, live camera pictures, graphics generator output and/or telecine slide or film displays.

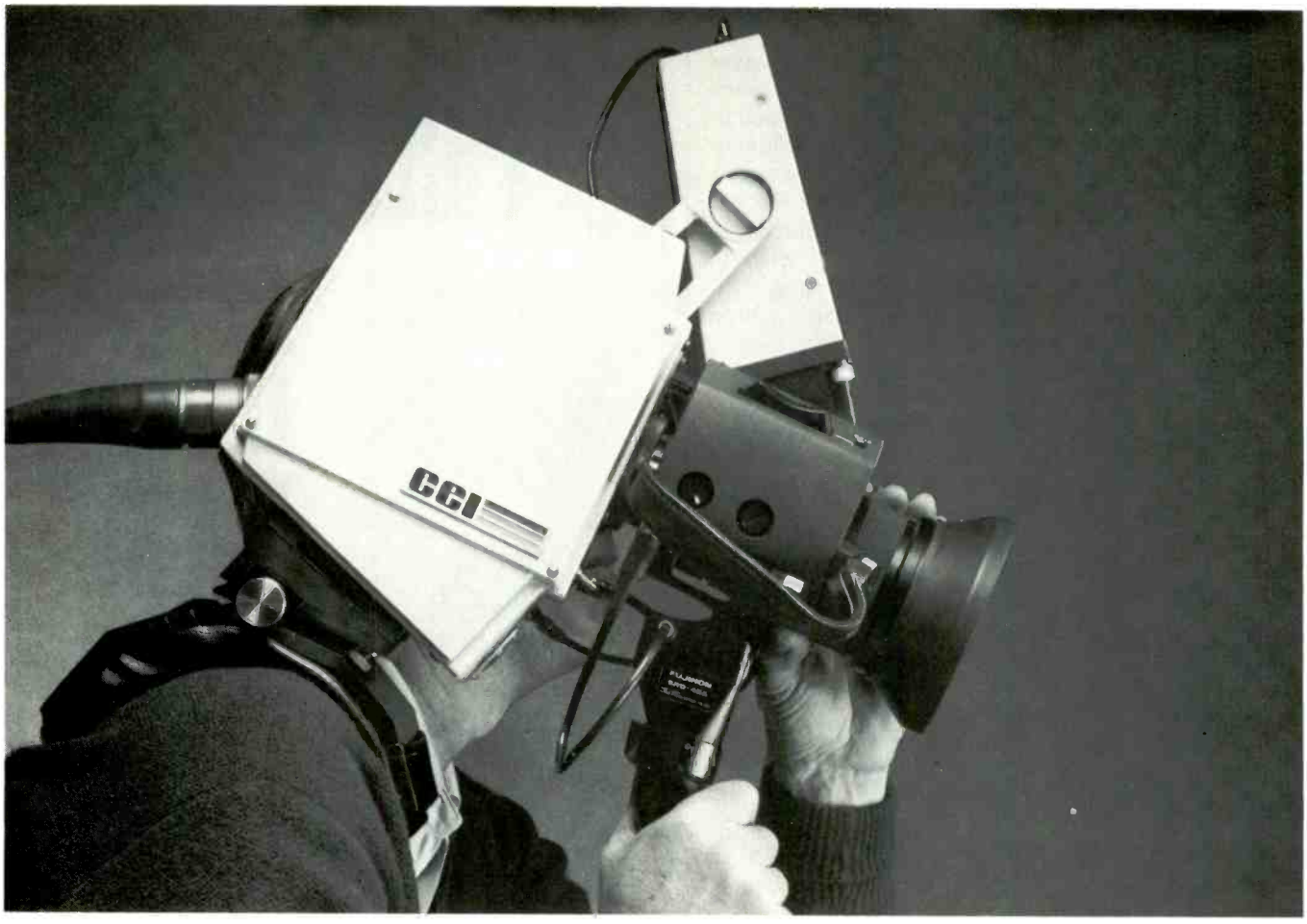
With the digital store controller interfaced to the tape transport, video head drum and record/reproduce electronics of a VTR, the VTR is instantly transformed into any one of four special systems. A random access picture store, an electronic animation stand, are created when interfaced to the input. When interfaced to the output of a BCN-50, forward, reverse, and stop motion instant replay is possible as is high speed search for editing.

In all four of these special systems applications it is the component signal digitizing design concept of the BCN Digital Store which made possible the creation of this capability. In each system the VTR remains available for normal duty as a standard speed recording and reproduction system.

In addition to adding new capabilities to standard VTRs, digital video signal processing product offers writers, producers, directors and editors new techniques for television production and post-production, unlimited new effects and film-style production finesse, for costs which are both economical and controllable. Before these products came along, creating the effects seen in professionally produced spot commercials or in network variety shows required a full complement of studio and control room people operating cameras, switchers, VTRs, telecines, etc. Or, you used film, accepting its higher costs, longer lead times and "film look." Now they can be accomplished with one non-technical editor manipulating videotape playbacks at an editing console. The effects which can be created now surpass those which can be created on film even in the most creative of optical houses.

At least two olher benefits derive from the move to the use of digital video signal processing product in post-production editing. First, the results look "live." Because the processing is done in the digital domain, there are no tape equivalents of internegatives to add noise to the picture. Only one generation of videotape is required to go from first generation master tapes to a finished edited master with full effects, captioning and synchronous audio, once the team of the writer, director and editor understand the capabilities of digital video signal processing products.

The second benefit is the availability of time to review the master tapes unedited picture material before making editing decisions. Program communication or entertainment impact can often be heightened by the use of actions, expressions, etc. accidentally recorded on an out take which were discovered only during editing session reviews. **BM/E**



Can a 39¢ part ever put the CEI-310 out of action?

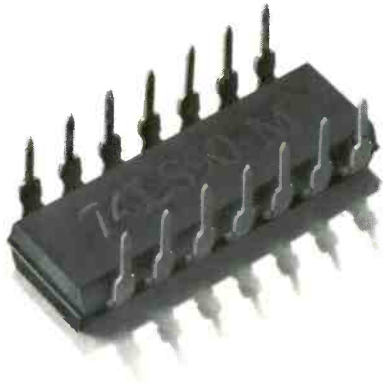
Not for long. If a 39¢ IC does blow, it's nice to know that the CEI-310 is American-made. Electronic components are American. And all readily available—from CEI or from commercial sources all over the country.

They don't have to come from the other side of the Atlantic. Or the Pacific.

And our schematics are American, too. Annotated in English. Probably a little more familiar to you than the ones from Holland or France or Japan.

But we're not just selling serviceability and easy-to-read schematics.

After all, a camera is ultimately judged by the pictures it makes. The CEI-310 gives you uncompromised full broadcast quality video performance, with outstanding signal-to-noise ratio, sensitivity, and resolution. And full production system control features.



Plus total modularity so it can do everything you've ever wanted a camera to do.

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And **reliability.** Our customers think the CEI-310 is the most rugged, most reliable production camera on the market. Ask one of them.

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BM/E's Panels Of 100 Survey Reveals The Industry's Areas Of Greatest Interest In 1978

AM stereo could be a surprise if FCC moves; ENG for TV will be hot no matter what; One-inch video is here.

WHEN INDUSTRY MANUFACTURERS lay out their goods this April in Las Vegas for the NAB Convention our survey shows that radio broadcasters will be crowding booths showing studio tape recorders and audio processors. And if you're a television broadcaster you had better get in line early if you even want to get near ENG cameras or one-inch videotape recorders.

This year *BM/E* greatly expanded its Panels of 100 Survey of Broadcast Industry Needs. Not only did we go for a larger sample seeking responses from panels of engineers, managers, and operations personnel at radio and TV stations across the country but we changed the way we asked broadcasters to state their interest in equipment.

In previous surveys we asked broadcasters to check off only those items of equipment in which they were "most" interested. This year, however, we asked them to state their degree of interest in various equipments as "very," "some," "low," or "none." The results are, we think, more illuminating and interesting since we can now see to some extent the momentum behind this interest. For instance, 90 percent of the TV panelists reported that they were either "very interested" or "somewhat interested" in one-inch videotape recorders with those listing "very interested" outnumbering the "somewhat interested" by a better than 2 to 1 margin. Those interested in quad videotape recorders, however, constituted only 46 percent of the respondents with most of quads strength (nearly 3 to 1) in the somewhat interested category. This overwhelming interest in one-inch compared to the interest in quad, would seem to indicate that if one-inch technology pans out, the market for quad machines in broadcasting is under some very heavy pressure.

We must point out, however, that interest in quad must still be considered good since one probable implication of this data is that nearly all broadcasters already have quad machines and very few, as yet, have one-inch machines. So, this 46 percent interest in new quad machines strongly indicates that broadcasters have not counted them out — not by a longshot.

In addition to equipment interest, we also asked a lot of questions about broadcasters' plans for this year's NAB Convention. Attendance in Las Vegas will be up this year over last year's Washington convention. Nearly 65 percent of the panelists said they would be attending this year versus only 63 percent who said they would attend last year.

Among television broadcasters, nearly 70 percent of the panelists said they would be attending, while for radio only 44 percent of the panelists said they would be going. As usual, this low radio figure reflects the underrepresentation of radio engineers at the convention. Nevertheless, attendance among both radio engineers and management will be up this year over last.

Of those respondents planning to attend, radio broadcasters will be spending about 11 hours during the four day convention touring exhibits while television broadcasters will spend about 13 hours looking over new equipment.

What radio broadcasters will be looking for

Consoles/mixers, audio processors, and studio tape recorder/players lead the list of equipment most wanted by radio broadcasters. There are differences in this interest however. Though tape recorder/players lead in total interest with 84 percent followed by consoles/mixers with 76 percent and audio processors with 75 percent, audio

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Panels of 100 Survey

processors interest seems to be the most intense. That is, nearly twice as many broadcasters indicated they were "very interested" in audio processors as indicated "some" interest. One reason for this is that processing technology is really improving. Another reason is that 1977 saw the introduction of significant advances in AM radio audio processing, the Optimod AM from Orban and the new Harris AM processing system.

The other highly rated products really form the industry staples with test equipment getting 72 percent, microphones getting 70 percent, and cartridge players getting 68 percent.

AM Stereo will be hot topic

With the report of the AM stereo committee in and some activity from the FCC, interest in AM stereo equipment is on the rise. In fact, interest will likely be more intense than our figures would seem to indicate since we presume that a number of FM-only broadcasters expressed low or no interest thereby dragging down the percentage margin. Nevertheless, 64 percent of all respondents indicated good interest in AM stereo. In fact, the interest in AM stereo may be related to the intensity of interest in new AM transmitters which was higher than expected. There seems to be great pent up desire for AM stereo and if the FCC moves positively this could blow 1978 wide open for manufacturers who've been sitting on their AM stereo equipment for years.

As for FM quad interest which is low, this may be more an expression of exasperation with the FCC than a lack of confidence in the technology.

Television's most wanted products

In television a pretty clear pattern of interest exists in what appears to be a plan for quick expansion of live ENG capability. Broadcasters across the country quickly ticked off a selection of "very interesteds" in ENG cameras, (95 percent), microwave for ENG (71 percent), time base correctors (82 percent), frame synchronizers (74 percent). As part of this pattern, interest in routing switchers appears to be on the rise with 67 percent. Though last year's figures cannot be strictly compared to this year's because of the changes in methodology, only 34 percent last year indicated any interest in routing switchers. In each of the above cases, the pattern of interest leaned strongly towards "very interested." On the other hand, the pattern of interest in still stores was more tentative. Though 70 percent of the respondents indicated either "very" or "some," those listing

Panels of 100 Survey

"some" outnumbered the "very interested" better than 2 to 1. This probably reflects the uncertainty regarding system size and price. Changes are occurring in this field so expect some activity here.

Other areas of interest related to ENG also remain strong. Videotape editors received a high rating at 75 percent, and ¾-inch cassette recorders got 77 percent.

Two products that saw the light of day for the first time last year, got high marks this year. Digital Noise reducers registered 71 percent and digital video effects garnered 63 percent. The quality of interest for both items was leaning towards "very" though digital video effects interest did seem a bit more tentative.

Staples of the industry such as video monitors and test equipment also rated well receiving 70 percent and 84 percent respectively. Audio consoles and mixers which received 34 percent under last year's method garnered 58 percent interest this year. Though difficult to interpret because of the change in methodology, audio does seem to be a growing concern among broadcasters.

Overall, the results of the survey seem to support the general wisdom that broadcasters are looking for smaller, lighter, and more automatic equipment. This would seem to portend strong markets for digital equipment and microprocessor controlled apparatus or other equipment employing automation of varying degrees.

Editors note: *The chart reflects only the overall grades of interest in the various equipments, and* ***is not*** *a comparative ranking. For instance, though transmitters are listed last on the chart, analysis of the complete data shows that it should be a very good year for VHF transmitters.*

NAB Exhibits, Answer To Broadcasters "Most Wanted"

Because of the late start for NAB this year (April 9-12) manufacturers are being very close mouthed this early regarding their specific plans. But BM/E editors have learned some of the things planned.

IF THE PANELS OF 100 SURVEY is an accurate gauge of what broadcasters will be looking for in 1978, then they will not be disappointed by the NAB exhibitors in Las Vegas this April.

Radio broadcasters who exhibited considerable interest in audio processors, consoles, and AM stereo will find much along those lines at NAB. One manufacturer, Audio Designs, promises an entire new line of consoles. Others, such as McCurdy, will be expanding their product lines. Listec Television Equipment Corp. and Bayly Engineering will be showing portable audio consoles; the former is marketing a Richmond Sound Design M82B. Television broadcasters should take note of these exhibitors, as well, since some of them will have consoles expressly for TV.

A long neglected aspect, intercoms, should be more interesting than usual since both Audio Designs and Automated Processes will be showing very sophisticated systems. Audio Processes will show a microprocessor controlled intercom system that can (and does) double as an audio distribution system with broadcast quality audio.

Automation for radio should show some additional developments with Cetec (Schaefer) introducing an English language programmable system. IGM will have some improved capabilities in their BASIC 1A system exhibited at NRBA. Harris will also be showing changes in their systems though they are not expected to depart from the trends they've already established.

Both Schaefer and IGM will show International Tapetronics' 1K Automatic Cartridge Library systems. The 1K is an Automatic Cartridge Library storage system for taped carts that garnered a lot of attention last year, and will be on display at ITC's booth as well.

Audio processors will be well represented and for many AM broadcasters this will be their first opportunity to see the Orban Optimod AM and the Harris AM processing systems. Other manufacturers of audio processors will be there so we can expect further developments along these lines.

AM Stereo is beginning to shape up as a reality. With the FCC now in possession of the AM Stereo Committee Report, some action is expected shortly. Harris will have their system on display and we should also expect to see the Belar and Kahn systems. Though we have not heard from the Magnavox or Motorola people at this time, we would expect them to be represented. Moseley Associates will definitely be there with their equipment designed for AM Stereo.

Panels of 100 Survey

Overall Interest in Radio Equipment

	Percent Actively Interested[1]
Tape Recorders/Players (studio)	84
Consoles, Mixers	76
Audio Processors	75*
Test Equipment	72
Microphones, Accessories	70
Cartridge Players/Recorders	68
Remote Pickup & STL	66
AM Stereo Equipment	64*
ATS Equipment	55
Noise Reduction Systems	55
AM Transmitters	54*
Turntables	51
Automation Equipment	48
Monitor Speakers	48
FM Monitoring Equipment	47
FM Transmitters	44
Business Automation Systems	43
AM Monitoring Equipment	42
Reverb & Special Effects	42
Antennas	40
Tape Recorders/Players (field)	40
FM Quad Equipment	32

[1]Percentage checking very interested or some interest

*Indicates those products which showed the greatest intensity of interest. That is, where degree of interest was weighted towards the highest end of the scale by a wide margin.

Overall Interest in TV Equipment

	Percent Actively Interested[1]
TV Cameras, ENG	95*
VTRs (one-inch)	90*
Test Equipment	84
Time Base Correctors	82*
VTRs (¾-inch)	77
Videotape Editors	75
Frame Synchronizers	74*
Microwave for ENG	71
Noise Reduction Systems	71
Video Monitors	70
Electronic Still Store	70
Character Generators	68
Routing Switchers	67
Time Code Equipment	65
Switching Automation	64
Digital Effects Devices	63
TV Cameras, Studio	62
ATS Equipment	61
Remote Control (status etc.)	60
Audio Consoles, Equipment	58
Master Control Switchers	56
TV Cameras, Studio/Field	55
Production Switchers (large)	54
Image Enhancers	54
Film and Slide Chains	52
CP Antennas	49
Lighting Equipment	48
VTRs (quad)	48
Slow Motion Recorders	42
Production Switchers (small)	42
Transmitters	34

TV broadcasters will get an eyeful

Though it appears that ENG in general will be a hot topic again this year, the one-inch helical video tape recorders should get a good share of the attention. Sony and Ampex are expected to have their "Type C" standard machines there and don't be surprised if the RCA booth has one of the Type C machines from Sony in their booth with the RCA label. But, if the Fall SMPTE Conference in L.A. was a hint of things to come, bet on Bosch-Fernseh to pull out all stops in Las Vegas to tell the BCN story. BCN which meets SMPTE Type B standards for segmented helical scan videotape recording, is being developed rapidly to offer a plethora of sophisticated features.

ENG cameras will also be hot. Though last year there was not a great upsurge in the number of cameras being offered we do expect some expansion here. For one thing, Cinema Products will definitely show their MNC-71CP, which they believe will be to electronic cameras what the CP-16 is to film cameras — a workhorse. Cinema Products showed the camera at the Los Angeles SMPTE meeting for the first time and got considerable interest. The camera was designed and built by NEC but is built along general lines described by Cinema Products. We do know that JVC will show an improved version of their CY8800 introduced at Vid Expo and we expect to see something new from Sony. Hitachi will show its FP-1011 for the first time at NAB though it has been shown elsewhere. As yet, we've received no definite word from Ikegami, RCA, or others though new cameras are expected. Philips is another company expected to show a new camera this year but we know very little about its exact description.

Field cameras (modular) were a major change in camera design last year and we expect to see others this year. If not, CEI, RCA, and probably Philips will show something along these lines.

Digital devices by the score will be present

Every year the number and variety of digital devices grows. This year will be no exception, though we can expect to see an increase in the number of TBCs and other devices using CCD (Charge Coupled Device) technology. A number of companies have introduced new TBCs such as CVS and Microtime during this past year and their new models will no doubt be displayed.

Image enhancement and noise reduction should also be further developed. Thomson-CSF will be there with an improved model of their Digital Noise Reducer having increased its signal-to-noise improvement and simplified its controls. Though for the past year Thomson has had a virtual monopoly on this technology, don't be surprised if at least one other company doesn't offer a similar device.

Digital special effects and frame synchronizers will be another big area. Vital Industries, which last year showed its digital special effects package, the Squeezoom, in prototype form, reports that a production model will be displayed this year. Vital will also show improved features for its PSAS (Programmed Switching Automation System) this year. The Grass Valley Group's DVE will also garner more interest this year. Micro Consultants is expected to have its DPE (Digital Picture Effects) 5000 as part of its exhibit this year though last year it was restricted to invitation-only demonstrations in their suite.

One surprise we know about this year will be from American Data Corporation. They will have a complete computerized business and technical automation system on display. This system will do both business and technical automation and should prove to be well worth seeing. The new system is designated the ADC-3100 Series Computer Automated Master Control Switching System. In addition, ADC will show new production switchers featuring new special effects options.

Graphics Systems and Still Stores will be hot. Look for much greater variety of graphics and still storage systems this year. Chyron, for one, will be showing a new Graphics and Titling System. We also expect new systems from others.

Still stores will change in a number of ways. ADDA Corp. has worked out a number of systems structures to offer a good variety of choices in power and cost to broadcasters. Arvin/Echo will, of course, be showing their still store, but the big story here will be a first glance (for many broadcasters) at the Arvin/Echo Slo-Mo.

The above are only a few of the highlights (and some of the rumors) we know about. We are currently investigating in great depth the plans for April's NAB. Next month a thorough report will tell everything we know about what's happening at NAB '78.

Editor's Note:
Because of the late April date of this year's NAB, we did not receive information from many manufacturers. Next month, however, we will have as complete a picture as possible on what each exhibitor will be showing. We will also supply complete Convention information on exhibits and programs in the March issue.

GREAT IDEA CONTEST

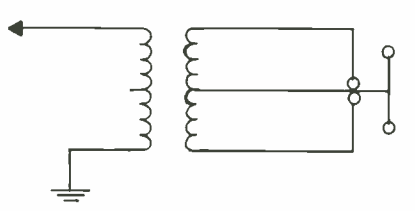
6. Feeding Mono Source Into Stereo Input.

Daniel Patterson, Chief Eng., KTHS-AM/KAAM-FM, Berryville, AK.

Problem: To feed a mono source into a stereo input making two channels in phase.

Solution: The equipment used was a Gates Mono Criterion Cart machine and a Gates Stereo Statesman Console. The mono inputs on the console were not used due to the fact that we already had two nets hung on each whereas Tape Input One (stereo input) was not being used. The output of the cart machine works into a single ended transformer with the secondary being center taped. The center tap was not used in the machine.

I made the center tap of the secondary common and fed the other ends into the left and right channels. This gave me two channels in phase with good quality. With other equipment I advise using an inphase cart and trying different hook-ups. Play the cart thru the cart machine, console, other equipment and transmitter. Monitor transmitter with a mono receiver. This is the vest way to make sure the audio is in phase.



Engineer Patterson uses center-tapped transformer to go from mono to stereo.

7. Maximizing The Variety Of Cuts On A Multi-Cut Cart.

James E. McKay, Engineer, WSB Radio, Atlanta, GA

Problem: How to maximize the variety of N spots scheduled M times a day. When a cart has multiple cuts and these are scheduled several times a day, it frequently happens that at a given time, some cuts are heard more often than others. Some may not be heard at all. In the worst case where N equals M, only one cut is ever played at a given time thereby defeating the purpose of multiple cuts. Even if N does not equal M, the sequence will still lock into a repeating unequal pattern unless the numbers N and M are related in a particular way.

Solution: Maximum exposure can only be achieved if N and M are relatively prime, i.e. they have no common integer factors. The easy way to select the numbers is to take both from a table of prime numbers. If N and M are unequal primes, then they are certainly relatively prime. A table of primes less than 100 is appended.

PRIMES LESS THAN 100 (from Eratosthenes, c. 250 b.c.)

2	13	31	53	73
3	17	37	59	79
5	19	41	61	83
7	23	43	67	89
11	29	47	71	97

It is not really necessary for both numbers to be prime. For example, M could be selected arbitrarily, then the nearest convenient value of N taken from the table such that N is neither equal to M nor a multiple or submultiple of it.

8. Manual Operator Control of TCR-100 Event Sequencer.

Carl Roszczybiuk, Engineer, WSNS-TV, Chicago, IL.

Problem: It is frequently necessary to reprogram the Automatic AB Sequencer because a new "home" position has been selected, because a reject has been required or for several other reasons including operator convenience. Besides being bothersome and time consuming, the reprogramming is another possible source of error.

Solution: A manual control permits the operator to select any event in the sequence as "next event" at any time without operating the carousel and without resetting the thumbwheels. The "fix" given here is simple, does not disturb the original circuit and requires no additional controls.

In the original RCA circuit, shown in Fig. 13, titled "Sequence Counter", in Volume I of the TCR Diagrams Manual, a clock pulse is combined with other signals to provide a low at the input of JKFF 206 whenever all of the conditions have been fulfilled which dictate an advance in sequence. An external switch to ground that point in the circuit will produce an advance, provided it is properly debounced. A low frequency pulse source is provided for this purpose. If the switch is pressed briefly and released, a single advance will occur; if the switch is held in, advancement continues until it is released.

For the operator control, the unused B section of the Transport Option AB switch turned out to be perfect, since this switch must already be on to use the sequence counter. Because one lug of the switch was used as a convenient tie point, it is necessary to move a 5.6 K resistor before adding the components to be described. We moved it to an unused pilot light terminal below the B switch assembly. The white wires which are moved in this operation provide the +5 volt source for the added circuit elements.

The added circuit consists of two sections of a type 7400 integrated circuit in an R-S configuration for switch debouncing. This develops a control signal to gate through pulses at a PRF of about two per second, from a pulse source consisting of three sections of a type 7401 open collector quad 2-input Nand circuit. The remaining Nand gate in this chip is not only used to gate the low rate pulses through, but, since it is of the open collector type, forms a wired-on circuit with the output of Nand gate 209 in the Sequence Counter. Do not omit the 2.2 mf bypass, or the slow clock pulses may get into the 5 volt line. The circuit operates in both local and remote control modes. Design the circuit to mount on the rear of the Control Panel between the Transport Control and the Record Mode switches. Connect as shown in the drawing.

VOTE NOW!
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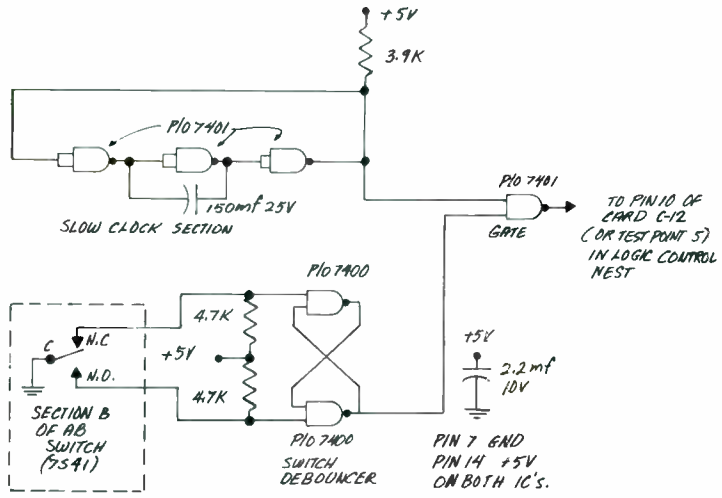
On Reader Service Card



Pulse source and switch debouncer allow manual control of TCR-100 event sequencer.

9. Delayed End-Of-Message Pulse.

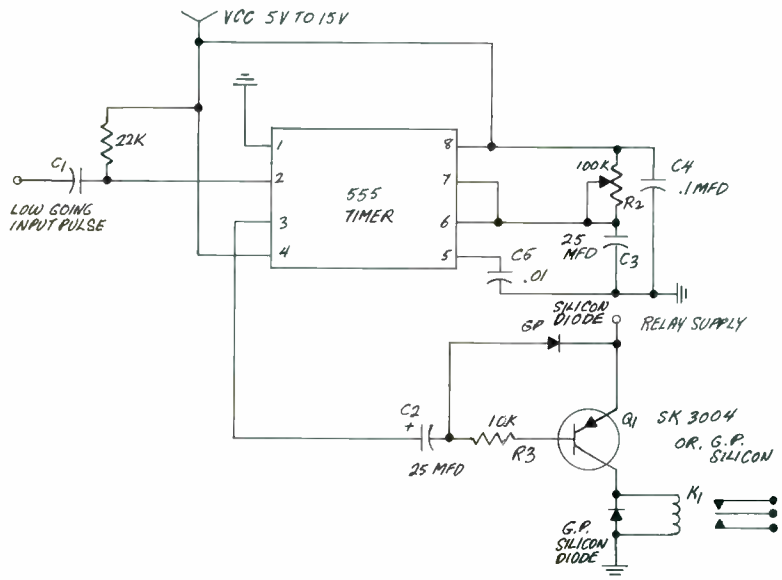
Jim Purcell, WFHR/WWRW, Wisconsin Rapids, WI.

Problem: Our program automation system required a delayed end-of-message pulse to switch off the audio from the source which has just played. (Ordinarily switching off the audio channel is accomplished by a trailing-edge pulse from the end of the auxiliary tone but our old programmer was not designed for the contemporary overlap programming.)

Solution: The 555 timer I.C. is a natural for this task. The 555 has appeared in circuits used for timing, but the circuit shown is different. Instead of pulling in a relay for some predetermined interval the relay is energized at the end of the timing cycle, thus the original pulse is delayed.

The 555 is connected in a standard one-shot M.V. mode with pulse duration determined exclusively by R_2/C_3. When output pin #3 goes low, C_2 discharges thru the base resistor R_3 turning on the transistor and pulling in the relay until the capacitor is discharged. (The holding time of the relay is determined by the sizes of C_2, R_3 and the transistor base resistance. With the values shown the relay should hold for nearly 2 seconds.)

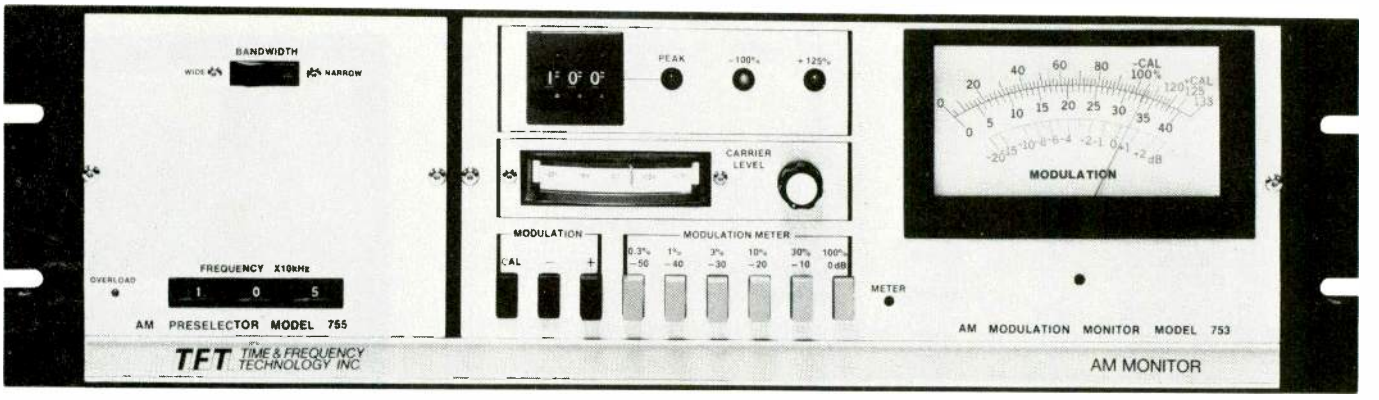
The neat thing about the 555 timer is that it can be operated at any value V_{CC} from a logics power supply of 5 volts to as much as 15 volts. The relay and driver may be powered by a supply appropriate to the normal relay voltage.



Circuit uses 555 timer to produce delayed pulse, which can turn off audio source after end of message.

Another TFT first in AM Modulation Monitors

THE EXTENDER



Extends Modulation Capability

TFT's new, competitively priced Model 753 precision broadband AM Modulation Monitor now accurately measures the +125% peak modulation and meets the new FCC monitoring requirements. A full complement of quality TFT features, for maximum transmitter modulation to the outer limits of coverage and for proof-of-performance measurements is also provided. The Extender is in a class by itself.

- Digitally settable peak modulation flashers for +125% and -100%.
- Built-in +125% and -100% calibrators
- Excellent transient response (no overshoot)
- Built-in meter attenuator for proof of performance measurements
- Modulation meter and peak flashers calibrate automatically over a ±40% carrier level change
- FCC Type Approval No. 3-234.

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By adding the new TFT Model 754 or 755 Preselector, broadcast stations, consultants, and regulatory agencies can tune in any AM station via thumbwheel switches. Then, they can precisely monitor them off-the-air. Exclusive features include:

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TFT *TIME AND FREQUENCY TECHNOLOGY, INC.*
3000 OLCOTT STREET, SANTA CLARA, CA 95051 (408) 246-6365 TWX No. 910-338-0584

Circle 166 on Reader Service Card

INTERPRETING THE

FCC RULES & REGULATIONS

Advertising Time Limitations

By Frederick W. Ford and Lee G. Lovett;
Pittman, Lovett, Ford and Hennessey, Washington, D C.

RECENTLY, THE COMMISSION "strongly admonished a network for permitting one of its owned and operated radio stations to broadcast advertising in excess of the maximum represented in the station's license renewal application. The maximum referred to was 18 minutes of commercial matter per broadcast hour. The radio station exceeded this maximum at least 11 times within a period of three months.

The Commission found that the licensee had failed to live up to its representations in its license renewal application and concluded:

> Although no further Commission action is contemplated on the basis of the information presently available, you are strongly admonished for your failure to conform your commercial practices with your representations to the Commission and you are expected to adopt procedures to prevent such violations in the future. This matter is being made a part of the records for [the radio station].[1]

As this case illustrates, the Commission takes very seriously representations of maximum commercial advertising time in renewal applications. Broadcasters should completely familiarize themselves with the Commission's policies concerning advertising time limitations *before* making representations in their tri-annual renewal applications.

License renewal application

Paragraph 19 of FCC Form 303-R, the license renewal form for AM and FM stations, requires a statement of the maximum amount of commercial matter that the applicant proposes "normally" to allow in any 60-minute segment of the broadcast day. While there is no Federal statue or Commission rule placing an absolute ceiling on the number of commercial advertising minutes per hour,[2] the Commission has an obligation to make an affirmative public interest finding *before* granting the license renewal application. If, in its reasonable judgment, the Commission concludes that a licensee proposes an excessive number of 60-minute segments during the broadcast week with more than the represented maximum minutes of advertising, it will designate the renewal application for hearing.

The Commission's responsibility to grant license renewal only if consistent with the public interest forms an effective ceiling to the number of 60-minute segments with more than 18 minutes of commercial matter. Over the years, the Commission has accepted a policy of not questioning between 18 and 20 minutes per hour of commercial advertising (a) within 10% or fewer of the broadcast station's weekly hours of operation, and (b) if there is sufficiently good cause.

There are a number of good cause exceptions recognized by the Commission. As a preface, it should be noted that a good cause reason for exceeding the 18 minute limit for one station may *not* constitute good cause for another station. It all depends upon the specific facts of the situation. Broadcasters should keep this in mind when deciding whether or not to exceed the 18 minute per hour limit.

Among extraordinary circumstances, the Commission will likely recognize: (1) A newspaper strike which severely cuts back upon local advertising available to citizens residing in the community of license of the broadcaster; (2) political primaries or elections where a large number of candidates make equal time or other demands; (3) broadcast operating failures; (4) public service emergencies; and (5) the seasonal nature of advertising in certain geographic locations.

Another exception to the 18 minute per hour limit comes in connection with special programs where, for valid reasons, the normal amount of commercial matter is significantly lessened, but the preceding or following 60 minute segments have correspondingly increased amounts of such matter. For example, it is not unlikely that the Commission might agree that a presidential press conference would qualify as such special programming. If a broadcaster were only able to include 16 minutes of advertising during the 60-minute segment containing a press conference, the broadcaster would be justified in having 20 minutes of commercial advertising during the preceding or following 60 minute segment.

It is easy for a broadcaster to figure out how many times during the broadcast week the 18 minute limit can be exceeded pursuant to the above-described "unwritten" Commission policy. Simply multiply the number of hours in the broadcast day by seven and divide the resulting figure by ten. For example, a station that broadcasts 24 hours a day, 7 days per week, has 168 60-minute segments. Ten percent of this figure is 16.8. Thus, a broadcaster can safely[3] exceed the 18-minute limit 16 times during the broadcast week.

A broadcaster does not have *carte blanche* to exceed the 18 minute limit *unless* it has good cause.

---

[1] *CBS, Inc.*, 41 RR 2d 1351 (1977).

[2] While many licensees propose a 14 or 16 minute ceiling, the Commission will approve a normal ceiling of up to 18 minutes per hour. Hence, all references herein are to an 18 minute ceiling.

[3] But, note carefully, the following paragraph.

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As noted above, a licensee must state in its license renewal application (Paragraph 19) the maximum amount of commercial matter that the applicant proposes normally to allow in any 60-minute segment and the percentage of hourly segments per week that this amount is expected to be exceeded. Three years after the renewal application is filed, the Commission calls the licensee to account for this representation. Paragraph 17 of FCC Form 303-R requires the licensee to state the number of 60-minute segments in the composite week containing over 18 minutes of commercial matter. The licensee must submit an exhibit listing, for each 60-minute segment containing more than 18 minutes of commercial matter, the following: (1) the amount of commercial time in the segment and (2) the day and time broadcast.

If the number of these segments does not comport with the licensee's representations in Paragraph 19 of the 303-R license renewal application filed three years before, the applicant must submit an exhibit explaining the reaons for the variations. The Commission may initiate further investigations to determine whether or not the licensee has made a misrepresentation to the Commission and whether license renewal will serve the public interest.

It becomes clear that careful planning and consideration is necessary when completing Paragraph 19 of Form 303-R. Similarly, once the representation concerning a normal commercial matter ceiling is made, a licensee must carefully supervise broadcast operations to avoid the broadcast of excessive commercial matter in contradiction to these representations. The FCC views deviation from these commercial representations as a "very serious matter."[4]

Program length commercials

One frequently recurring pitfall in the area of commercial matter representations is the program length commercial.

A program length commercial is program matter designed primarily to promote the sale of a sponsor's product or services rather than to serve the public by either entertaining or informing it. A good example of a program length commercial is a 30-program extolling the virtues of a seaside Florida community which is produced and paid for by a Florida land development company. In such a case, the Commission found that the program was not entertainment or documentary in nature, but rather commercial because it promoted sale of the Florida company's housing developments.

The Commission has stated that the primary test of a program length commercial is whether the purportedly noncommercial segment is so interwoven with, and in essence auxiliary to, the sponsor's advertising to the point that the entire program constitutes a single commercial promotion for the products or services.[5]

A program length commercial is *normally* 5, 15, 30 or more minutes in length and often violates a licensee's representation concerning the maximum amount of commercial advertising matter in any 60-minute segment. It is for this reason that broadcasters should be especially wary. The Commission has deemed the broadcast of program length commercials to be "a serious dereliction of duty."[6]

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[4]*KORD, Inc.*, 21 RR 781 (1961).
[5]*Program Length Commercials*, 29 RR 2d 469 (1974).
[6]*Eugene Television Co.*, 28 RR 2d 305 (1976).

Political spot announcements

One of the reasons stated above for permitting in excess of 18 minutes per hour of commercial advertising is the demand generated during political primaries and elections. Often, numerous candidates wish to broadcast paid political messages to the electorate. As has become a tradition during the past few years, the days immediately preceding an election can become saturated with political broadcast advertising.

Hence, the Commission will also permit broadcasters to go beyond (a) the 18 minute limit and (b) the 20 minute limit (permitted for 10% of the 60-minute segments in the broadcast week) to (c) a 24 minute limit *if* the additional four minutes are used *exclusively* for political advertising. Several examples are given below to illustrate the operation of this policy.

Background facts for example: Assume that a station has a policy of limiting commercial advertising to 18 minutes per hour. The station's policy, detailed in its last license renewal application, is to exceed this limit by two minutes — a 20 minute limit — in no more than 10% of the hours of its 168 hour broadcast week (i.e., 16 hourly segments per week). The station's policy is also to exceed the 18 (or 20) minute limit by 4 minutes per hour for political advertising in no more than 10% of the hours of its 168 hour broadcast week (16 hours per week) during the 45 days before a primary election or during the 60 days before a general election.

Example 1: The station has broadcast exactly 20 minutes per hour of commercial advertising 14 times this week. It may now broadcast 20 minutes per hour of non-political commercial advertising two additional times this week, because of the 10% limit noted above.

Example 2: A general election will occur in 60 days. The station may exceed its 18 minute limit by 4 minutes 144 times during this 60 day period *if* the 4 minute advertising segments are all political in nature. The calculation for this figure is as follows: 24 60-minute segments in the broadcast day times 10% times 60 days equal 144. The station does *not* have to space these segments equally (e.g., 18 per week). If it wants to, the station may cluster all 144 segments in the final three weeks.

Example 3: Assume the facts given in example 2, above. The station is in the final week before the election and still has 20 of its 144 4 minute "political" segments left with which to exceed the station's 18 minute per hour commercial ceiling. However, the station has broadcast "good cause" non-political commercials for 20 minutes per hour 16 times (10% of the 168 hour broadcast week) already this week. Can the station still exceed the 18 minute limit for the remaining 20 4 minute "political" commercial segments? The answer is "yes." The 4 minute commercial political segments are simply tacked on to the 18 minute commercial segments, rather than on to 20 minute commercial segments. Note, carefully, that the 10% calculation involving the extra 2 minute non-political commercial segments does not relate them to the 4 minute political commercial segments which also are determined by a 10% calculation.

Conclusion

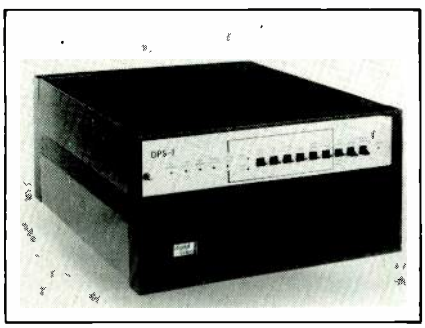
As the preceding examples demonstrate, planning and implementing a policy of commercial advertising ceilings (and exceptions to the ceilings) can become quite complicated. Consultation with your communications counsel is important. Likewise, it is important to develop a written policy upon which to develop "examples," as shown above, to assist station personnel in understanding how to comply with commercial matter representations made to the Commission at license renewal time. **BM/E**

BROADCAST EQUIPMENT

Some interesting products appearing this month are: a new all-digital time base corrector and processing system with a 32-line window; a system which takes over all CATV channels in a community, for emergency announcements; a digital remote control system with 10 raise/lower channels and telemetry for less than $2000.

All-Digital Video Processing 300

New video processing system includes time base correction with a 32-line window. Model DPS-1 has an internal test signal generator and microprocessor control. Generator puts out eight numerically produced signals:



color bars, linear ramp, and modulated stair step. The totally digital operation allows analysis of burst signals for line clock phase and frequency correction to the nearest one-half nanosecond. Video signals are converted to 8-bit words, at four times the color subcarrier frequency. DIGITAL VIDEO SYSTEMS.

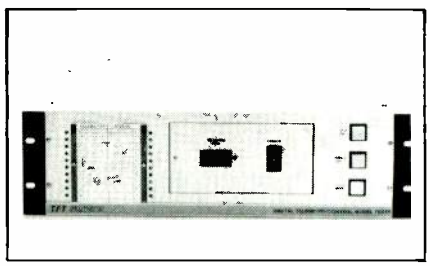
Local Alarm System for Cable TV 301

Emergency announcements by a local authority — police, town government, or whatever — can be delivered instantly to a community with a system that takes over all local CATV channels automatically. The CEAS (Civil Emergency Alert System) can be installed in any central office, such as a municipal building, and uses a dial telephone set for input. An official wanting to alert the whole community simply lifts the receiver and dials a cer-

tain number; he is then "on the air" via CATV. System uses a transmitter at the origination point connected by dedicated telco line to the CATV headend (or headends). CADCO.

Low-Cost Digital Remote Control 302

Digital remote control system provides ten channels of raise/lower capability plus telemetry. Model 7601 can be connected to transmitter by telco line or



by microwave, STL, or SCA. System can be calibrated and adjusted by one person. Optional is a ten-channel status indicator using LED's. Basic system, $1995.00. Status indicator, $495.00. TIME AND FREQUENCY TECHNOLOGY.

For more information circle bold face numbers on reader service card.

Remote AM Antenna Monitor 303

Fully remotable AM digital antenna monitor (FCC type approved) has true ratio readout, full stability with unsymmetric modulation. Model CMR has DC outputs for remote phase and radio readings, plus LED displays for continuous phase sign, and BCD outputs. $1990 (for two towers). GORMAN-REDLICH.

Color Sync Generator 304

Color sync generator and companion genlock add complete NTSC pulse capability to 5900 Series distribution equipment. Model SY-5990A generator has oven stabilized crystal oscillator, meets FCC part 97 requirements. Pulse rise/fall times are controlled to 140±20 nS. Model SY-5995A genlock has lock-in range for ±20 Hz for subcarriers, ±150 Hz for horizontal. SY-5990A, $550.00. SY-5995A, $350. DYNAIR ELECTRONICS.

Portable Videocassette 305

Portable videocassette system consists of a black-and-white camera, ½-inch videocassette recorder, and an optional three-inch monitor for viewing results in the field. Model VT-350 video cas-

sette recorder has 30-minute playing time, stop action, variable speed frame search, freeze frame, electronic vertical interval editing. Operator can playback at any speed, stop on any wanted frame. The VC-300 camera has a C-mount,

8:1 zoom lens, detachable electronic viewfinder, built in microphone with automatic AGC. AKAI.

Stereo Reverb System 306

Stereo reverb system uses two Accutronics reverb units with completely independent controls. Model QA-201 has a volume control and high frequency tone control in each channel. Compressor/limiter circuit optimizes drive to each channel. An overload indicator monitors three different points

in the circuit for overload. Input capability is from −20dBm to +18dBm. Input has 60dB of common mode rejection. QUANTUM AUDIO LABS.

Video Titler 307

Video keyboard titler allows selection of 1, 2, 4 or 8-line displays. Model KBD-1 has a keyboard with full cursor

control for editing, adjustable-speed horizontal crawl, 16-digit line, and 8-line page. The memory holds 4 pages. It is microprocessor controlled, and automatically "fences" a * symbol and resets to the beginning of the message for continuous loop operation. Brightness is controllable, and display size is selectable from 14 to 28 lines digit height. Numerous options are available for additional operating features. $1,195.00. PORTAC. (Exclusive marketing, VIDEO COMPONENTS, INC.)

Modular Amp Series 308

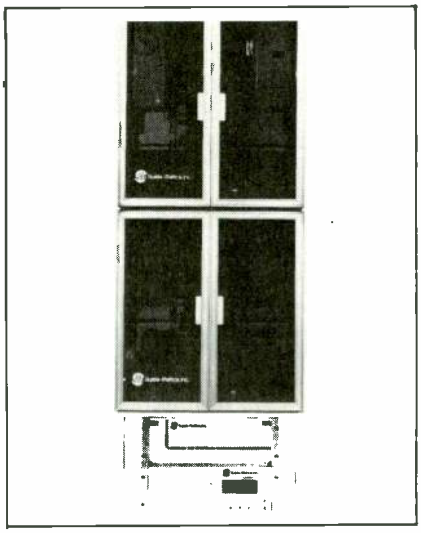
Modular series of video and audio amplifiers all fit in nine-position rack frame. "Omniframe" Model TMF20 is cross-wired for AC power to each of the nine positions. It fits standard 19″ rack and takes 3½″ of vertical space. Available for system are: Model TB5 balanced/unbalanced video amplifier, with up to 10dB of adjustable gain; Model TC5 clamping video amplifier, for reduction of hum disturbance caused by ground currents; Model ADA-206 audio distribution amplifier, providing up to six balanced outputs at +18dBm; Model PDA220A pulse distribution amplifiers, which regenerates pulses to standard four-volt level; and the Model VDA210-4 video distribution amplifier, with four isolated 75-ohm outputs. INTERNATIONAL NUCLEAR CORP.

Scrambler for Pay TV 309

Modulator/scrambling encoder, for pay TV has an output capability of 56dB for seven channels, 60dB for three channels. Companion decoder is a simple passive device which requires no power or overt action by the user. It can be tuned on site for a maximum notch of 60dB. TELEMINE COMPANY.

Automated U-Matic System 310

Automated system for U-Matic videocassette playback runs for 12 hours of unrepeated programming without reloading. Model 6T6 uses two VMP-6 video cassette decks with multiple loading, plus a UDS-23 sequencer unit which controls start and stop times. With two sources, programming can be "back to back" without pauses for the



automatic cassette changes. System has automatic pre-roll, instantaneous video-to-video switching, automatic rewind, and clock for pre-programming 24 hours in advance. Some of the options are: 65-event digital clock programmer; control for a third source, such as a single deck or another 6-hour VMP-6; the RAIM time base corrector

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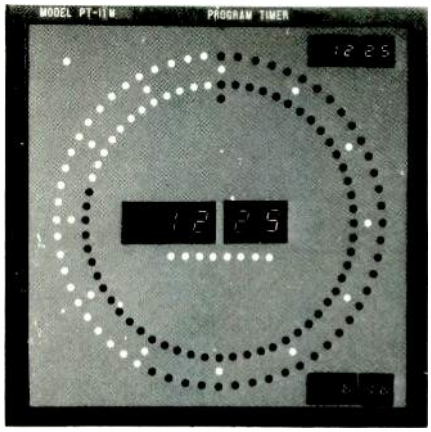
MODEL PT-10,PT-11,PT-12 PROGRAM TIMER



MODEL PT-11M

MODEL PT-11C

PATENT PENDING
ONE GLANCE, OK!
THE ULTIMATE PROGRAM TIMER

- **MODEL PT-12 with cue has a cue display at the top of the main time display. "SLOWER", "FASTER", "START", "STANDBY" and "REPEAT" are displayed in an easy-to-understand manner.**

- Rap time, remaining time or elapsed time can be output.
- Since the effect is the same as that of a clock, misreading of the time doesn't occur.
  The performers can read the time in this semicircular state.
- Designed to be applicable to all items in broadcasting work.
- May also be used instead of a stopwatch.
- Master/slave possible. Up to 10 units can be driven by one output. Since it has two outputs, a total of 20 units can be operated.
- Master and slave can be connected with one coaxial cable.
- Since signals are transferred at a low level through coaxial cable, there is no fear of induction or noise effecting other equipment.
- Since timing is performed electronically, there is no mechanical noise such as that of conventional clocks.
- Other devices can also be considered by means of code output.
  Other devices and optional interface meet all requirements.
- Combination with a control panel, etc. is recommended. Special mounting dimensions are also available.

NTI America, Inc.
1680 North Vine Street LOS ANGELES, California 90028
Phone 213-462-8945

Circle 170 on Reader Service Card

Broadcast Equipment

for on-air broadcast quality. Basic system, suggested retail is $7,495.00. SYSTA-MATICS, INC.

Microwave Antenna Carrier 311

Antenna carrier for mounting micro-

wave dishes on top of vans and trucks folds down to less than 18" above the roof, and reaches to 29 feet when upright. Model SS2900BC has power trim for tilt and rotation of the antenna, and compact method for taking coax to the dish. VAN-LADDER, INC.

Cable TV Automation 312

Keyboard controlled automation system for cable TV consists of a high resolution character generator, digital cassette memory, and machine controller for automatically switching 6 or 12 program sources. "Merchandiser" has microcomputer management, uses character generator for announcements and promotion, cassette memory to hold program sequence. Microcomputer automatically carries out sequence. $10,495 for basic system; add $2500 for control of six programs, $3500 for control of 12 programs. SYSTEM CONCEPTS.

Rugged Remote Studio 313

Portable "studio" has space for a console, two turntables, cart machines, rack space for open reel machine, power amplifiers, reverb, equalizers, etc. Model 704 is made of high density particle board, has a hinged front cover

For more information circle bold face numbers on reader service card.

that locks to prevent entry and opens down to give desk space for the operator. Unit is on heavy-duty casters. $995.00 for cabinet. (Prices for fully

equipped unit available.) DYMA ENGINEERING.

Transmitter Monitor 314

Remote monitoring system automatically reports any abnormal change in status of up to 16 functions. "Monitel" uses a telco line with automatic dial up from the transmitter when any abnormal change occurs, and supplies location and nature of the monitored fault. OMICRON.

Color Bar/Background Generator 315

Three-signal generator takes in NTSC sync, blanking and subcarrier signals and puts out color bars, color background and color black signals simultaneously. Model 383 $(CB)^3$ has adjustable delay, 200 nS to 1.0 microsec, for each output. $1,350.00. SHINTRON.

Two-Way Line Extender 316

Line extender for cable TV has built-in two-way capability. Model JLE-300-2W handles 35-channels, can be used to upgrade systems to 300 MHz, or for extending existing systems with capability to feed more subscribers per active device. JERROLD ELECTRONICS CORP.

Dual Magnetic Reproducer 318

Dual magnetic reproducer system for magnetic film can interface with either film or tape machines for sound-on-film and sound-for-tape in motion picture and teleproduction operations. Model PM-85-SL can be had as two reproducers, two recorder/reproducers, or in other combinations. Recording can be on multiple tracks if wanted, up

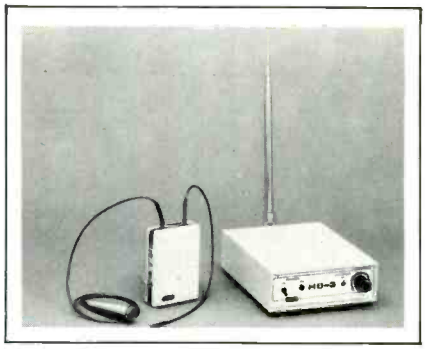
continued on page 108

Broadcast Equipment

to six tracks of recording and 12 tracks in reproduction. Transport mechanisms are servo-controlled. Plug-in assemblies allow use of either 16mm or 35mm film. RCA.

Wireless Microphone System 317

Wireless microphone systems operate in 150-210 MHz band. Transmitter can



be used with regular or rechargeable battery, and with any microphone head. EDCOR.

Zoom Viewfinder 319

A zoom viewfinder for motion picture and television directors has 10:1 zoom range, direct reading focal length, focusing eyepiece. Model Mark IV focal range is from 12mm to 120mm in 16mm, from 25mm to 250mm in 35mm format. AGE, INC.

Video Backpack/Cart 320

Video backpack and cart is designed for use with the Sony DXC-1610 camera and any of the new portable VCR's, including the Sony SL 0-340. "Porta-

Brace Series B'' has camera support putting weight on back and hips; independent positioning of the camera at eye level; ability to swing camera away from eye during walking. Included is foamed-padded nylon case for the video recorder. Carrier structure functions as both a backpack and a cart. $350. K.H. PRODUCTS, INC.

Digital Special Effects 321

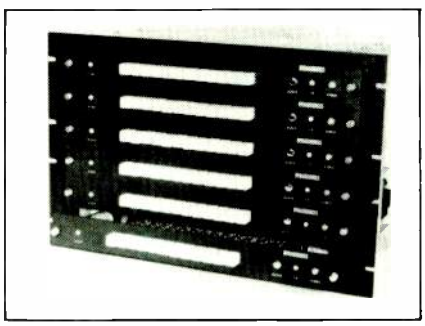
All-digital special effects unit has 16-output delay line. Model S1066 uses a computer-programmed read-only memory to select the time of each output, and its amplitude and phase. The ROM can store up to 32 different programs, and the number of variations in effects available is nearly infinite, many so new that they have no names. EVENTIDE CLOCKWORKS.

Miniature Floodlight 322

Quartz miniature flood light is 2½"x2½"x4", uses either a 250 watt 3250°K or a 300 watt 3350°K dichroic quartz lamp, operating at line voltage. Effective range is 50 feet. $27.50. PACKAGED LIGHTING SYSTEMS, INC.

TV Routing Switchers 323

Vertical interval switching is available on the 8500 Series of routing switchers. Series uses a single rack to hold up to



six of its modular units. Each module has both video and audio switching and a self-contained power supply. System can handle up to 12x12 without serious signal degradation. DYNASCIENCES.

Triple Cart Deck 324

Triple cart reproducer has three playback decks, all driven by a single motor and power transformer. Model CT5500 has independent controls for each deck, plug-in decks for easy cleaning, full, emotable digital logic, control, and no-click FET switching. AMPRO BROADCASTING, INC.

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William J. Healey

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Judy Milford

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BM/E READER SERVICE CARD February 1978 Issue

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	1		2		3

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What articles would you like to see?

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GREAT IDEA BALLOT *Fill in entry number of Ideas you rank 1, 2, 3*

No.	Rank	No.	Rank	No.	Rank
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300	301	302	303	304	305	306	307	308	309	310	311	312	313	314	315	316	317	318	319
320	321	322	323	324	325	326	327	328	329	330	331	332	333	334	335	336	337	338	339
340	341	342	343	344	345	346	347	348	349	350	351	352	353	354	355	356	357	358	359
360	361	362	363	364	365	366	367	368	369	370	371	372	373	374	375	376	377	378	379
380	381	382	383	384	385	386	387	388	389	390	391	392	393	394	395	396	397	398	399

Use until May 31, 1978

COMPLIMENTARY SUBSCRIPTION QUALIFICATION CARD

1. I would like to receive BM/E (Broadcast Management/Engineering)
☐ YES ☐ NO

2. Please check your business classifications

☐ AM Station
☐ FM Station
☐ TV Station
☐ Non-broadcast TV
☐ Campus Limited Radio
☐ CATV Facilities
☐ Microwave, Telephone, Satellite Company
☐ Recording Studio
☐ Teleproduction Facility
☐ Government
☐ Consultant
☐ Lawyer
☐ Manufacturer/Distributor/Dealer
☐ Other (please specify) _____

3. Are you responsible for more than one station or facility?
☐ YES ☐ NO

4. My primary area of responsibility is: (please check one)

☐ Corporate Management — Board Chairman, President, Owner, Partner, Director and VP or General Manager (other than in charge of engineering or station operations management)

☐ Technical Management & Engineering — VP Engineering, technical/engineering director, chief engineer, engineering supervisor, other engineering or technical titles

☐ Operations & Station Management/Production & Programming — VP operations, operation manager/director, general manager, station manager, production manager, program manager, news director, and other operations titles

5. Signature _____ Date _____

Name _____

Title _____

Station Call Letters or Company _____

_____

Street _____

City _____ State _____ Zip _____

Is this your business address? ☐ YES ☐ NO

If not, please give us your business address below so that we can avoid sending duplicate copies

Name _____

Station Call Letters or Company _____

Street _____

City _____ State _____ Zip _____

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