

FEBRUARY 1977

BME

BROADCAST MANAGEMENT/ENGINEERING



**Special Report: Digital Technology For Broadcasters - Part 1
More Than "Black Boxes?"-You Can Count On It!**

Outlook For NAB '77 Show In Washington D.C.

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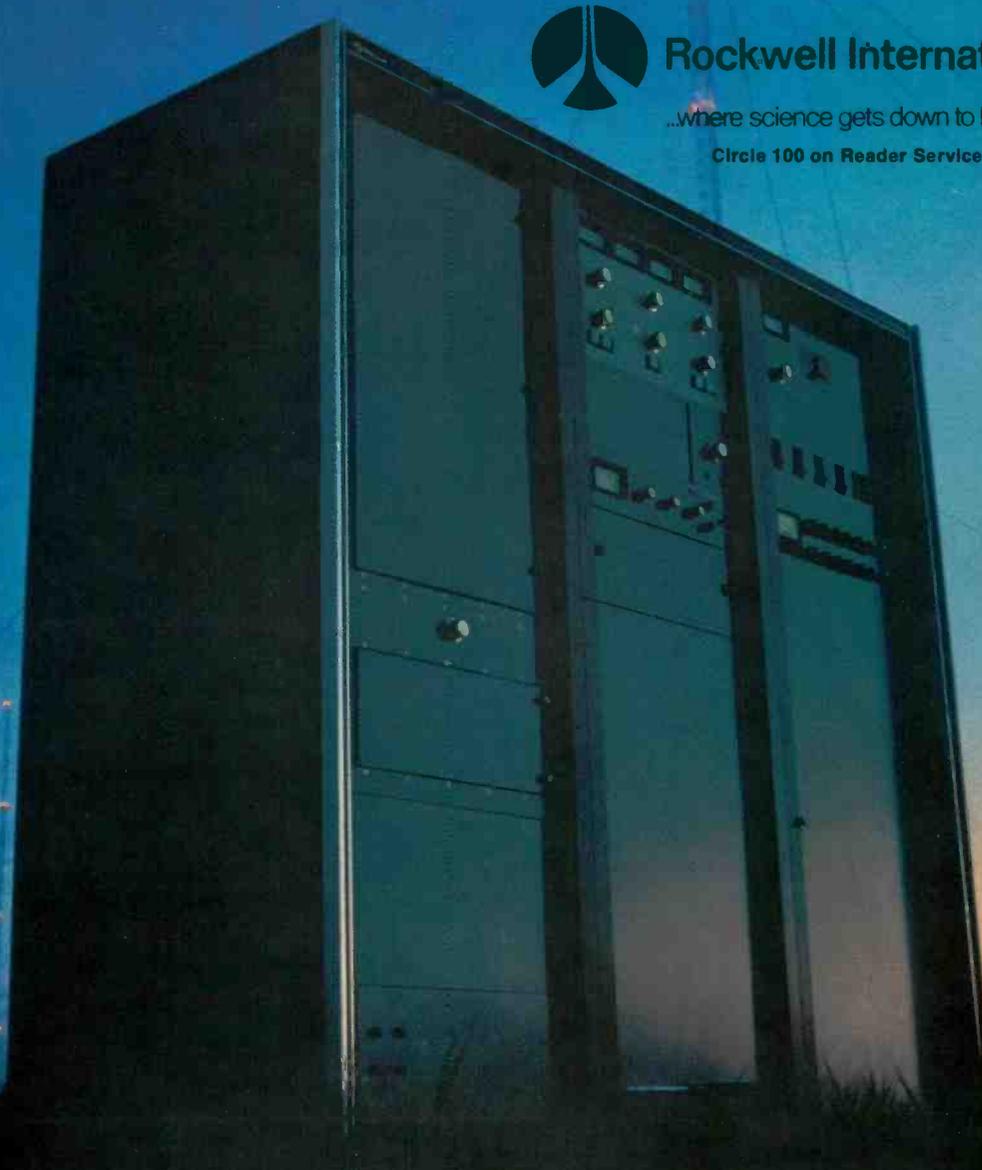
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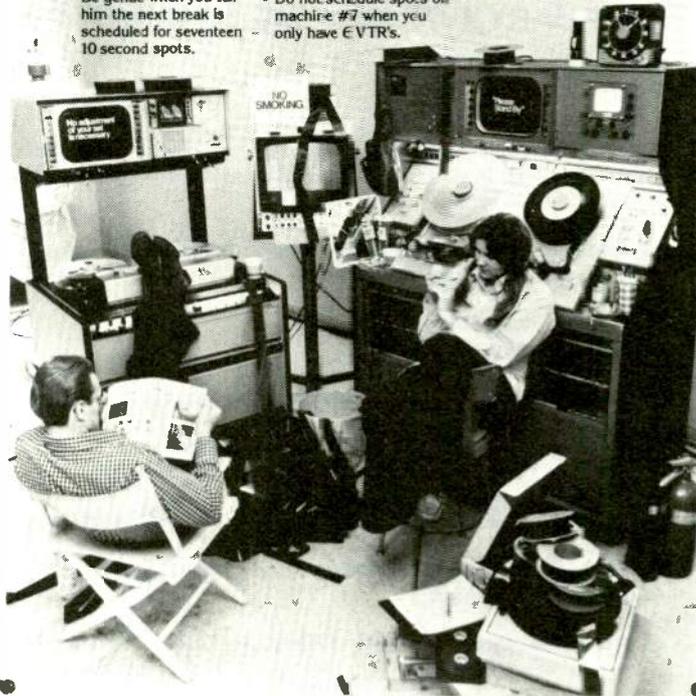
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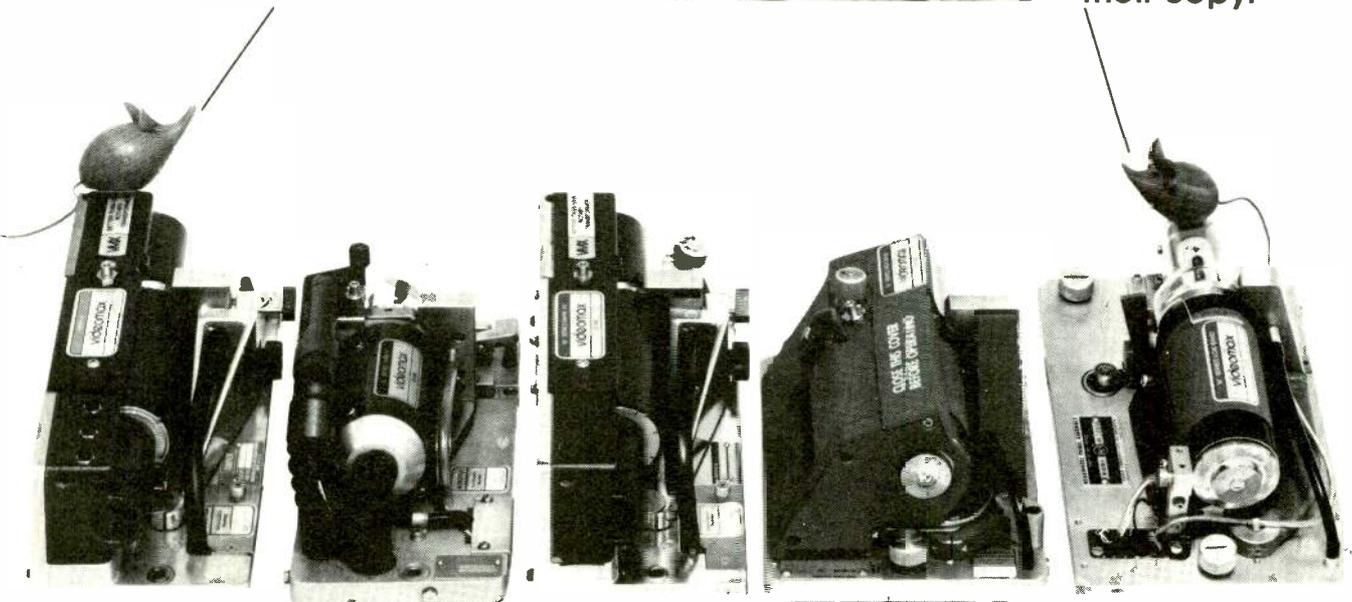
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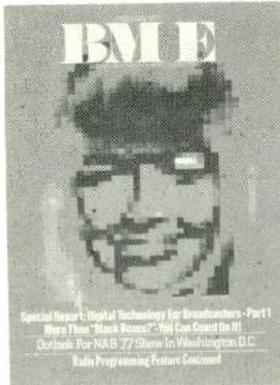
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BM/E

BROADCAST MANAGEMENT/ENGINEERING

FEBRUARY 1977/VOLUME 13/NUMBER 2



Digital techniques in video and audio are emerging as a major new wave in the advance of broadcast technology. Our thanks to Ms. Patty Nettles who posed for the picture and to Colorado Video Inc. who used their Video Digitizer 270 to help produce this striking picture.

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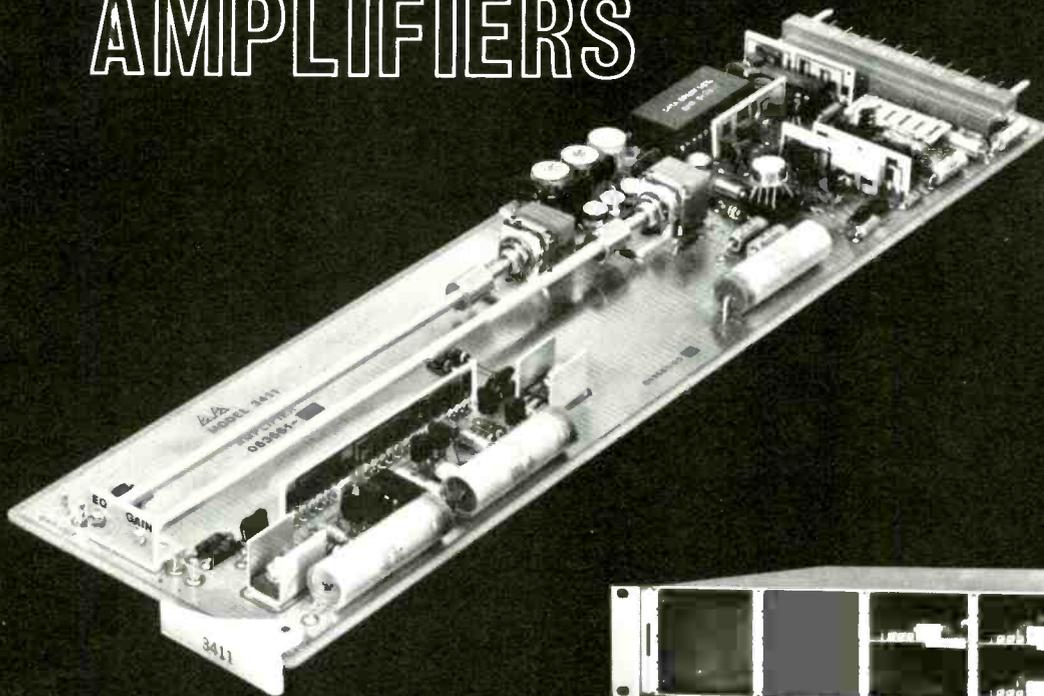
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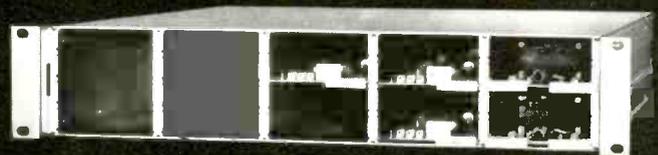


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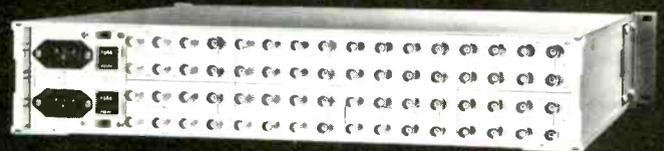
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BROADCAST INDUSTRY NEWS

Earth Antennas Under Nine Meters Declared Legal

In a declaratory ruling that seems certain to speed the already fast development of satellite networking, especially for CATV, the FCC has made earth station antennas of less than 9 meters diameter acceptable for licensing, on proper showing of technical adequacy. The ruling further specifies that applications for antennas down to 4.5 meters for receive-only use by cable television systems will be routinely processed, if certain information is supplied. The 9 meter limitation, the FCC said, was set up in 1970 to make sure that domestic satellite systems would achieve reasonably small inter-satellite orbital separations. But the FCC added that for the future the smaller antennas would be acceptable on showings that they did not compromise the Commission's effort to maintain 4° satellite separations. The ruling stimulated industry response almost immediately—see separate news story on the Hughes small-antenna earth station system.

HBO, NCTA Hail Small Antenna Rule; INTV Panel Studies Satellite Impact

The FCC's small antenna ruling also drew strong applause from Home Box Office and the National Cable Television Association. And it stirred very high interest at a panel discussion of satellite networking at the 4th Annual Convention of the Association of Independent Television Stations in San Francisco, January 10th (after this was written).

N.J. Nicholas Jr., president of the HBO pay-TV network, said that the FCC ruling "... unquestionably will encourage further growth of pay TV and other new services on cable systems." Robert L. Schmidt, president of NCTA, said the FCC's new procedures "... will open satellite service to many smaller and medium-sized communities."

The INTV panel, with Edward Q. Adams, vice president and general manager of WCIX-TV, Miami, as moderator, was given the subject, "The New World of the Satellite."

Hughes Offers Earth Station With Small Antenna

The force of the FCC ruling in favor of earth station antennas down to 4.5 meters (see FCC News) was quickly apparent when the Hughes Aircraft Company announced a series of earth stations with 4.5 meter antennas (the FCC's ruling was widely anticipated in the industry). The Hughes systems (and no doubt others that will follow) seemed certain to accelerate the already rapid spread of satellite networking in cable TV and broadcasting. Hughes pointed out that the systems will generally be mountable on roofs, saving real estate costs. Each system will include the antenna, low-noise amplifier, video receiver and all necessary connecting cables, waveguides, etc. The antenna, says Hughes, meets the FCC's side lobe requirements and will protect the system from interference from satellites at least 4° off the selected signal. Prices start at about \$28,000.

RTNDA—Growing In Numbers And Confidence

More than 900 registrants attended the RTNDA annual conference held in Bal Harbour, Florida, this past December. This was an increase of nearly 300 from the '75 conference held in Dallas.

Though the crush of unexpected registrants caused some shortages of seating at luncheons and some scheduling problems, the lure of the beaches drew enough people away so that the annual business meeting could not be held due to the lack of a quorum.

The managing directors report, however, showed an increase in membership from 1,095 to 1,373, and an increase in active news directors from 481 to 588. The conference also drew a record number of exhibitors, mostly ENG manufacturers, of 37.

Conference keynoter, Walter Cronkite, spoke out in favor of longer newscasts to provide the public, increasingly dependent on TV and radio news, with more of the background and "why" of stories. Cronkite went on to urge the members to press for more news at the local level and blasted stations that rely on news consultants rather than their own judgement.

David Brinkley also spoke about news "judgement" but was more concerned by what he sees as an anachronistic reliance by TV and radio news directors on print criteria for judging what is news. Brinkley went on to recommend that TV and radio ought to set about developing their own set of guidelines based on the nature of the medium and his own suggestion that a story should not be presented if one honestly does not believe it will interest at least 10 percent of the audience.

News "Stars" Get Greener

Top salaries paid by commercial television news operations in 1976 were half again as great as in 1972, according to national surveys conducted for the Radio Television News Directors Association by Professor Vernon Stone of the University of Georgia School of Journalism.

The cost of stars was on the increase at stations as well as at the nets. The typical salary being paid in news at the 415 stations surveyed in 1976 was \$320 a week, compared to \$210 found in a similar survey conducted by Dr. Stone four years ago. The median salary ceiling this past year was \$900 in the top ten markets and \$450 in the 56 markets of more than one million population. The highest paid newsmen were typically making \$330 in markets of a quarter million to a million and \$270 in smaller markets.

By contrast, salaries for the lowest paid members of TV news staffs increased only 14 percent—\$150 a week the median this year compared to \$132 four years ago. Even in the top ten markets, the median low salary was only \$170.

In radio news, salary increases were less than in TV. The typical increase was 12 percent for the lowest salary category and 32 percent for the highest. The median range for the 330 commercial radio stations sampled by Dr. Stone was \$140-\$200 compared to \$125-\$152 four years ago.

New Firm Will Push Fiber Optics For Cable TV

In a corporate creation that seemed likely to accelerate the adoption of
continued on page 81

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News

lightwave communications by the cable television industry, Insilco Corporation, of Meriden, Connecticut, and Fiber Communications, of Orange, NJ, have agreed to form a new company called Times Fiber Communications, for research, development and manufacture of fiber optic communications systems. Insilco will own 51% of the new company and the shareholders of Fiber Communications, 49%; total assets will be \$20 million. Fiber Communications was founded in 1975 by Drs. Franklin W. Dabby and R.B. Chesler, former scientists of Bell Telephone Laboratories, both of whom have had very extensive experience in fiber optic development; Dabby holds six patents in the field and Chesler, three. They have produced glass fiber cables for such pioneering efforts as Teleprompter's initial lightwave system, put into operation in July 1976.

Lawrence DeGeorge, vice chairman of Insilco, will be president and chief executive officer of Times Fiber Communications. The Insilco subsidiary, Times Wire and Cable, a principal supplier of coaxial cable, will be an operating division of the new company; Fiber Communications will be another division, and it will be headed by Drs.

Dabby and Chesler. Among the directors of Times Fiber Communications, in addition to Dabby, Chesler, DeGeorge, and others from Insilco, will be Irving B. Kahn, former head of Teleprompter. Dr. Dabby told *BM/E* in an interview that they plan to involve Times Fiber Communications in every aspect of fiber optics for cable, security systems, military aircraft, computer systems, automotive by-products, and other fields.

FCC Suspends All Fees; Courts Force Action

The Federal Communications Commission on December 22 took the unusual action of suspending pro tem, the collection of all fees from licensees under any of the services administered by it, effective January 1, 1977. The suspension was in response to four decisions set down on December 16 by the U.S. Court of Appeals in the D.C. circuit, which resulted from suits brought against the FCC by a wide range of licensees for returns of fees already paid.

These suits, in turn, hinged in various ways on the Supreme Court decision of March, 1974, which designated certain fees (but not all) as illegal.

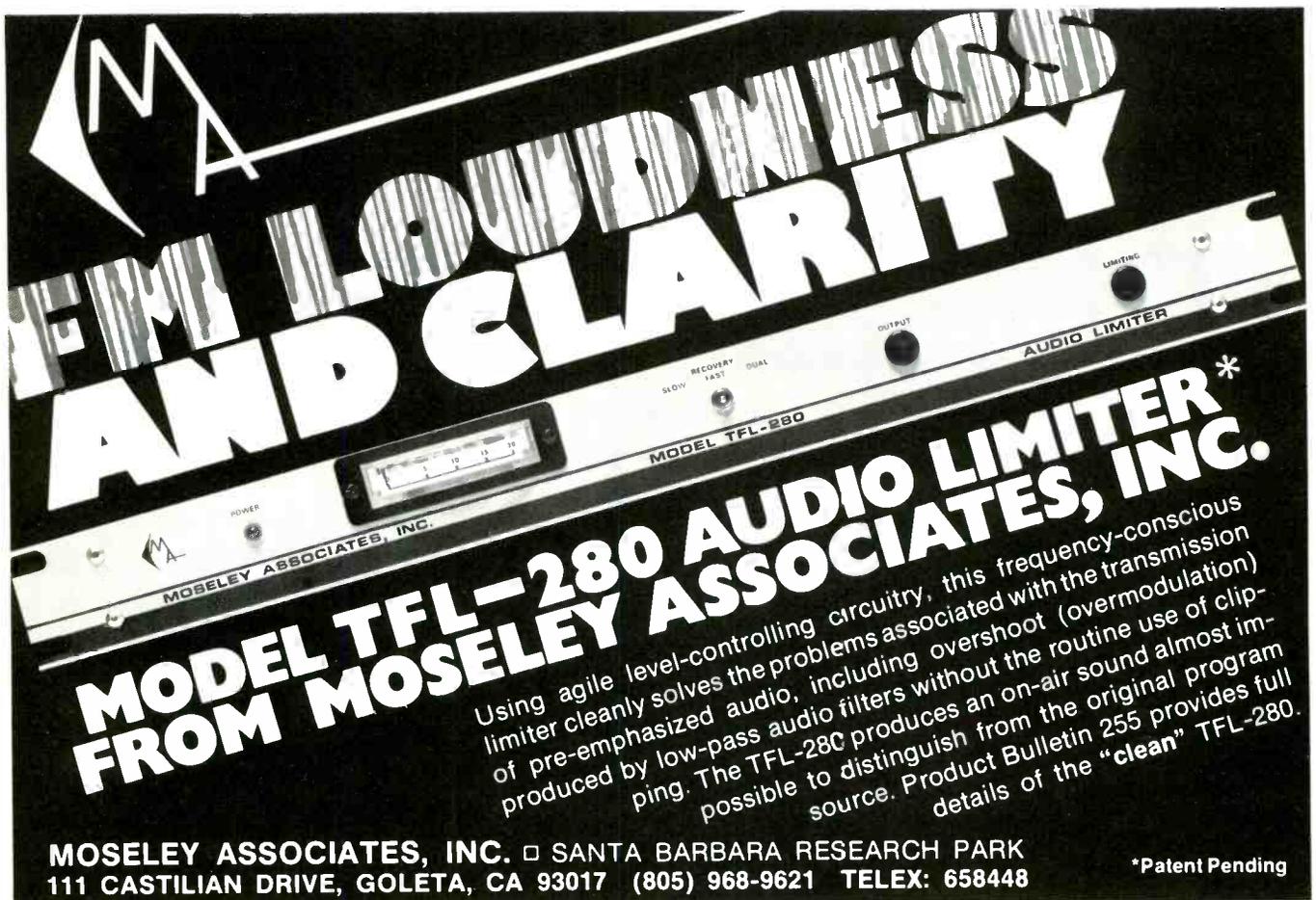
The latest court decisions, in effect, direct the FCC to justify each separate fee, and to calculate the cost basis for

each. The FCC said that suspension of all fees was the appropriate response, while it undertook the considerable job of studying the legal and administrative problems raised by the Court actions. The FCC said that the ordered refunds would be made as soon as possible, and that inquiries "will not speed the process."

FCC Starts Inquiry On UHF Noise Levels

In response to a petition of the Council for UHF Broadcasting, (see story in *BM/E*, November, 1976) the FCC has opened an inquiry and proposed rulemaking to reduce the allowable noise figure of UHF TV receivers. The present maximum allowed is 18 dB; the CUB has recommended that the figure be lowered to 12 dB within 18 months, and finally to 10 dB. The change has been opposed by the EIA, and the EIA of Japan, in part because of the anticipated increase in receiver cost. The FCC asked for responses to a number of questions, among which were: Would the change increase receiver susceptibility to other forms of interference? What will be the additional cost to consumers? Interested broadcasters should get the inquiry docket (#21010) from the FCC. Comments are due by February 15, 1977, replies by March 31st.

continued on page 11



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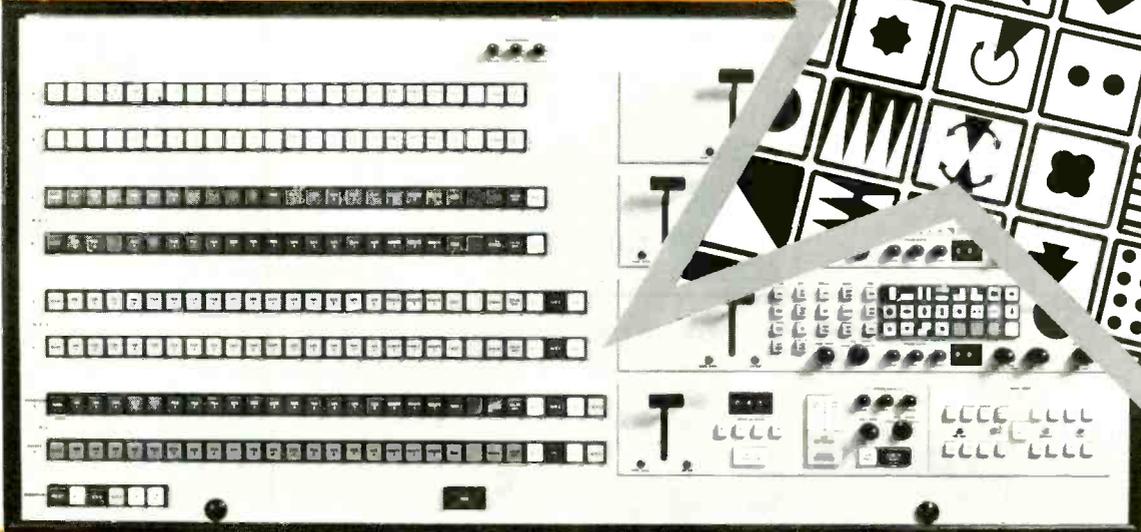
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News

Paramount TV Buys HTN

Hughes Television Network was sold December 28th to Paramount TV for an undisclosed amount. Hughes, which recently purchased 1800 hours of satellite time, and distributed numerous syndicated programs including Steve Allen's Laughback and the Liberty Mutual outdoors program, sold this plus its production equipment to Paramount TV.

Just why Paramount chose to purchase Hughes at this time is not known and Paramount officials are not talking. But industry sources speculate that the live capability and satellite time acquired will give Paramount a good lead into the pay-TV area. Paramount has just completed a very successful year in syndication operations and is known to be looking to expand its television operations.

NBC Top Spot Goes To Schlosser

Julian Goodman, chairman of NBC, announced that he has relinquished his position as chief operating officer and has named Herbert Schlosser to that post.

Goodman said in a statement that the move was prompted by part of a long range plan to consolidate management of the corporation. Schlosser, who is president and now also chief operating officer, will have unquestioned leadership of the corporation and its divisions: NBC network, NBC Radio, the five O&O TV stations, and NBC News. Goodman will remain as chairman of the board and a director of RCA, NBC's parent corporation.

FCC Briefs

A resumption of the FCC "payola-plugola" investigation has been stimulated by new information and complaints of illegal activities; the FCC Chief Administrative Law Judge will subpoena witnesses, books, records, as needed The FCC denied a request that all proposed rulemakings concerning cable television be mailed to all cable television licensees; the FCC said it would be financially prohibitive.

Non-commercial stations, under an amendment to the logging rules, will classify programs in the same way as on renewal form 342, rather than according to the (different) classes formerly set up for logging Annual cable television reports will in future be due 60 days after the FCC sends out the required forms, rather than on fixed dates.

continued on page 12



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(S) Camera World 1071 Sixth Ave. San Diego, Ca. 92101	(D/S) MINNESOTA Maritz Laboratories, Inc. 3000 France Ave. Minneapolis, Minn. 55416	(D/S) Gordon Yodar, Inc. 2911 Ladybird Lane Dallas, Texas 75220
(D/S) Adolph Gasser, Inc. 181 Second St. San Francisco, Ca. 94105	(D/S) MISSOURI Calvin Cinequip, Inc. 215 W. Pershing Road Kansas City, Mo. 64108	UTAH
(D/S) Film Equipment Rental Co. 363 Brannan St. San Francisco, Ca. 94107	(S) NEW JERSEY Cinecraft International, Inc. 11 Caesar Place Moonachie, N.J. 07074	(D/S) Stockdale Corporation 2211 West 2300 South Salt Lake City, Utah 84119
COLORADO	NEW YORK	WASHINGTON
(S) Film Equipment Service Company 1113 S. Pearl St. Denver, Co. 80210	(D/S) Camera Mart, Inc. 456 W. 55th St. New York, N.Y. 10019	(D) Glazer's Camera Supply 1923 Third Ave. Seattle, Washington 98101
CONNECTICUT	(D/S) F&B/Coco, Inc. 315 West 43rd St. New York, N.Y. 10036	(S) Phototronics 223 West Lake North Seattle, Washington 98109
(D/S) Cinelease, Inc. 2095 Old Durham Road Killingsworth, Conn. 06417	(D/S) Film Equipment Rental Co. 419 West 54th St. New York, N.Y. 10019	CANADA
DISTRICT OF COLUMBIA	(D/S) Mobius Cine Ltd. 7 East 47th St. New York, N.Y. 10017	(S) Cine Audio Ltd. 10251 - 106 St. Edmonton, Alberta T5J 1H5
(D/S) Branner Cine-Sound 5215 Wisconsin Ave., N.W. Washington, D.C. 20015		(D/S) Alex L. Clark Limited 30 Dorchester Ave. Toronto, Ontario M8Z 4W6
FLORIDA		Branches:
(D/S) Photomart 6327 S. Orange Ave. Orlando, Fla. 32809		(D/S) 7104 Hunterwood Rd., N.W. Calgary, Alberta T2K 4J6
		(D/S) 1070 Rue Bleury Montreal, Quebec H2Z 1N3
		(S) Steve's Camera Service 189 East 28th Ave. Vancouver, B.C. V5V 2M3
		(S) Western Camera Service Ltd. 1855 West Fourth Ave. Vancouver, B.C. V6J 1M4
		MEXICO
		(D/S) Deksa S.A. Av. Nuevo Leon No. 159 Mexico 11, D.F.

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CBS Takes Delivery On First Microcams

Just in time to start the new year off right, CBS received the first six production line Microcams from Thomson-CSF. According to a Thomson-CSF spokesman, the company expects to be able to produce 25 Microcams monthly.

Since last year's NAB, when Thomson showed a handmade "pre-prototype" model, the company has received more than 200 orders for the

camera. Among the orders are commitments from all three major networks and an option by CBS to absorb every other Microcam produced. With a production line run of 25 per month, however, it is unlikely that CBS will take that many cameras, leaving others available to meet outstanding orders. The CBS option stems from their early participation and backing of the Microcam project.

The 8 pound Microcam (11 pounds with the electronics-pack belt) is expected to gain quick application in low-light level ENG situations since it is rated to perform at 5 fc, at f 1.4. The

camera sells for just under \$30,000 but numerous options bring the price somewhat higher. Thomson plans to bring the Microcam back to NAB this year, and promises a low-light level test that will impress broadcasters.

Kaiser Sells Out

Kaiser Industries Corp., parent of Kaiser Broadcasting, announced an agreement in principle to sell its 77½ percent interest in the broadcasting subsidiary to Field Communications Corp. for \$42,625,000.

Field Communications, a wholly owned subsidiary of Field Enterprises, Inc., owns the other 22½ percent of Kaiser Broadcasting which began operating in July 1973.

Kaiser Broadcasting owns and operates UHF-TV stations serving Boston, Philadelphia, Detroit, Chicago, and San Francisco areas. If earnings of Kaiser Broadcasting achieve certain levels in the next three years, the purchase price could be increased as much as \$11,625,000.

New Minority CATV Association

Under the auspices of the NCTA, minority cable television franchise holders have formed a trade association to promote minority ownership of CATV systems.

The new organization is tentatively titled The American Association of Minority Cable Television Operators and it will seek membership support from minority cable television owners and operators on a national basis. According to the group's spokesman, Clayton Sinclair of Inner City Communications, Atlanta, GA, the immediate and primary goal of the group will be to obtain financing for minority owners and potential owners.

Sinclair said the association will sponsor activities beneficial to the minority system owner such as planning financial assistance programs and directing operators to management assistance sources. Immediate plans are to incorporate, establish a Washington office and select legal counsel.

News Briefs

The NAB has scheduled a "radio programming college" to be held next September in Los Angeles. The exact dates are not set but will be determined so as not to interfere with summer vacations or fall ratings sweeps. Some speculation persists that the new NAB radio conference is a move to counter NRBA's efforts to organize radio broadcasters but a spokesman for NAB denies this, stating that NAB had been planning such a radio activity for more

continued on page 15



FM-601 STEREO AGC/LIMITER

- Peak/average comparator design assures maximum signal
- Fast 5 usec attack time for 10 dB limiting
- Both stereo channels automatically tracked in one package

Broadcast Electronics' new advanced design Stereo AGC/ Limiter does everything an FM broadcaster needs to maximize and improve his FM signal. Unique signal processing including peak/average comparator, fast 5 usec attack time, audio gating to minimize unwanted noise and return to normal gain circuitry does it all. Everything is in one compact package.

One stereo processor at \$1795.00 does the work of two conventional AGC's and two limiters. Monaural version FM-600 at \$1495.00 replaces one AGC and one limiter.

For details call or write Broadcast Electronics, 8810 Brookville Road, Silver Spring, Maryland 20910. Telephone: 301/ 587-1800.

BROADCAST ELECTRONICS, INC.

PRODUCERS OF *Spotmaster* TAPE CARTRIDGE EQUIPMENT

A FILMWAYS COMPANY



Circle 106 on Reader Service Card

Amperex announces a new family of Plumbicon® tubes with 37% less lag*

When we first introduced the Plumbicon, its obvious superiority made it seem like the "ultimate" TV pickup tube. But in the dozen years since then we have produced a steady stream of advances in technology that have vastly improved its performance.

Now, with the new XQ1410 family of Plumbicons, we bring you the next step forward in pickup tubes for broadcast color: Internal bias lighting—resulting in a dramatic reduction in lag that conquers even the toughest low-key lighting conditions.

No more color fringing...vastly reduced picture smear...even better dynamic resolution than before—and all with the traditional Plumbicon's spectacular color performance.

Bias lighting has been offered before...as in our XQ1080, available for the past four years...but never in a fully integrated line of variable- and fixed-bias light tubes. The XQ1410 family is physically and electrically interchangeable with our industry-standard XQ1020 family. Only a minor field change is required to permit adjustment of bias light intensity if you use variable-bias tubes. (We supply complete instructions, of course.)

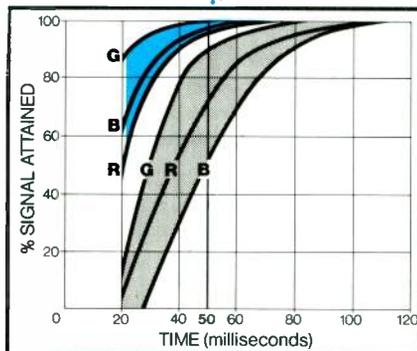
With bias lighting, the Plumbicon's near-zero dark current rises to a few nanoamperes to modify the target's beam-acceptance characteristics. The effect is to sharply decrease both rise time (signal buildup lag) and decay lag in all three channels. As shown below, the result of optimizing all three bias currents, in a "typical" camera, is a 37% reduction in lag.

Since the bias light intensity can be externally adjusted in each of the XQ1410 tubes...luminance (XQ1410L), red channel (XQ1410R), green channel (XQ1410G), and blue channel (XQ1410B)...all channels can be matched within the camera for identical lag characteristics, thus optimizing overall camera performance at levels never before achievable. The result: A new plateau in the quality of broadcast color. You'll have to see it to believe it.

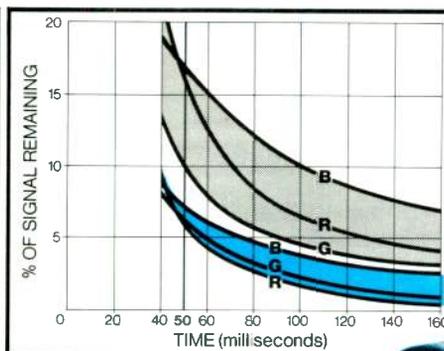
For detailed information on our latest advance in the technology of the Plumbicon...the pickup tube used by 90% of all TV broadcasters...write or telephone: Amperex Electronic Corporation, Slatersville Division, Slatersville, Rhode Island 02876. Telephone: 401-762-3800.

IMPROVEMENT IN XQ1410 RISE TIME LAG PERFORMANCE with bias-light-induced dark current

At 50 ms, average % signal attained rises from 71.7% to 98.5%—a 37% overall improvement in rise time lag performance. Selecting optimum dark currents (e.g. Red = 4nA, Blue = 8nA, Green = 3nA) reduces spread in % signal attained from 39.5% to 3%—a 13X improvement in "incremental rise time lag."



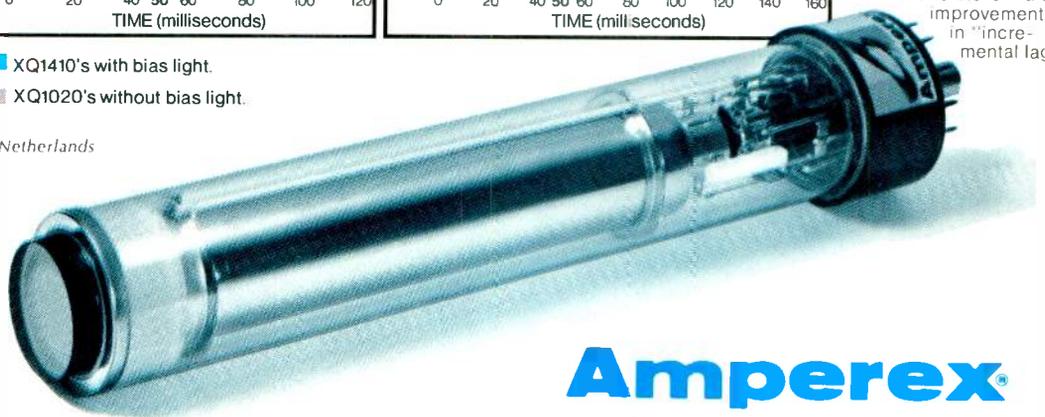
■ XQ1410's with bias light.
□ XQ1020's without bias light.



REDUCTION IN XQ1410 DECAY LAG with bias-light-induced dark current

At 50 ms, average % signal remaining falls from 15% to 7%—a 50% overall reduction in decay lag. Same optimum dark currents reduce spread in % signal remaining from 7% to 0.8%—a 9X improvement in "incremental lag."

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A NORTH AMERICAN PHILIPS COMPANY

For further details and applications information, send for Bulletin No. 31.

Circle 107 on Reader Service Card

FEBRUARY, 1977—BM/E

For best performance by a machine.



Why Sony's U-matic video cassette concept won an Emmy.

Since its introduction in 1971, the U-matic concept has become the standard for many fields—business, industry, education, government, medicine and broadcasting.

The U-matic is now used by each of the major networks and hundreds of local TV stations.

It helps get news on the air faster and less expensively.

And now, this year, for the development of the U-matic, the television industry has awarded Sony our second Emmy. (We won our first in 1973 for the development of Trinitron.)

So perhaps it's now time to put an Emmy-winner to work for you.

What the U-matic can do for you.

In business and industry, the U-matic is being used to train personnel, to merchandise products and

to improve corporate communications. In schools and colleges, the U-matic is giving students access to a greater range of learning materials, whenever and wherever they need them.

In hospitals and medical schools, the U-matic is helping to teach students and inform doctors of the latest techniques.

To find out what the U-matic can do for you, contact your authorized Sony Video Products

Dealer. He'll be happy to show you.

Or contact Don Marro at Sony Corporation of America, Video Products, 9 West 57th Street, New York, N.Y. 10019.

He'll be happy to put you in touch with someone who can show you. One way or another, see Sony's U-matic. It's one Emmy-winner whose show won't be cancelled.

SONY®

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Circle 108 on Reader Service Card for a demonstration
Circle 109 on Reader Service Card for literature

News

than three years **NRBA**, which had scheduled its annual conference for Chicago, has now moved the event to New Orleans, October 9-12.

The **Society of Cable Television Engineers** and the Broadcast Cable & Consumer Electronics Society of the IEEE, will host the **Second Annual Conference on CATV Reliability**, February 23 and 24, at the Quality Inn, Presidential Park, Atlanta, GA. Twelve new papers will be delivered on the subject The **IEEE New Technical and Scientific Activities Committee** will sponsor a one-day Communications Transmission Seminar on **Digital Transmission and Switching Techniques**, March 24, at Princeton University, Princeton, New Jersey.

The Los Angeles **Videoshow** will be located in the brand new Hotel Bonaventure in the downtown commercial center, May 4-5, 1977. Information can be obtained from Educational & Industrial Television Magazine, P.O. Box 565, Ridgefield, CT 06877, sponsor of the event.

Broadcast technology has quietly entered a new age that promises to be as exciting as the early days of the 1940's and 1950's, according to Stephen Koppelman, president of Electronics, Missiles & Communications, Inc. Koppelman sees an extension of "free television to thousands of communities" previously dependent upon cable TV through the increased use of television translators for which there are more than 131 applications pending before the FCC.

Wometco Enterprises has purchased 100% of the stock of **Columbia Cable TV** and has plans to invest as much as \$3 million to expand the system in Columbia, SC, and out into the metropolitan region. Wometco also reported that it had signed the final contract for the purchase of **WZZM-TV**, Grand Rapids, Michigan.

The **audiovisual industries**, during the recent recession, plunged deeper but bounced back quicker than did the economy as a whole. According to a report by Hope Reports, the western New York marketing research firm, the GNP dipped 6.6% over 15 months while the "AV-GNP" dropped 11.3% in 9 months before it turned around.

More than 200 manufacturers will exhibit their wares at the **Exposition for Advanced Consumer Electronics** to be held March 22-24, at the Pacific Terrace Convention Center, in Long Beach, CA One of the prime movers in the future of consumer electronics will be CB radios according to an **Arthur D. Little** forecast that calls

continued on page 16



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Contact us for the reasons that have made **LPB Consoles** the practical choice among broadcasters.

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Circle 110 on Reader Service Card

Introducing the new QUICK-SET Hercules Cam Head with 140 lb. capacity.



For most new generation broadcast camera heads—even with large zoom lenses and teleprompters

Although it weighs only 25.5 lbs. (11.6 kg.), the Hercules has a load capacity of 140 lbs. (63.6 kg.)—enough for most new broadcast camera heads even when loaded down!

Smooth, flawless panning via a precision bearing system. And tilting (to 50° up or down) is effortless, too. Dual interchangeable cams perfectly counterbalance the camera load and specific center of gravity. Easily accessible drag controls allow precise adjustment to operator's preference.

Set for dual handle operation, Hercules Cam Head comes with patented Quick-On dove-tail camera plate, providing quick, easy balance for all cameras. Can also be equipped with wedge plate, wedge plate adapter, as well as second telescoping control arm.

QUICK-SET



INCORPORATED

instrument-positioning equipment

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Phone: (312) 498-0700

Telex: 72-4362

Circle 111 on Reader Service Card

Just A Friendly Reminder

ANTENNA MONITORS

In case it happened to slip your mind and you are one of the few remaining directional stations yet to comply with paragraph 73.69 of the FCC Rules . . . you have until June 1, 1977 to have in operation a "Type Approved" antenna monitor.

WE CAN HELP YOU

We have supplied over 90% of all "Type Approved" antenna monitors (both meter and digital readout) now in service.

We invite your questions concerning installation, operation, remote control, sampling systems, etc.

YOU CAN HELP US

When the last deadline rolled around our order backlog resulted in an eight month delivery cycle. If you order now, you can avoid the last minute rush; we can deliver as required; and you will not risk missing the June deadline.

ASK THE EXPERTS!

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MODEL 610

Used in recording studios; disc mastering studios; sound reinforcement systems; TV, AM, FM broadcast stations to maintain a sustained average signal at a level significantly higher than that possible in conventional limiters, and with performance that is seldom attained by most linear amplifiers.

Rack mounted, solid state, new functional styling, the Model 610 is in stock for immediate shipment.

Specifications are available from:

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(801) 392-7531



Circle 113 on Reader Service Card

News

for a sales volume of \$1.3-1.8 billion by the end of the decade . . . Frost & Sullivan, another leading market research firm, expects video entertainment systems to offer the best long-term market potential for the U.S. consumer electronics industry. The bad news is that they are expected to lose ground to foreign imports.

Business Briefs

Cox Broadcasting Corporation announced an agreement to acquire from Sudbrink Broadcasting of Maryland, the assets of FM Radio Station, WLIF, in Baltimore for \$3.9 million . . .

Community Broadcasting Service, Bangor, ME, licensee of WABI-TV and AM and WBGW has purchased WCJB-TV in Gainesville, FL, an ABC affiliate on Channel 20.

RCA has received an order, valued at approximately \$400,000 for television studio equipment from the state of Alabama for use in its Montgomery Educational TV Center. In Brazil, **RCA** has accepted orders from TV Cultura for television studio equipment valued at \$850,000 and from a new television station operated by Radio Guanabara for approximately \$1 million worth of transmitting equipment.

Theta-Com AML has changed its name and address to **Hughes Aircraft Company, Microwave Communication Products**, Bldg. 237, P.O. Box 2999, Torrance, CA 90509 . . .

Systems Wire and Cable Inc., Phoenix, AZ, announced that the FTC has approved an agreement whereby a consortium of Systems management personnel and **The Entwistle Company** will purchase the firm (SW&C) from its parent, **The Anaconda Co** . . . **Switchcraft, Inc.** plans to purchase a modern factory building in Sullivan, IL, "to relieve the growing production load on the company's Chicago and Paxton, Illinois, plants."

Ampex Corp. announced an average 6 percent increase for its audio and video products, effective January 1, 1977 . . . **Versatile Video, Inc.**, the first major independent videotape production facility in Northern California, has purchased two **Philips LDK-25** color studio cameras and a **LDK-15**, portable studio and field camera . . .

AF Associates has received a contract from ABC Network for the design and construction of two mobile vans for remote telecasts. When fully equipped, the two vans are expected to cost approximately \$3 million . . . Three **IVC-9000** Broadcast VTRs have been delivered to, and an order for an **IVC-8050**, one inch VTR has been received from **Video Tape Associates**, Ft. Lauderdale, FL.

How did these broadcasters get ahead of the competition?



"The Compositor has excellent fonts-- they're clean, they are sharp-looking, and they are distinctive... we have as much memory storage as we're ever going to need. You can change directly from any page to any other page without any problem whatsoever-- you don't have to stick with the original sequence. The Compositor gives you super flexibility."—Don LaCombe, KING Production Manager

"The Compositor's on-air display is a marvel... head and shoulders superior to the competition. We've virtually discontinued using hotpress for supers."—Galen Daily, KRON Program Manager



KRON · SAN FRANCISCO



"We used the Compositor for the first time on election night. We were very pleased with the clarity and color. I'm sure we had the best election show in town that night."—Donald Loose, Manager WTMJ News Operations

"We used our new Compositor system during the election and were very happy with it. It seemed to me that the character edging made our display easier to read than the competitions'. We moved ahead of the other stations soon after the election results started coming in."—Terry Harrison, KTVK-TV Engineer



"...the election went like clockwork--I couldn't have asked for anything better. The Compositor display is clear and easy to read...you just glance at it and you've got it. We were ahead of the competition getting numbers on the air."—Tom Craven, KGW Production Manager

"We were well ahead of the competition election night... the reason, I feel, was in large measure due to the Compositor. It's easy to use, and prevents a great deal of possible error. Where the TM unit really shines is its computer interface with the character generator, which eliminates the extra step of manually entering the election results."—Bill Gill, WOTV News Director



These broadcasters agree: with or without the TED election reporting option, the new Compositor I Titling/Graphics System offers a superior on-air look. With graphic-quality fonts and instant access to any page in memory at any time, the software-based Compositor I provides the fast on-air operation demanded by production personnel, the artistic quality demanded by advertisers, and the competitive edge that broadcast management is looking for. For details, please call Jack Daniels at (801) 972-8000.



Compositor I

TM **TeleMation**
the discovery people

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Circle 114 on Reader Service Card

**ARE YOU SATISFIED WITH YOUR
REFURBISHED VIDEO HEADS?**

**Now
you can get
a better head
for \$825!**

Are you completely satisfied with the refurbished heads you're using now for your Ampex or RCA quad machines? Surprisingly enough, you might not be if you could inspect and test them as completely as we can, part-by-part, and tolerance for tolerance.

So what's the point? When it comes to the quality of our refurbished heads, we'll put our money where our mouth is. You pay \$895 the first time around, which is itself a full 20 to 25% below the competition. Then the price for that head drops to \$825 thereafter for the exact same refurbishing procedures you got the first time.

How do we do it? Fourth generation tooling and 18 years of experience let us give you a better product at a lower price. So, if you're not completely satisfied with your refurbished heads, send us one or a bunch and let us prove why we're better.

Incidentally, if you're interested in finding out the condition of the head you send in, ask us for an Original Condition Report. It may surprise you.



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RADIO

PROGRAMMING & PRODUCTION FOR PROFIT

Talk Shows That Pull Their Weight

New every-issue feature

This is the second edition of *BM/E*'s new monthly programming feature for radio management—programming and production for profit. We'll be discussing program formats that win listeners in your market and production techniques that sell listeners—to stay tuned to your station (effective promos, IDs) and to buy the products and services advertised in your commercials.

We'll include reports on syndicated programs in your market and how they are doing, profiles of syndicators and news about syndicated features. These reports will be designed to help each station management choose the most effective programming for the station's market and audience. With the number of syndicated programs offered to radio stations growing by leaps and bounds, we believe that many radio station managements will welcome evaluations, reports, guidelines, aimed to help in sorting the programs out.

IF WE DEFINE A "TALK" show as any spoken material that is not news or closely news-related, we have a long list of categories, probably 40 or more, running from biographies to cooking, from political comment to buying advice, from drama to health information, from local problems to religious instruction, etc. . . etc. And there is a wealth of material in each of these classes currently being offered to radio programmers.

But unfortunately, as every station management knows, you can't just order up one from Column A, two from Column B, and get a winning program mix. Every potential program has got to be heard in advance so the station program director or manager can apply his own special feel for his own market: will it work?

Further on, *BM/E* lists a small selection of talk shows that do work for a number of stations. This is our first survey in this field and it touches only

a few spots in a vast area. We will widen the coverage greatly in forthcoming issues.

Already, though, some guidelines have emerged that look generally useful. The station manager may aid his decisions by classifying his purposes which usually include: getting pure entertainment that will attract listeners; giving the station the image that management wants; programs that help people and the community; enlarging sales with material that directly helps certain specific classes of advertisers (but it must help the listener too or it won't go); satisfying the FCC's public service requirements.

Under the entertainment heading, we should note the strong beginnings of a comeback for radio drama, exemplified most clearly by the success of the CBS "Mystery Theatre" (see *BM/E*, June, 1976). This show is aimed primarily, of course, at the CBS network affiliates, but it is available to "outside" stations in markets where there is no CBS affiliate, or where the CBS affiliate turns the show down.

A generally available drama series with already established pull is "This Is Your FBI," distributed by O'Connor Creative Services (see listing below). We can be sure that the show's popularity is not suffering from the current (no doubt temporary) political misadventures of the FBI.

Other drama programs seem sure to come in response to the established demand for this old, but again new, radio category. Station managements should be on the lookout for them. Program directors of today will recognize the need for a fast pace and good production involving expert use of music and sound effects. The "far-out" sounds available with the latest special effects devices (see article elsewhere in this issue) can add greatly to the effectiveness of radio drama.

Like the more serious drama, radio comedy is also a very old class that shows some signs of reviving. The age-old "sit com," for a long time, was totally appropriated by television. But some radio syndicators are beginning to get good response to updated sit-com material (see *Casino Loot* listing below).

Humor comes in a basketful of different forms and every example has to be checked out for sharpness and

taste. Radio used to have plenty of it (where is the Fred Allen of today?). But even if sustained radio satire, like Allen's peerless brand, is out of public favor, good humorous material in a form meeting current taste is bound to please today's listeners. A station can use small bits of humor judiciously sprinkled into the program mix, like light seasoning carefully chosen to enhance the dish, and a number of program suppliers are supplying this kind of humor, or plan to. One interesting variation is the "News Blimps" of Progressive Radio (see listing), on the air at more than 60 stations. It combines news and humor in a rock music framework aimed to attract the young-adult rock fans.

"Inspiration" comes in as many styles as humor and must obviously be used with similar care and a light hand. Well-done biographies of persons who have made some large contribution to their nations or to society in general have inherent strong appeal for every kind of listener. (See O'Connor's "Profiles in Greatness" below.)

To go to the other end of the spectrum, there are many programs intended to corral sponsorship by particular classes of advertiser. One example in our listing is the new "Sound Advice" series of Progressive Radio, aimed at hi-fi dealers, already on the air in five cities including Philadelphia, New Orleans, and Tampa. Other examples are the long-established series of Purcell Productions, shown below. The popular formula, as already indicated, is a short piece which supplies definite service to the listener, in an area involving a particular class of advertiser.

A special variety is a series with political comment which jibes with the opinions of some strong advertiser. This juncture of interests has put a number of politically-oriented talk shows on the air.

A final note in this short preliminary survey of talk shows: Many, probably a majority of them, use music as intro, "seasoning," enhancement, and if it is well done, it adds greatly to the appeal. The story on special effects further on in this issue may help station managements to evaluate the use of this very new kind of "enhancement" in particular talk shows.

Listen
to the
lament of
CHARLES FLYNN,
station engineer,
KIJV, Huron, S.D.

"The total system has worked so well that I haven't had to work on it at all. I really like to work on this type of equipment, and I haven't had anything to do."

In January, 1975, KIJV installed 2 IGM Go-Carts back-to-back for a total of 84 cartridge positions. Events are programmed into an IGM RAM (Random Access Memory) Control System with a capacity of 2048 events. That's the basic system and it works like a dream. Right, Mr. Flynn?

IGM

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206-733-4567

Read the whole story about KIJV's system in the IGM News, No. 1-77. Send for it today.



Circle 116 on Reader Service Card

Radio Programming

Talk Shows—a preliminary selection

O'Connor Creative Services, Box 8888, Universal City, CA 91608. Tel: 213-769-3500. (Each program has two commercial availabilities.)

"Profiles in Greatness"—Five-minute programs, 195 in complete series, narrated by Efreim Zimbalist, Jr. Thumb-nail sketches of people who accomplished the exceptional in the arts, sciences, humanities and sports, from Moses to Grandpa Moses, from Shakespeare to Babe Ruth.

"Viewpoint"—Five-minute programs, daily political comment by Barry Goldwater. On more than 200 stations.

"Traditions"—260 one-minute inspirational vignettes, with Art Linkletter, about religious, patriotic and festive celebrations—Christmas, Mother's Day, etc.

"The Edge of Science"—260 five-minute programs on science mysteries: unexplained phenomena like the Bermuda Triangle, the Abominable Snowman, Atlantis, Etc.

"Link's Little Ones"—Art Linkletter asks children questions, gets original, humorous answers. 5-minute segments, 260 programs.

"Lovewords"—Intended for stations that have primary emphasis on music. Includes *Random Lines*, very brief uplift comments on love, faith, friendship, etc., 1000 supplied; plus 200 on record intros, also inspirational, supplied complete with the record used. Instructions for use tailored to each station's format and needs.

"This Is Your FBI"—104 30-minute programs based on actual cases in FBI files, with dramatic production.

Progressive Radio Network, 321 Rider Ave., Bronx, NY 10451. Tel: 212-585-2717

"News Blimps"—Three-minute news features with dramatic production—satire, rock music, actualities, sound effects. Aimed at the "rock" group, young adults. Such topics as consumerism, technology, the environment, politics, the arts. 12 supplied each week, on 7 in. tape reel. Electronic logo intro, on more than 60 AM and FM stations.

"Sound Advice"—two-and-a-half minute shows, 65 in series, with useful advice for hi-fi owners—adjustment, repairs, etc.—not buying but use advice. Solid information for the 18-34 male group who are overwhelmingly the hi-fi buyers. Effects on sound demonstrated. For hi-fi dealer sponsorship.

Purcell Productions, 300 W. 55th Street, NYC 10019. Tel: 212-PL7-5300.

Each 60-second program—130 in each series—has a slot-in for the commercial. Supplied on tape. Abbreviated 30-second versions available on disc. Each aimed at sponsorship by advertiser in field, as indicated.

"Car Care"—Tips for car owners (how to start with a vapor lock, etc.). (Car dealer, auto service organization). Highly useful material.

"Sports Special"—Great sports events of the past narrated in dramatic style, writ-

ten by sportswriter Milt Shapiro. (Sporting goods dealer).

"Health Hints"—Family program, valuable health information, written by Ted Stoll of Medical World News. (Drug store).

"Kitchen Korner"—Exciting recipes and unusual kitchen tips by Nancy Palmer, home economist. (Food accounts).

"Do It Yourself"—Wide range of suggestions for homemakers, both men and women, by writer Bill Finger. (Building supply, hardware store).

"The Great Outdoors"—Features on hunting, camping, etc. (Sporting goods dealer).

"Camera Club"—Non-technical tips on camera use, by Charles Sinclair, editorial consultant to Eastman Kodak. (Camera shops)

Casino Loot Productions, 232 8th Street, Brooklyn, NY 11215. Tel: 212-768-1587.

"Dead Air"—Half hour situation comedy series, 13 programs, five commercial availabilities in each. Programs can be played twice.

"Idiotorials"—(In preparation). 60-second humorous comments.

Alcare Communications, P.O. Box 72, Philadelphia, PA 19105. Tel: 215-687-5767.

"Update—Where Are They Now?" Three-and-a-half minute programs, five produced each week by Newsweek Broadcasting Service, based on the "Update" column in Newsweek Magazine. Events of years ago recreated with the actual voices of those who took part—Red Grange, Francis Gary Powers, Roy Rogers, Alger Hiss, etc. Narrated by Mort Crim. Running in many markets.

"One Moment, Please"—60-second optimistic "comment" with Mort Crim, intended for personal "uplift," running in 160 radio markets.

"What An Idea"—45-second daily "bright" drop-in, lively, helpful tips, recipes, car service, etc. With Jean Crane.

"Living Better"—Two-and-a-half minute daily feature, advice on personal financial problems—taxes, insurance, real estate, banking, etc., by Bernard Meltzer, financial commentator for WOR, NY.

Programming Briefs

Summit Productions, Hollywood, says production is near completion, with release scheduled for late January, on a 13-week radio special, "Sentimental Journey." It is based on the music and memories of the "roaring 20's" to the "fabulous 50's." Four years in the making, the series is designed to air one hour per week, but each 1 hour show can be aired in ten-minute segments if the station wants. Demo discs available to radio stations from Summit.

Filmways Radio, Los Angeles, announces entry into production of syndicated programming for radio. The first product will be called "The 20/40 Format," an adult contemporary

music package aimed at the 20-40 age group, the generations who have reached adulthood with contemporary music. Two major market air personalities will introduce the music; programs can be customized to a station's own use.

Radio Arts, Burbank, says that more than 60 stations are using its first program package, "The Entertainers," an adult MOR series brought out about a year ago. In November, the firm added another format package, "Easy Country," already on the air through several stations. The series consists of "smooth" country recordings by traditional and modern musicians, aimed for today's adult country audiences.

O'Day Broadcasting, Honolulu, has bought about \$170,000 worth of radio automation equipment from **IGM, Bellingham, Wash.,** for station KYYX-FM, Seattle, and KORL, Honolulu. The equipment will be used for operation at the two stations and also for production of syndicated pro-

gramming.

Century 21 Productions, Dallas, announced completion of production on "Non-Stop Two," a series of 12 radio contests, already presold in 20 markets. A follow-up on the firm's original contest series, "Non-Stop," now on the air in 150 markets, "Non-Stop Two" will consist of 300 production units, 23 custom jingles, and a 183 page operations manual. It was produced by Dick Starr, general manager, and writer-director Roy Nilson.

TM Programming, Dallas, is inaugurating a new format, "Beautiful Rock," based on a six-year research project which included questionnaires, interviews, preference tests, and focus groups. TM says the format could not be produced six years ago when they first evolved the concept, because the music was not then available in the needed quantity. Now, however, TM finds "Beautiful Rock" established with the 18-34/49 group, and intends to bring this group "their albums."

BM/E's Program Marketplace

Syndicators For Radio

John Doremus, Inc.,

John Hancock Center, Chicago, Ill.
60611. Tel: 312-664-8944

This highly successful syndication operation has grown out of the super energy and on-air talent of one man, and he is still the main "product" and the dominating figure—John Doremus. Coming up through a long series of listener-grabbing DJ assignments and music program "hostings" on radio and TV, largely in the Chicago area, Doremus went on his own in 1967. At one point in his "hosting" career, he had added to his rock programs a "wall to wall beautiful music" program with great success. This became a centerpiece, as "The John Doremus Show," in his independent syndication and it is still in that center spot.

Doremus also established his firm in two other major fields, production of creative commercials for a long list of big industry sponsors; production of in-flight audio entertainment for several airlines.

In order to handle the out-sized volume of work the firm has developed, Doremus has assembled a group of writers and music consultants. Heading the writer group is Al Bland who had a powerful reputation in broadcasting and advertising before he joined Doremus. Experts in several fields of music are also on tap.

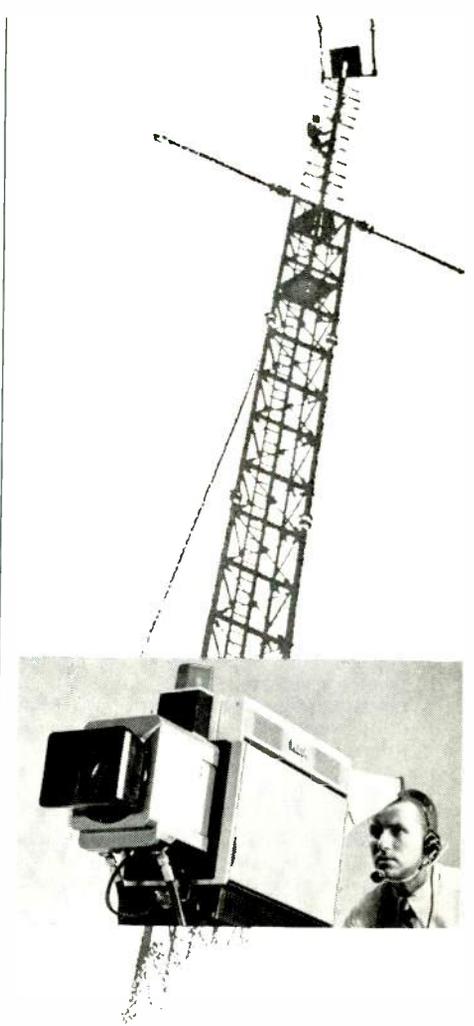
Essential as these added talents clearly are to the business, the whole thing is still very much the "John Doremus Show." First there is the voice; even a telephone conversation with Mr. Doremus is a special experience in resonance for the caller. This commanding voice quality obviously stands him in good stead as host and commentator on radio programs.

But even the best voice can't win without something to say, and the Doremus "talk" is obviously the essence of his appeal. He adds to his music selections a framework of friendly comments, anecdotes, humor, inspiration, with a generally upbeat feel, a positive attitude to the listener. This puts him, one program director reports, on a strong "one-to-one" relationship with each listener and helps the station involve the audience strongly with its programming in general.

This involvement, another station reports, extends to a strong feeling that Doremus is there, in that station, and he gets a heavy laudatory mail (every program director's bread and butter) and frequent telephone calls. A number of listeners have rather apologetically called the station with variations of the following: "Look, I don't want to get John in trouble, but I was in (some other city) last week and he is working on station XYZ over there too."

Doremus is, in fact, currently "working" on between 70 and 80 AM and FM stations, with one or more of his pro-

continued on page 22



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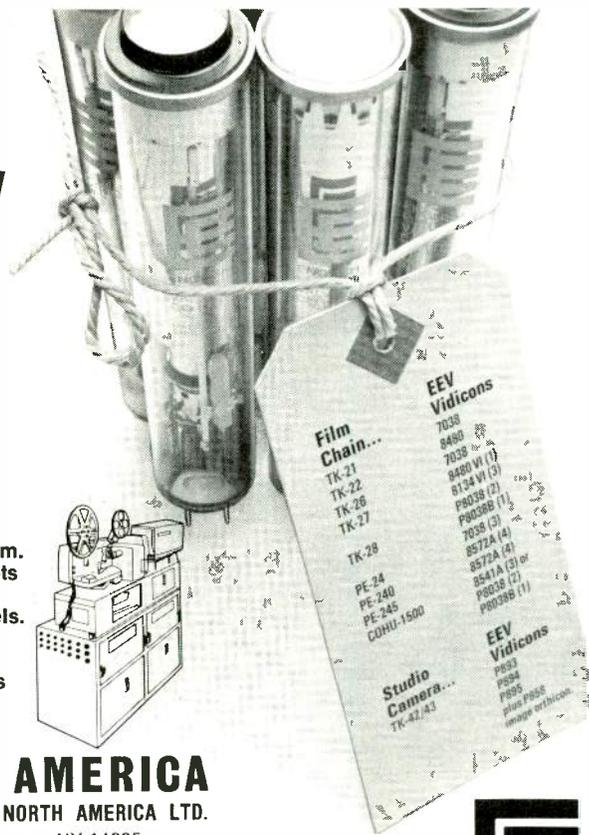
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Radio Programming

grams. Most of those stations are aiming for an over-25 (or over-35) audience since the Doremus music is basically MOR: it is not aimed at the teen-age and young adult rock group. Demographics has a lot to do with the appropriateness of the Doremus shows to any particular market.

Doremus has confessed to an interviewer that he has a deep attraction to history. This combines with his sincerely positive feeling about people in a number of his enterprises. "Your Passing Parade" is a series of short accounts of people and events—events mostly as they involve people. These true stories range over the world and relate how people came through when the going was tough, or how they made some outstanding contribution to their countries or communities.

The same Doremus interests were deeply engaged in one of his most successful series for an advertiser, actually heard on a great many radio stations as a nationally-sponsored program. "The Spirit of '76" told about people, both famous and obscure, who had made some contribution to the growth of this 200-year old country. The series was originated for Union Oil Company and ran for a couple of years, with numerous repeats.

Doremus will "customize" his material for individual stations, including the production of ID's, promos, etc. For the production of the programs, and of commercials and promotional material, Doremus has studio facilities and recording equipment at his offices designed to do the complete job of getting material onto tape.

Because of his great success in the advertising field, *BM/E* was curious about the role of syndicated programming for radio in his future plans. He told *BM/E* in a recent interview that the radio programs would stay at the center of his activities, getting better and better, he hoped, as time went on. His organization is now geared for high efficiency in producing the programs, and he, himself, is "creating" the talk and the flow of music with all his characteristic zest.

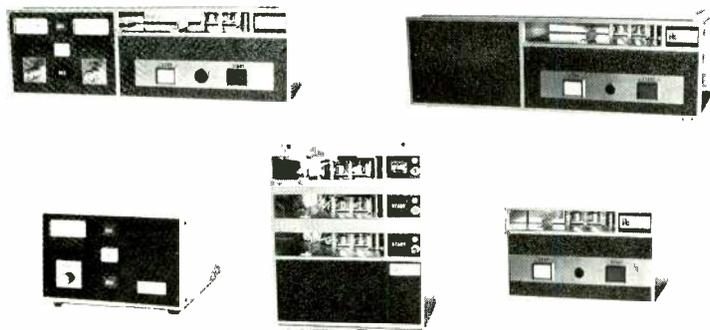
The programs

"The John Doremus Show"—Available as 55-minute shows with 11 minutes of commercial availabilities in each. Five to 30 shows weekly. Each show has four segments; each segment starts with Doremus' commentary, then three uninterrupted musical selections, then Doremus' commentary again, then 3 minutes for local inserts.

"Your Passing Parade"—Series of half-hour shows, descriptions by Doremus of people and events, present and past—human interest and uplift stories.

BM/E

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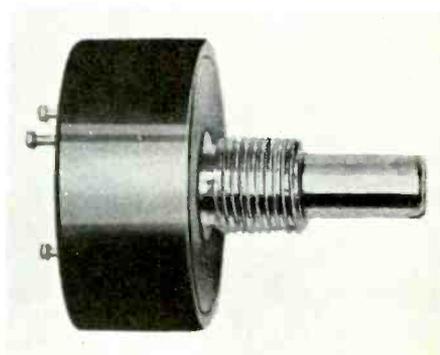
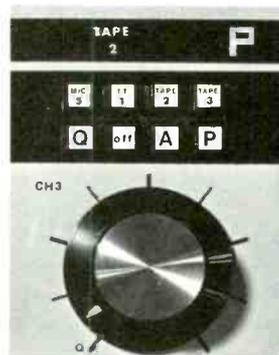
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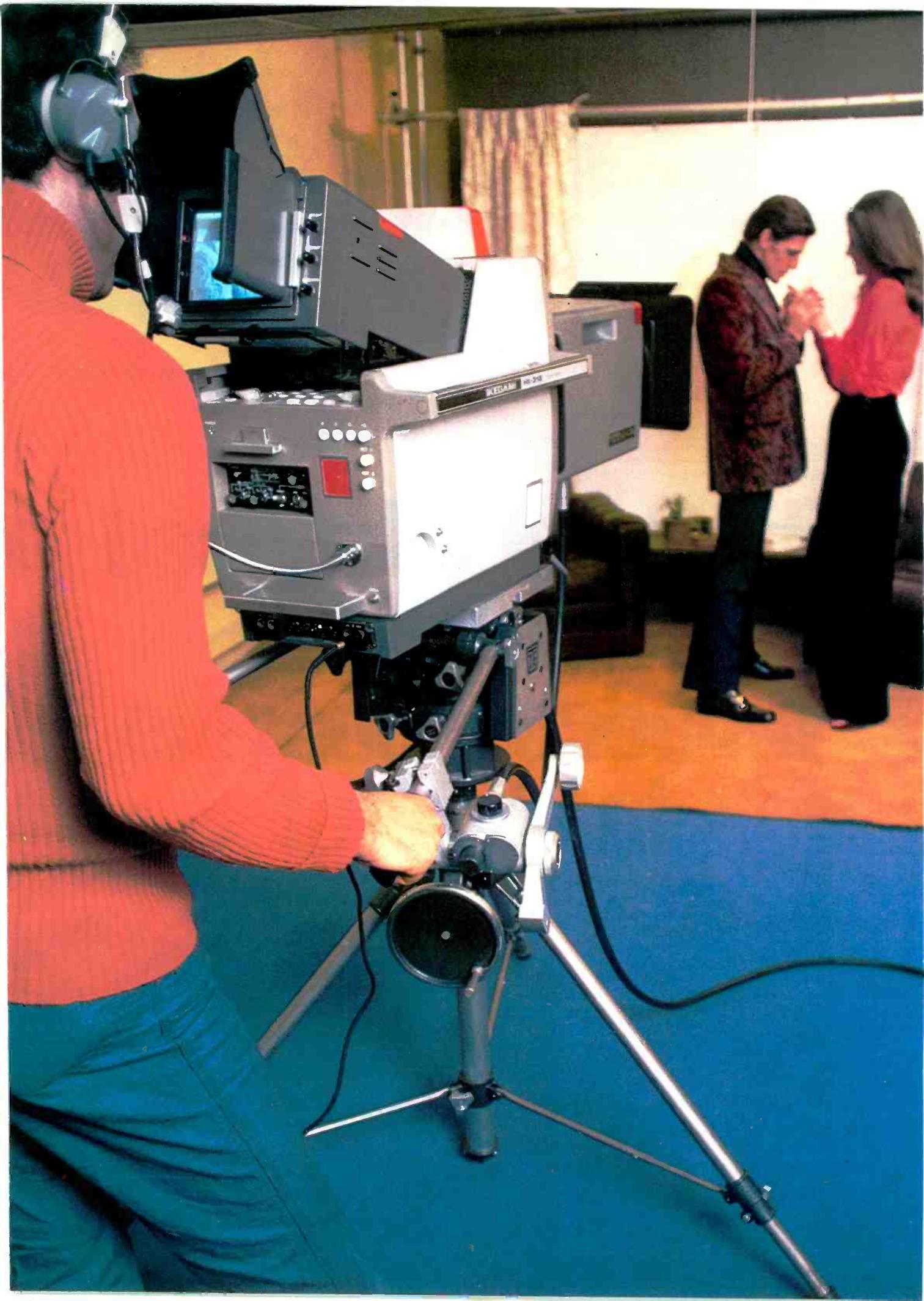
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The fire, earthquake, election and touchdown company now brings you love scenes in Studio Two.

The new HK-312 studio camera from Ikegami, the ENG experts.

Wherever there's been news, from natural disasters to national elections to sport events, Ikegami ENG cameras have been there with the news teams. Now Ikegami makes news of its own: the introduction of our new state-of-the-art HK-312 studio and field camera.

We've built ENG cameras so good in the rough-and-tumble of news-gathering that more Ikegami ENG cameras are in use than all others combined. So imagine how good an Ikegami camera can be in the stable environment of a studio.

Very good indeed.

Ikegami's new HK-312 color-TV camera is like no other. It has a built-in minicomputer that helps trim the daily camera checkout from a one-hour ritual to an automatic run-through that's shorter than a 20-second commercial. With its auxiliary computer, you'll be able to cycle your Ikegami HK-312 (and up to four other Ikegami HK-312 cameras linked to it) through every adjustment parameter in under two minutes: white balance, black balance, flare correction, gamma correction, video gain, beam alignment, and eight registration functions.

All this before you start shooting. The HK-312 gives you three 30-mm Plumbicon tubes for highest picture quality. You frame your shot on a high-intensity, high-resolution, seven-inch tiltable viewfinder. Signal-to-noise ratio is better than 54 dB.

We've combined the zoom lens and camera tube into a single rigid assembly for highest accuracy of the optical axis. Class-A deflection amplifiers assure maximum linearity and best picture quality. Black level balance correction is automatic. Picture quality and brightness are maintained in spite of flare.

A complete two-line image enhancer provides horizontal and vertical detail correction. A special comb filter keeps background noise to a minimum.

All this and a lot more.

If your budget or production requirements are smaller, use our tried-and-tested TK-355 studio camera. Five were used for network feed at the 1976 Democratic National Convention where camera failure would blow a lot more than a few fuses.

The TK-355 uses three 25-mm Plumbicon tubes which are bias-lighted for reduced lag at low lighting levels. This reduces studio lighting and air conditioning power consumption. And the camera is more compact and lighter, a little easier to maneuver. The unique half-rack CCU facilitates multi-camera studio installations.

Both broadcast cameras use TV-81 minicable for ease of handling.

If you need a small, fixed-position camera for announcer booth and newscasting, check out the Ikegami HK-309. It can be operated remotely or simply turned on and left in fixed position.

For movies, the Ikegami TK-950 is a large-image film-chain broadcast camera system for 16-mm or 35-mm film or slides with highest quality color reproduction. Much of its operation is automatic, requiring a minimum of engineering support. Its unique optical system is dust-shielded and unusually compact.

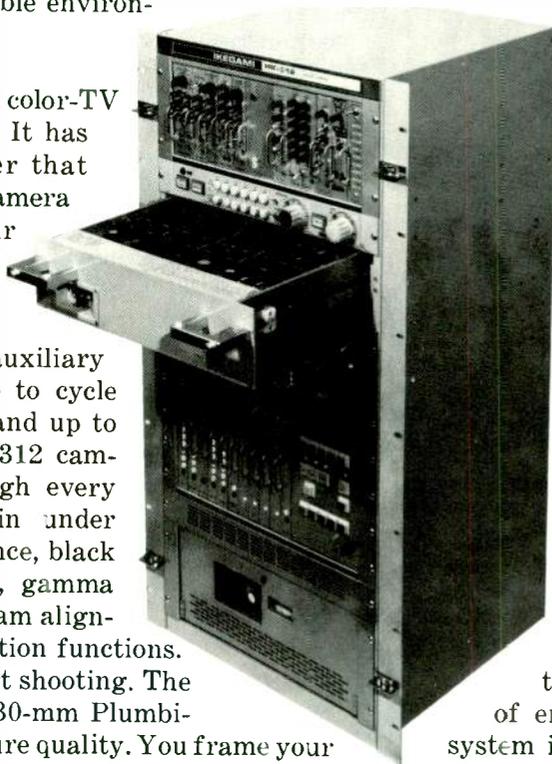
Ikegami has been famous for its ENG cameras for a long time. Now take a look at what we can do with studio cameras. For specs or a demonstration, get in touch with us. We have nation-wide distribution.

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Plumbicon is a registered trademark of N.V. Philips.

Camera-control unit for the HK-312



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!



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2873

The Impact of Digital Technology On Television: Is Analog Anachronistic?

TBCs and frame synchronizers are here in full force as articles that follow show. These are but the first steps of a revolution underway.

THERE IS A GROWING TREND towards processing the video signal using digital techniques. Though methods of digitalizing the video signal have been known for a quarter-century, most of the methods were impractical (See Hurst article, p. 48), until Large Scale Integrated circuits became relatively plentiful and inexpensive.

With the phenomenal growth of computers and software over the years, digital technology has been employed increasingly in certain aspects of the broadcast business, traffic, accounting, sales, and worked its way into the engineering side of the industry through machine control systems and switching. The application of digital technique to the video signal itself however, is a relatively new phenomenon roughly traceable to the TBC.

As you read the following articles, you will find that the swell of digital equipment and digital approaches is fast becoming a new wave. The impact of digital television will be extensive and it is inevitable. How far the techniques should be carried, however, depends on reasoned and informed input from broadcasters themselves. In the articles that follow, you will find some basic theory, explanations of some of the "black boxes" and their applications, and thoughts on how broadcasting might make better use of the developing digital technology. *BM/E* will continue to follow this story and try to provide you with some of the information you will need to keep track of developments and formulate your own responses to them.

We have been in the midst of what has been described as the "black box" stage. As a single problem has been identified that does not respond well to traditional analog engineering procedures, digital technology has been turned to for the solution. (See Sanders article, p. 28.) This problem/solution process has produced the TBC, frame store, character generator, frame synchronizer, repositioner and promises to continue as the year's NAB exhibits will prove. Increasingly, digital black boxes are gaining a greater share of rack space. This is a process that will continue into the foreseeable future. Not everyone, however, is convinced that this is the direction that ought to be pursued.

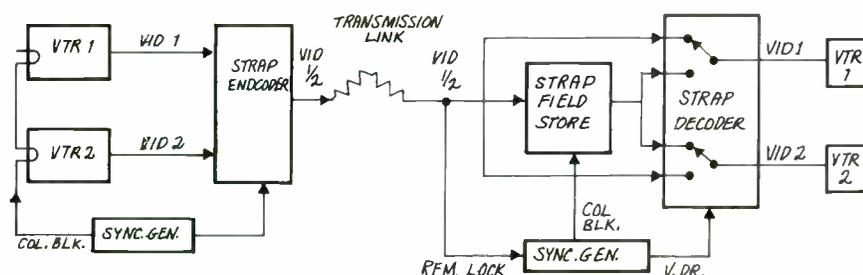
At present, the structure of the television signal system requires that whenever the signal is encoded digitally for some function, then it must be reconverted to analog form before passing along to the next stage. So, essentially, the communications channel is still analog as is the initial imaging system, much of the control, and the transmitting system. There is a chance that many of the benefits held out by the promise of digital television may not be realized due to the lack of standardization in the way each successive black box is designed.

Some engineers are beginning to develop ways of using digital techniques to grant creative people even greater latitude for handling visual images. Digital special effects are now available and they permit the creation of effects that were previously only available in film and some that were never before available in any medium. The digitalizing of the creative aspects of television, however, creates a need for a different approach to development of equipment. (See Leonard article, p. 36.) If our information is correct, at least one manufacturer will show up in Washington with a device next month that will exploit the benefits of digital manipulation of the visual signal to a degree previously unheard of.

Whereas the adoption of "black boxes" has been swift because the relative advantage is glaringly apparent, the adoption of creative digital equipments may not be as rapid. Here, there is the problem of getting creative people to learn to adjust their imaginations to a technology they may not fully understand. They will need time to explore the new possibilities of working with digital television and create a new set of aesthetic disciplines.

In fact, the question of fully utilizing the creative potential of the "black boxes" we already have, has merely been scratched (See Quilitzsch article, p. 33). So, Americans are approaching digital television step-by-step. Our NTSC analog system is standardized throughout the North American continent. As long as the signal ends up in the NTSC format, we can build as many black boxes for as many reasons as we like.

Our European brethren, however, have a slightly
continued on page 28



STRAP is currently in experimental stages but could be a significant example of how to reduce costs for multiple news feeds using efficient digital techniques.

Digital Video

different situation. With two standards, PAL and SECAM, and a large portion of their program material coming from the U.S. in NTSC, their interest in digital television may largely be ascribed to standards conversion. The existence of multiple standards is more than just a hindrance to the distribution of television programs. It also requires every manufacturer of equipment in the European Economic Community to design in two standards. To some degree, this works as a restraint to trade between the economic partners and implies a waste of resources. The impetus to develop an all digital system may, however, provide Europeans with an advantage in the long run.

The challenge confronting the American broadcasting industry then, is not whether we will adopt digital television but questions of how, why, and when. Currently, the how appears to rely on the acquisition of successive black boxes, that is, black boxes which solve specific problems and offer immediate benefits for which analog approaches offer nothing comparable. Added to this is the emergence of creative video devices offering new flexibility to producers. These will be adopted less rapidly since the benefits must be demonstrated and questions of reward will have to wait until management has a chance to look at the balance sheet.

The economics of digital television, along with the technical superiority of the system for noise reduction, are likely to be the leading causes in the adoption of digital television in the United States. Since distribution is no problem as the entire continent is on the NTSC standard, there is less pressure to develop an entirely digital system. Remaining are problems of bandwidth, which will affect recorders and certainly over-the-air transmission, and problems of developing digital standards so that all these various machines will be able to converse.

In the short term, research and development is far from a standstill. CBS is currently experimenting with a system for transmitting two video feeds over the same common carrier channel simultaneously. The system is called STRAP (Simultaneous Transmission and Reception of Alternating Pictures). The notion is that the system will be used initially to carry multiple news or

ENG feeds along the same telco line. It is not expected to be applied to other program material than news since the pictures produced at the receive end are single field. Essentially, two VTRs feed into a STRAP encoder. The encoder alternately digitalizes field "A" from VTR 1 and then field "B" from VTR 2 sending the fields as a single frame down the telco line. At the receive end is a device consisting of a STRAP field store, sync. generator, STRAP decoder and two receive VTRs.

When the mixed video frame (Field A from VTR 1 with Field B from VTR 2) reaches the receive end, it is separated again and one field is sent into the field store unit where it is held. The other frame is sent immediately to the STRAP decoder where receive VTR 1 is switched to read that field. The other field, in the meantime, has been transmitted from the field store to the STRAP decoder and is being read by receive VTR 2. During this interval the second mixed frame has been transmitted and routed through the process so that VTR 2 gets its second field direct from the decoder and VTR 1 gets its second field from the field store-decoder circuit. What results is a continuous stream of single fields to the VTRs. The CBS Network, a heavy user of telco lines, views this system as a way of reducing news feed costs by being able to use a single transmit channel to carry a multiple feed. How much savings will be realized, however, will be learned when the common carrier sets a rate for this type of transmission.

Next month at the NAB Convention in Washington, Thomson-CSF will unveil a digital noise reducer for television—a device that CBS Television Network engineers had a hand in developing. This device is designed to be installed in the television system just prior to the modulator at the transmitter. At this last stage, the signal is digitalized and noise is removed so that whatever cumulative errors have accrued are subtracted. Signal to Noise improvements are expected to be in the range of 12 dB or more.

BM/E will be presenting more information and details on these developments and others in Digital Video Part II this June. Suffice to say that digital television is a current and growing trend. The breadth and scope of it will be examined in June as the editors of *BM/E* analyze the rate of adoption for digital television and prognosticate, with the help of the many television experts, how digital television is likely to succeed.

Making Sense Out Of Time Base Correctors

By Mark L. Sanders

Digital time base correctors have gone far beyond their original task of eliminating or reducing time base errors and are now offering a wide range of features to improve the video signal. Here is what these features can do for you and how they do it.

IN JUST A FEW SHORT YEARS following its introduction in 1956, the videotape recorder had become an essential tool to broadcasters throughout the world. But it wasn't until 1961 that its biggest hurdle was overcome—time base errors. That was the year the first time base corrector, developed by Charles Coleman, was shown, and

Mark Sanders is Senior Product Manager, Audio-Video Systems Division, Ampex Corp., Redwood City, CA.

marked the genesis of an industry which has grown with increasing momentum right up to the moment.

More recently the intensity of electronic news has spurred a period of dazzling technological advancement in time base correctors, and today the broadcaster has an array of dozens to choose from. Confronted with making a choice, it is vital to understand just what a time base corrector (TBC) can do, how it works, and the relative merits of the various techniques used in these systems.

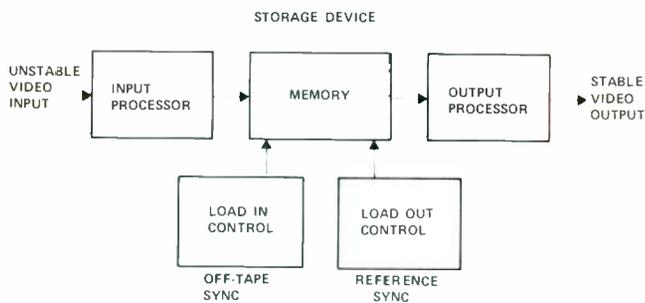
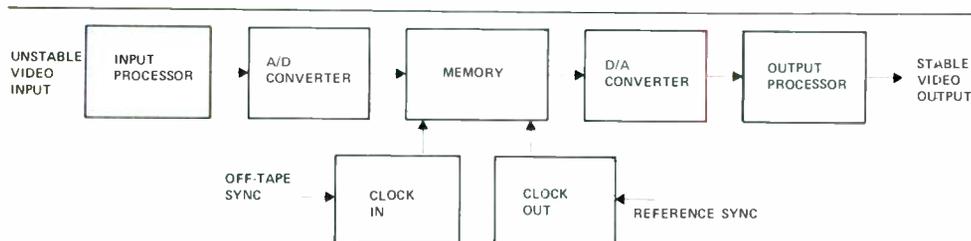


Fig. 1. A time base corrector in its simplest form.



A simple digital time base corrector.

Just what is this black box which is so essential to videotape recording and so expensive? The answer begins with one unavoidable fact: It is not possible to move tape past a head absolutely smoothly in a mechanical system. These inevitable disturbances are called flutter and wow in an audio recorder; in videotape recorders they are known as time base errors. In fact, they are one and the same.

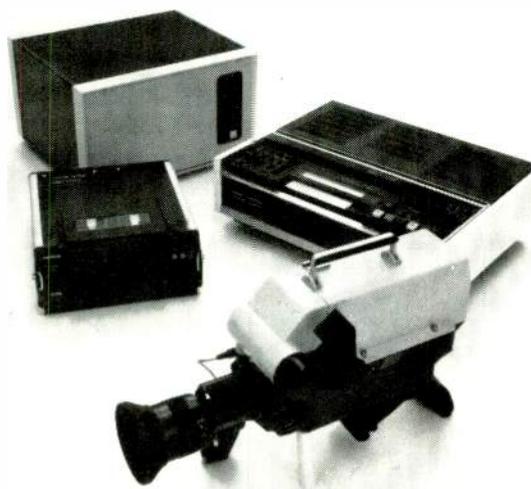
Fortunately for the audiophile, small amounts of flutter and wow can be tolerated (a time base stability of a few hundred milliseconds). For video, however, time base stability must be reduced to a few nanoseconds, or several orders of magnitude smaller! Time base errors may appear as hooking, skewing, banding, jitter or scalloping in the picture. Furthermore, even though a picture may be geometrically correct, there may be color break-up and hue changes across the picture, (due to the critical phase relationship in the NTSC encoded signal). Reducing these instabilities calls for a time base corrector.

In their simplest form, all time base correctors are similar: A signal is transferred into a storage device at an unstable (off-tape) rate, and withdrawn at a stable (reference) rate, as shown in Fig. 1.

In operation, the input signal is first processed by filtering, clamping, and stripping sync. This "offtape" synchronizing information is used to generate a "clock" signal to load the video into the memory. Reference (usually house) sync is used to generate the clock signal to unload video out of the memory. This smoothed-out video is again processed, and exits as a stable television signal. At this point commonality of all TBCs ends.

Analog and digital time base correctors

All early TBCs were "analog" correctors, and used some type of voltage-variable delay line as the memory device. These delay lines stored "analog" information, hence the name. Because of the high stability inherent in quadruplex recorders, these early TBCs required only a limited correction "range" or window, and were capable of very high quality. But by their nature analog delay lines are expensive and contribute various types of noise and non-linearities to the signal. Beyond about one horizontal television line ($\pm 1/2$ H) they become prohibitively expensive, and can seriously affect the signal quality. Digital time base correctors function in a similar manner,



Digital time base corrector is an indispensable part of basic ENG set up.

except that the signal is translated to the "digital" domain by means of an analog-to-digital (A/D) converter before clocking into the memory. The memory, of course, must store digital information, which is why the system is called a digital time base corrector. When clocking stored video out of the memory it must undergo conversion back to the analog domain, as shown in Fig. 2.

The business of converting the signal to and from the digital domain adds complexity to our "simple" system, but enjoys three distinct advantages:

1. Digital memories are far less expensive than high-quality analog delay devices.
2. Once in a digital form, a video signal need not be degraded, no matter how long the memory it is stored in.
3. While in the digital form, other types of processing such as dropout compensation and velocity compensation may be easily accomplished, again without additional degradation.

The longer the correction range required, the greater the advantage of the digital approach.

Memory range

Range is one of the most important considerations in a TBC. Why? The answer again requires a look at funda-

continued on page 31



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Digital Video

ments of videotape recording. Fig. 3 shows the relative video track formats of three common VTRs.

Note that the quadruplex video path is recorded nearly

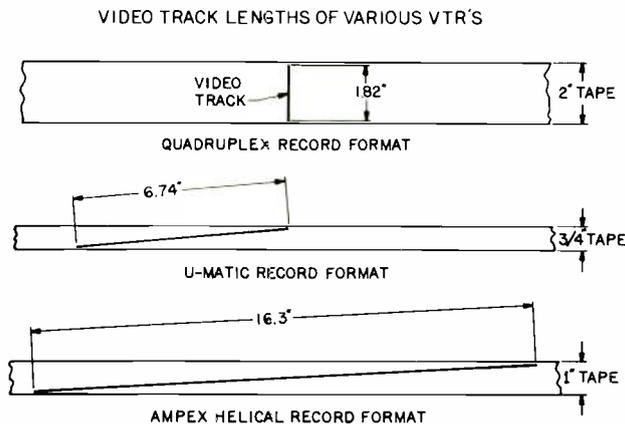


Fig. 3. Three popular videotape formats.

vertical to the direction of tape motion. It is relatively insensitive to tape perturbations, and the result is very small time base errors. The two helical formats are more nearly horizontal, and imperfections in tape motion are translated into relatively large time-base errors. Moreover, in a portable VTR motion can cause inertial effects which result in extraordinarily large errors.

Today virtually all "standalone" TBCs are of the digital variety, and have a range of at least two horizontal TV lines. This is important, for if a TBC has a lesser range which is exceeded, total picture breakup may occur. If the range is at least ± 1 H, however, it is a simple matter to "drop" an entire TV line just as the signal is about to bump the limits of memory. The resultant picture will move up (or down) one line at a time, which is far less obtrusive than picture breakup. Of course, the larger the correction range, the less often this will occur. Today time base correctors with ranges of up to 10 television lines are available. (The process of handling overloads of the TBC requires that the memory size be somewhat larger than the correction range—so don't be fooled by specs quoting memory size or range instead of correction range. A TBC boasting a 3H memory range may only have a correction range of ± 1 H.)

Averaging and line-by-line techniques

After correction range, perhaps the most important performance criteria is the method of developing the "clock" signal used to load data into the memory. All time base information is contained in sync and burst, which occur at the start of each TV line. But a continuous signal is needed to load the memory.

All "averaging" TBCs use a "phase-locked loop" or flywheel circuit. It is an oscillator running at about the subcarrier rate, and pulsed each line by burst or sync (you may like to think of it as gen-locking). This flywheel scheme "averages" errors over up to 10 TV lines, and is simple and effective on slow and medium rate errors. Line-by-line correctors, on the other hand, correct instantaneously as new time base information (sync and burst) is presented. This is more complex, but has the ability to correct high-rate errors and even edit discontinuities.

It's fair to say that the line-by-line system can attain the highest performance level, given a reasonable quality signal (all quadruplex VTRs include a line-by-line TBC). But the averaging technique has the advantage of overlooking the "sins" of a poor quality signal. This is especially important in U-standard and 1/2-inch VTR applications where quality drops rapidly with each generation, to the point where sync and burst information may become severely degraded. Averaging correctors are very forgiving of this, whereas a line-by-line unit could balk entirely. Two of the very latest units on the market actually combine both averaging and line-by-line techniques into the same TBC, to reap the advantages of both systems.

Picture straighteners

There is another important category of TBCs, which makes no attempt to correct to broadcast specifications of stability, but nonetheless will sufficiently stabilize a video signal so that an acceptable picture is produced on a monitor without hooking or jitter. These so called "picture straighteners" are usually low cost and of limited range, but are fully satisfactory for many CATV, educational and other non-broadcast applications.

Sampling rate

In all digital time base correctors, the analog-to-digital converter (Fig. 2) "samples" the video signal at a periodic rate, and converts each sample to a digital word. Sampling theory dictates that the rate must be at least twice the highest frequency of interest (4.2 MHz in television). In practice it must be even higher, and integrally related to the subcarrier frequency to avoid beats.

Most manufacturers utilize a 3-times subcarrier sampling rate, but two manufacturers (DVS, CVS) have chosen a 4-times rate instead. This has the advantage of making the complex filtering (required in the digital-to-analog D/A converter) easier, is capable of wide bandwidth, and lends itself to noise reduction by correlation techniques. It also requires more memory however, and great care is required due to the very high digital clock rates involved (14.32 MHz).

Bit rate

Each analog "sample" in the A/D converter is translated into a digital word, consisting of a number of bits. A single bit can define two digital states, or levels (it may be easier to think in terms of "shades of grey" in a digital video system). Two bits yield 4 levels, 3 bits yield 8 levels, etc. It has been shown that with the best video tape recorders capable of almost 50 dB signal-to-noise ratio, no visual improvement can be observed from a 6 to a 7 bit digital video signal. For this reason, most digital time base correctors utilize an 8 bit system. (8 is also a convenient word size to handle "logically.") One manufacturer, however, has selected 9 bit system. CVS applications engineer Ron Frillman acknowledges that no discernable improvement in today's VTRs can be seen with a 9 bit system, but notes that future developments may make the higher bit rate advantageous. Brian Matley at Microconsultants, Inc. counters that "a 9 bit system, in combination with a four-times subcarrier sampling system pushes the bit rate much higher, and challenges the state of the art." He adds that "The MCI concept is to stress reliability before technical innovation."

Digital Video

It should be noted that it is in the A/D and D/A converters where signal quality is determined in a TBC, and design excellence is the overriding factor. Suffice it to say that both 8 and 9 bit, 3 and 4 times subcarrier systems of good design are capable of "transparency," adding virtually no degradation to television signal.

Dropout compensators

Dropout compensators (DOC) are frequently offered in TBCs, since a top-quality DOC is not too difficult or expensive to implement in digital systems. But since even very inexpensive VTRs may include a DOC—why have one in the TBC? The answer is performance. Some low-cost recorder "DOCs" do nothing more than clamp to a grey level when a dropout occurs. Others use the previous video line and substitute it for several lines. A top-grade DOC should replace video only over the actual duration of the dropout, and furthermore it should reinsert correctly phased video, which requires going back two lines.

Velocity compensation

As noted earlier, time base information only occurs at the start of each line. But errors may occur across the entire line as it scans from left to right. These are called velocity errors, seen as hue shifts from left to right across the picture. "Averaging" TBCs average velocity errors too, and so tend to reduce their levels ("inherent velocity compensation"). A true velocity compensator works by measuring the difference in burst phase from one line to the next, and develops an additional correction signal which is applied across the line. This correcting signal is a linear ramp, which to a first approximation compensates for velocity errors across the line. All true "vel comps" are line-by-line devices, and a line-by-line velocity compensator should not be confused with a line-by-line time base corrector.

Heterodyne operation

Most of the inexpensive VTRs ($\frac{1}{2}$ " and $\frac{3}{4}$ ") do not have sufficient video bandwidth to record a direct color (4.2 MHz) signal. A heterodyning process is used to "fold" the chroma back down, using a lower frequency subcarrier. This is the so-called "color-under" system, and unfortunately the phase relationship between burst and sync is destroyed in the process. Heterodyne circuits in most TBCs restore this phase relationship before processing the signal as direct-color. In many TBCs the "two-wire" approach is used, in which "coherent subcarrier" (correctly phased with sync) is fed back into the VTR. This requires a VTR modification, and makes remote news gathering via microwave impractical because of the need for a feedback signal. More sophisticated heterodyne accessories in a few TBCs are capable of "single-wire" operation without degradation, albeit at increased expense.

Picture enhancers

At least one TBC manufacturer (Microtime) offers a built-in picture enhancer, although most picture enhancers are sold as separate devices. Enhancers perform two main functions. First, many small VTRs have serious chrominance-to-luminance delay problems, usually seen as red "smear." An enhancer can be used

to separate the chroma and luminance, and provide a control adjusting their relative phase position. A second problem with inexpensive VTRs is the rapid loss of high frequencies due to the limited bandwidth. Enhancers may "peak-up" a signal wavefront, and combing or coring techniques can give a subjective improvement of up to 3 or 4 dB in signal-to-noise ratio. There is a danger inherent in picture enhancers however—repeated use can create large transients and spikes in a signal which will cause a TBC to malfunction. Enhancers may also cause degradation to high quality signal, but they will provide significant improvement in low quality signals.

Synchronizers

The trend in TBCs has been towards ever-increasing correction ranges. As memories become denser and less expensive, the day may come when it is practical to utilize field or frame synchronizers (simply a very wide-range TBC) for everyday TBC applications. Today the half dozen synchronizers available are costly (three or four times the cost of a TBC) and most lack the sophistication of the latest TBCs. But their advantages are powerful—an "infinite" window, freedom from hot-switch transients and timing problems. Synchronizers today are an important tool to the broadcaster, and will become more so as designs (and prices) improves.

Charge-coupled devices

The application of analog charge-coupled devices (CCD's) as inexpensive delay lines has caused some to predict the return of the analog TBC. The signal quality of these devices does not now support that contention—but they have shown remarkable improvements in a relatively short time, and the prophesy might come true in the future.

Selecting a TBC

Armed with all this information, how does one make a choice? It depends upon your need. If your goal is simply to feed a monitor or CATV line and remove skew errors, a picture straightener may be completely adequate. If you are a broadcaster, do production work or a lot of dubbing, you'll want a true TBC.

If your work is confined to the smaller formats, an averaging TBC will do the job. If you anticipate using one of the new broadcast-quality one-inch formats, a line-by-line corrector will provide top performance. You may want both to get top performance in any situation.

Regardless of what type VTR is used, a line-by-line vel comp and a true dropout compensator will help extract the best possible signal quality. This is especially important for electronic journalism.

Do you use portable U-standard VTRs? Due to gyroscopic effects these devices can have enormous errors, and the larger the correction range of the TBC, the better. Just as important is the overload characteristic of the TBC (portable VTR errors can reach 20 or 30 TV lines, beyond the range of any TBC). Some TBCs break up badly during overload. The better ones handle it smoothly, without breakup or color shift.

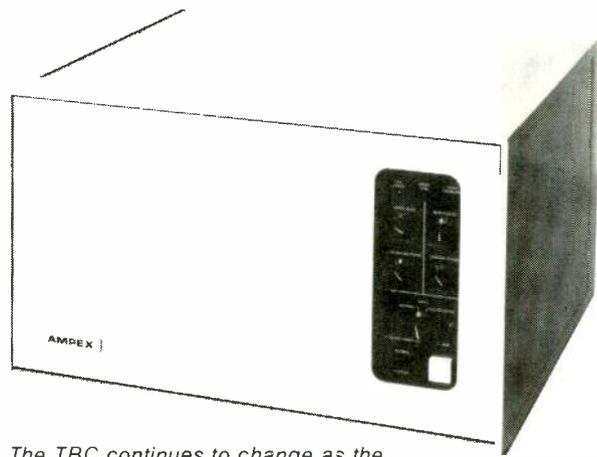
Serviceability is a vitally important consideration in a high-technology device containing thousands of integrated circuits and transistors, and is frequently overlooked. Is it modular with easily changed circuit cards? Does it incorporate diagnostic circuitry? This is becoming an increasingly important tool in servicing. Look at the power supply—can it be set for high or low lines

operation? Perhaps more important, does it have over-voltage and overcurrent protection? A failure here could be catastrophic. Are fans and filters required? Size, weight, even power consumption may be important factors.

TBCs—the future

The tremendous attention which has been focused on electronic journalism in the last three years has thrust an electronic wallflower, the TBC, into the limelight as an essential part of electronic newsgathering. It was the triple combination of high-quality portable cameras, light-weight portable VTRs, and the wide-range digital time base corrector which made this possible. None were ideally suited, however, and in the last year a "second generation" of TBCs, designed especially for newsgathering, has been introduced. They are smaller, lighter, have larger ranges and more features.

Just as electronic news was the darling of the broadcast industry two years ago, today it is the new breed of one-inch helical VTRs. Capable of high-quality performance and features never before available, these VTRs place new and special demands upon time base correctors. The ability to provide slow motion and still-



The TBC continues to change as the demands of users change and new applications are found.

framing promise to become important new tools in videotape editing, and require accommodations not found in many TBCs today.

One thing is certain—time base correctors will continue to play a role of increasing importance to videotape recording, and to the television industry.

The Use Of Synchronizers For Broadcast Television

by Herb Quilitzsch

The effect of framestore synchronizers on the television industry is impressive. Considering the short time these have been available their acceptance has been remarkable.

WHILE THE ENGINEERING DEPARTMENT is becoming more familiar with the technical advantages of synchronizers, it is vitally important that production departments understand the new world open to them through the proper use of the digital framestore synchronizers.

The ability to lock various video sources to the television station has long been a concern to broadcasters and the advent of live remote productions and electronic news gathering has promised to further complicate the situation. Past methods of locking these sources to the station has imposed serious limitations on the effective use of all available television inputs.

The basic framestore synchronizer allows the locking of any non-synchronous source (whether from a satellite, network line, microwave, or remote recorders and cameras) to the receiving station. The advantages to this type of synchronizing becomes manifold both from a technical and production viewpoint.

With the framestore synchronizer connected as in Fig. 1, the inputs may be non-synchronously switched via the routing switcher while maintaining a continuous H&V locked output from the synchronizer. This allows the output to be fed directly to inhouse quad recorders, as

Herb Quilitzsch is Video Product Manager for Micro Consultants and, as such, has been involved in demonstrating the versatility of frame store synchronizers to broadcasters throughout the U.S. and Canada.

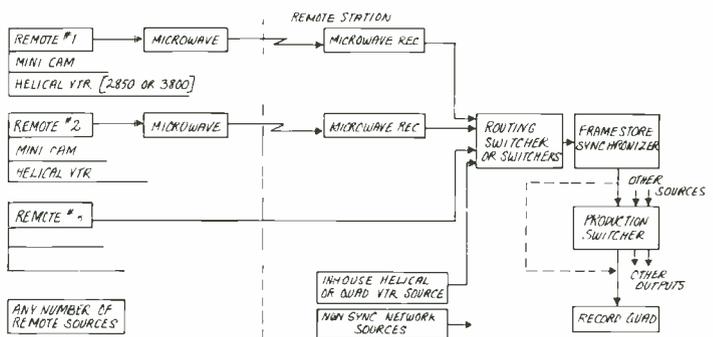


Fig. 1. Synchronizers in the TV station.

well as the switcher, without the usual quad disturbances encountered with this type of hot cut. Many users are implementing synchronizers in this manner to eliminate the breakup encountered with quad recorders during network recording for delayed playback.

The Fig. 1 configuration also permits the implementation of special effects such as fades, wipes, and splits, etc., provided by the production switcher. The ability to do these effects on non-synchronous signals is perhaps the most revolutionary aspect of the synchronizer from a production standpoint. The present method of locking the station to the remote is a classic

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example of the tail wagging the dog; any loss of signal from the remote results in a crash switch back to station lock. Furthermore, the ability to switch from remote to remote is difficult, if not impractical. With the frame synchronizer, the director may select the live remote on preview and fade or other effect from the station to the remote without disturbing house lock.

A switch from remote to remote is a simple matter of a routing switch. The result is a clean switch without rolling, tearing, or the need to cut to black. An effect from remote to remote requires two synchronizers or, alternatively, the locking of the station to one remote and fading to the other with the synchronizer. Note that timing differences of remote sources are not a concern when routed through the frame synchronizer. Also, since the output of the digital framestore synchronizer is always synchronous with station or locking inputs, phase-in time on remotes is eliminated.

Additional features currently being offered with the new generation synchronizers such as TBC, freeze, and compression further enhance their utility and flexibility.

The ability to compress a full video picture has become a powerful production tool. Compressed pictures are now becoming commonplace in the coverage of sports and news events. The compressed insert may still be switched synchronously thus extending its capability further yet. A frame or field freeze is available on most synchronizers and may be displayed without noise bands associated with a video recorder in the absence of a stillframe disc unit.

The inclusion of time base correction as an integral part of the framestore synchronizer offers a tremendous advantage over a conventional time base corrector. Digital time base correctors have a limited window of correction, usually three to six horizontal lines. Conse-

quently, when time base errors occur outside the window of correction, the resultant picture will hop vertically on the monitor. The frame store synchronizer offers an infinite window for correction of any time base errors occurring within the video recording. This feature is of greater importance in electronic news gathering where gyroscopic time base errors exceed 30 horizontal lines when the operator carrying the recorder is in motion. As the basic synchronizer allows for time base correction without requiring a return vertical lock to the recorder, it is capable of remotely time base correcting any video source. This often eliminates the need for a time base corrector located at the remote end prior to the transmission of the TV signal from a VTR.

The use of the state of the art technology has allowed the frame store synchronizer to be housed in a package requiring only 8 3/4" of rack space, thus extending its capability to OB vans and other applications where portability and space is an important factor. (Fig. 2).

The coverage of events such as the Twenty-Sixth Annual Emmy Awards have displayed some of the uses for frame synchronizers. Here the synchronizer was fed by a portable camera which was microwave linked within the theater. Synchronization of this camera afforded constant mobility.

The set-up of last year's Annual Hydroplane Race in Seattle, Washington was made easier by using a similar technique with the camera located in a blimp. Three additional unlocked sub-remotes around Lake Washington were linked by telco and microwave through a routing switcher to the synchronizer. Not only did this allow effects from van locked sources to remotes but saved on additional locking lines to the sub-remotes.

While quick set-up remotes are prime applications for synchronizers, there have been complex event coverages where multiple synchronizers permit handling of multiple remotes as though they were generated inhouse. The Summer Olympic Games in Montreal were an important test for frame store synchronizers. Fig. 3 illustrates the configuration used. The synchronizer virtually eliminated the concern for timing differences between remotes caused by dopler effects in the microwave signal from the helicopter covering such roving events as the cycling race and walking marathon. Again, it was now possible to produce video splits between remotes.

Frame store synchronizers are essential for creative electronic news gathering production. This new approach to system locking not only allows the full facilities of the effects switcher to be applied to live news coverage, but takes advantage of the synchronizer's ability to compress full pictures to one quarter size. Some news departments are applying the compressed remote over the shoulder of studio newscasters. The compressed picture will still be fully synchronous with station sync and can be switched from source to source without tearing or picture roll.

The compressor facility of the synchronizer has been used extensively in sporting events by all three major networks. Pre-recorded events or player introductions are displayed as an insert at the top left of the screen.

The future expansion of live remote broadcasters depends heavily on the ability to synchronize inputs with the TV station. The requirement to open the production switcher to all inputs available can only be accomplished with the techniques offered by the frame store synchronizer.

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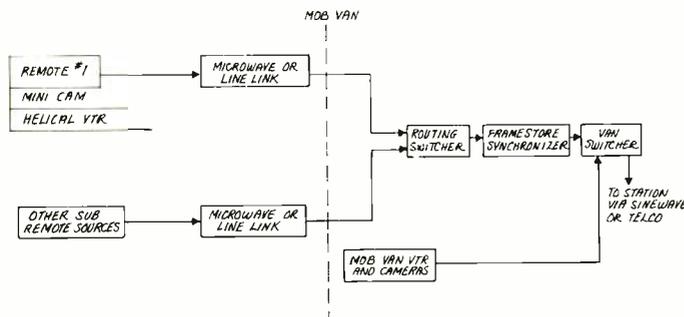


Fig. 2. Synchronizers in the mobile van.

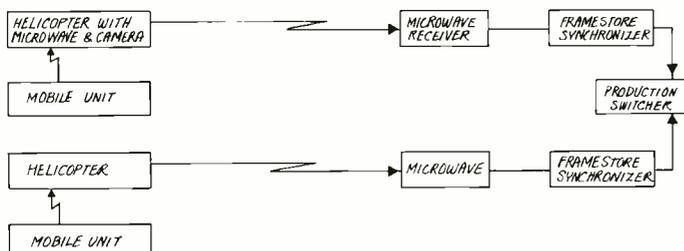
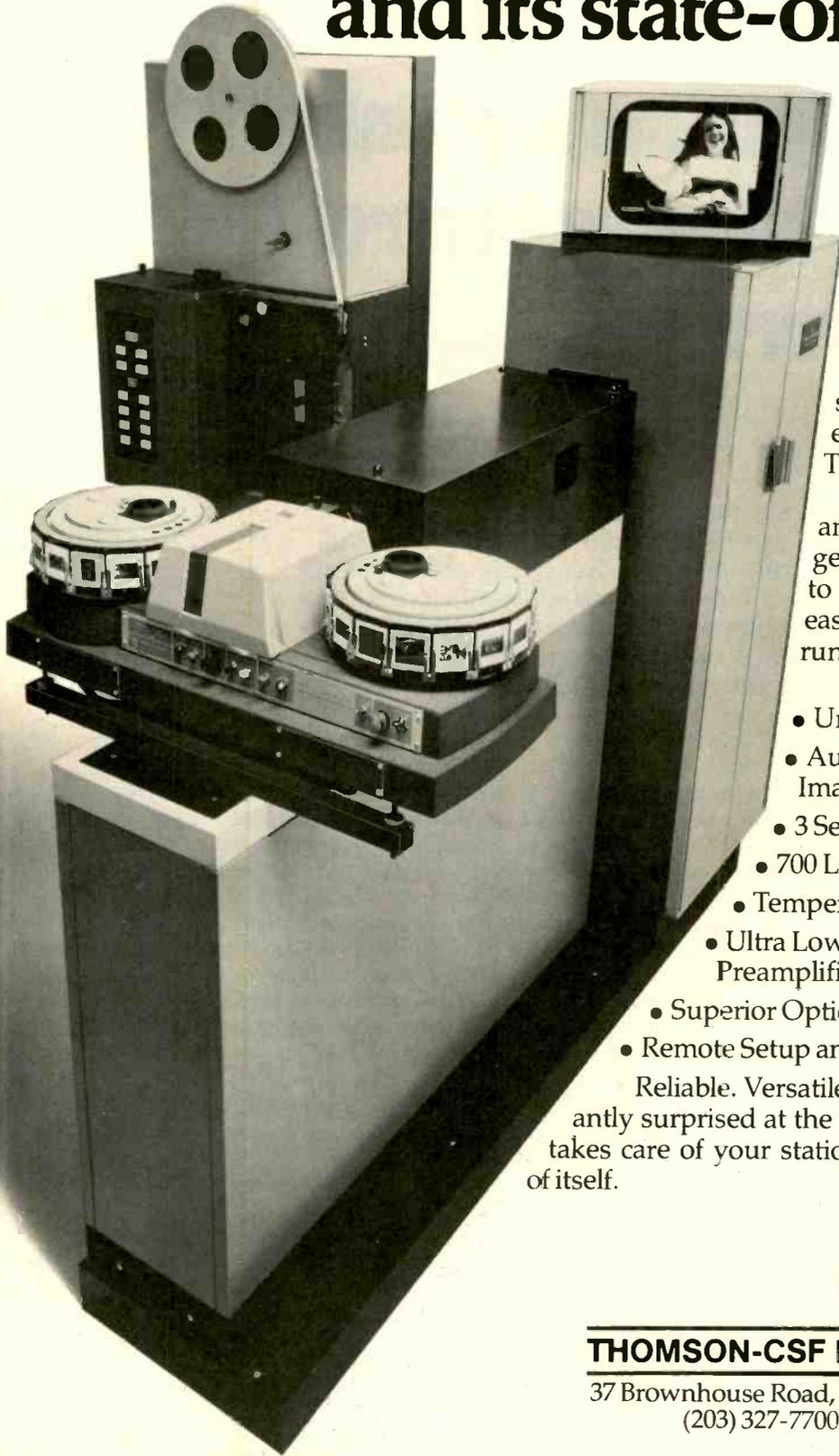


Fig. 3. Synchronizers at the Montreal Olympics 1976.

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Digital TV Systems Can Unleash Creativity, Improve Control And Reduce Errors

By Eugene Leonard

Digital memory and circuits are fast becoming so cheap that broadcasting as we know it can be revolutionized. Better control, more creativity, fewer errors are possible. But digital television will make its full impact only when management/engineers/producers can jointly conceptualize its potentialities and act in concert. A system's viewpoint must replace our black box orientation. Management must take the lead in bringing about this understanding.

THE DIGITAL "WAVE OF THE FUTURE" was late in impacting the broadcasting field. Now that it has hit, the implications are overwhelming. But there is still a great deal of uncertainty and misunderstanding as to the role that digital techniques can play.

Our introduction to digital video has been via individual black boxes—such as character generators and time base correctors. Each box solves a single problem. However, broadcasting is a unique field which embraces both high technology and artistic creativity. Future demands call for the capability of digital *systems* as opposed to black boxes.

Any discussion of digital systems in broadcasting must be conscious of the three faces of broadcasting:

- Engineering and Operations
- Artistic and Creative Production
- Management of the Business

At the present time most advances have been made in the area of engineering and operations—those digital black boxes we spoke of. There has been little examination of the video studio as a whole and the relationships between elements. Thus the industry is not yet ready to apply digital systems techniques in any optimal way.

The business management side has begun to use computing systems. But once one moves out from the accounting and into the scheduling, traffic, logging, government relationships, marketing and sponsor-payments area, new considerations come to the fore.

In the artistic and creative production area, except for post-production editing, very little has been done. There is an absence of communication between the professional skilled in the digital arts and the professional skilled in the creative arts. The basic reason for this is that the professional skilled in the digital arts* has a habit of reducing his thinking to numeric statements. He is most comfortable with a machine interface (control panel) involving "bit" switches and numeric displays. The creative professional on the other hand, finds such an interface restricting and inhibiting of the creative process. The task then is to discover the means by which the creative professional can directly access and manipulate digital tools to accomplish his purposes more rapidly and with less drudgery.

The three areas in the broadcast field under discussion in this article interact very strongly with each other. Any system that is devised for one must provide for appropriate flow of information between it and the other areas. For example, the results of any creative effort should interface with, and be readily processed by operating

*By professional in the digital arts, we mean, essentially, the programmer. It would be a shame if the broadcast industry goes the way of other fields. In most other fields, as digital specialists stormed the ramparts, they built a mystique about themselves.

Early in the computer era, control programs ("software") were expressed in "machine language" ("1's and 0's") and only a few experts could use computers. More human language has been invented using words like "add" or "print" but, still, specialized expertise is required and over the years the software practitioners have become a priesthood. They interpose themselves between the laity of people who need computers to solve their problems and the "deity" of the computing system.

For digital TV to move ahead, it will be necessary for broadcast professionals to master the overall concepts involved so that they can direct the application of this tool. Indeed it is necessary for the professional to get involved because the market is not quite as inviting as others that have come before. Computer people are not likely to make the R&D investment in TV that they have in the areas of banking, retailing, etc.

Mr. Leonard is president of Systems Resources Corp., Plainview, NY 11803.

personnel.

The black box era must end. My company has been the leader in the electronic character generation field but what we have produced is a series of boxes. In most of our installations the interconnection with the rest of the broadcast system is purely via analog video signals. Master sync comes in and title, edge and color go out. The information manipulation is done by a manual keyboard. Messages are composed and stored and retrieved on demand, but there is rarely information or control interaction between our devices and the rest of the broadcast system.

Providing black boxes is the beginning but very far from the goal of digital applications in broadcasting. The broadcast system extends out to the sales group in the field selling spot time; to the program director; to the set designer; to the writer; to the producer, and impacts every corner of the operation. Each segment of the system must, in fact, interface with the other segments.

Adoption of digital techniques can improve the human contribution to the system. It does this by decreasing the need to do routine jobs—by both creative and non-creative people. The “cost,” however, will be the effort to resolve confrontations that are likely to evolve between the groups.

In exploring the interactions between the three basic areas—technical operations, creative/artistic, and management—and contemplating their impact on the industry's structure, one must start with current applications of the digital technique.

Technical Operations Area

Within the area of technical operations, the digital technique breaks into three groups of applications:

- Control
- Content Processing
- Content Generating

Control In the area of control, digital devices have been available for years. Digital event switchers go back to the first days of computing and used such (now primitive) devices as gas tube counters and stepping relays. Today the same functions are accomplished by general purpose computers specially programmed and equipped with special hardware interfaces. In both cases, the objective was clear. A memory must receive and store: 1. the sequence of events; 2. the times at which those events were expected to occur; 3. the equipment involved in accomplishing the event; 4. the signalling instruction (either automatic or manual) to provide the necessary warnings; 5. the actual switching instruction required to accomplish the event. These systems have led to some savings but more can be expected once all legal, social and organizational problems are solved.

Integration of the traffic information with the event switcher has begun both in terms of on-air scheduling and media identification. It would be desirable to see more standardization in this area so that network signalling contained enough information to allow the local station to exercise its switching control on receipt of that information. Another important interface involves the proper identification of media as it is received from associated external agencies so that its status is always retrievable.

There is no real standardization in the way media is brought into the broadcast system, whether in the form of transmission from the network or in slides or tapes

received. Such standardization is necessary in order to eliminate intermediate human interventions which introduce error-generating hazards. The technology is waiting to be adapted but the organizational and business requirements must be worked out.

Digital techniques are being used for in-plant signalling between machines. Various systems are in existence using a diversity of signalling codes and transmission media. But because there is no standard interface for media identification; specific content cannot be automatically associated with the appropriate machine and switched accordingly.

Another area in which control has gone digital to a great extent is in the monitoring and logging of the transmitter activity (as well as the remote control of the transmitter). Here the function is somewhat more isolated from other functions in the system but not completely so. After all, the ultimate proof of broadcast would be the ability to establish that the radiation has been proper and included the desired content.

Systems considerations suggest that the introduction of the media into the broadcast system include not only identification to be used by the event switcher and machine control system but also some sort of “fingerprint” that can be used to assure a sponsor that the information was properly radiated.

Content Processing Perhaps the most dramatic intrusion of digital techniques into television has been that involving content processing. The signal enhancer, the time base error corrector, the frame-synchronizer, the standards converter, and the still-frame store are all examples. All have taken the form of “black boxes” which exist between input and output analog signals.

Digital manipulation alters the format of the signal usually to correct inadequacies. However, we can't expect much more to occur (for example “tagged video”) until the industry has studied its problems sufficiently and can specify a digitized signal format to allow an all-digital plant. Thus, the “hybrid” digital-analog intermix will continue for some time.

In the case of the still-frame store, there is a beginning of an interface with the creative world in that the media must originate in some creative area. The media inputs for the most part are photographs, art cards or film. That being the case, there remains a strong question as to whether the basic store of information should be analog or digital. This question must be answered differently depending upon the application involved. Digital memory costs are dropping and for slide stores and picture content manipulation, a cross-over may be expected within the coming twelve to eighteen months.* For slide storage a basic requirement is for random access (equal speed) to all active stored material. High capacity interchangeable analog disc random access memories which are stable enough to require minimal time base correction are available. Random access digital disc memory designs for mini-computer applications in other fields are becoming available at competitive prices. However, behind the digital mass store, a high speed electronic “frame” memory is required. But costs of such memories are rapidly dropping to the point where their

continued on page 38

*Analog memory is still cheapest. Restating a VTRs capacity into bytes and bits (8 bits equals one byte), we see the cost per bit is 4.8×10^{-8} cents. For analog disc stores, it is 1.3×10^{-6} cents. Computer tape, by comparison, is 1.7×10^{-5} cents per bit. Present frame synchronizers using semiconductor memory costs 9×10^{-1} cents per bit. See: Evaluating Memory Systems For Digital Video, page 41.

Digital TV Systems

combination with the digital disc will match the economics of the analog disc which must be digitally corrected.

In other areas such as storage of video moving picture information, no foreseeable digital technique can challenge video tape.

Content Generation Basic digital content generators involve character or graphics generation. High quality character generators such as Chyron II or Chyron III provide a mechanism for digital storage of a "dictionary" of shapes, assembly of such shapes as displays and storage of the digital information in order to recall the display on demand.

Next in line come the graphics generators which are freed from the rectilinear typewriter-like restrictions of the character generator. Areas on the screen can overlap and still be recalled instantly as well as treated variably. For example, a total map can be stored and retrieved in such a way that various areas on the map are selectively colored, flashed, shaped or otherwise manipulated at the operator's desire. This manipulation can be pre-programmed in at the time of composition, and be further modified by the decision of the director at the time of broadcast or taping.

The key characteristic of these devices is that while the overall content is generated by an operator at a composition keyboard, the basic shapes are created from artwork. The shapes may be stored, manipulated and rearranged, but the basic shapes involved in the display are not created by computation in the computer.

This is a very important distinction in that the next further step (i.e. computer generation of the shapes) requires the intervention of the programmer. We have yet to achieve any mutual understanding between the creative artist and the programmer.

When we get to the area of content generation we also enter the never-never land between the technical operating area and the artistic/creative area. A question can arise as to whether the job to be done is an engineering job or a graphics job.* For example the treatment in the next section regarding creation of video images could just as well include character, graphic and computer generators which have just been discussed under Technical Operations.

Creative And Artistic Area

The creative and artistic area in television may be

*In a number of other industries, the advent of digital technique has caused painful reorganizations of the industry. One need only think of the impact of the electronic technique on the newspaper business to realize that the techniques just now being applied were available for at least 10 years before the various organizations involved were able to reconcile their differences and avail themselves of the capabilities offered. The crunch lies with the earlier statement that the digital technique reduces the need for people doing routine jobs. It allows the creative mind closest to the point of origination of decision or origination of information to produce and control information which is then routinely processed by machines. The problem is that much of the routine processing is presently done by people. Those people represent an established element in the industry. There is a threat of displacement.

In the printing industry, a long period of negotiation and acclimatization was required before the digital technique was truly implemented. We can predict a similar course of development in the broadcast industry. But far-sighted management and understanding of the need for rearranging the relationship between people and their work may shorten the time period.

However, we have learned one thing from experience in other fields: While the advent of the digital tool may seem to destroy the distinctions between certain types of labor, in reality what it does is highlight the difference between routine labor and creative labor. The whole trend of our modern society is to remove routine labor from the human domain and put it where it belongs. As IBM says, "machines should work, people should think."

broken into three general categories:

- The generation of video images
- The manipulation of visual effects
- The processing of non-video information

In the generation of graphics, it is obvious that the creative artist is called upon. In the manipulation of visual effects, skills are needed with respect to camera positioning, montaging of signals, keying of signals and retrieving of previously stored patterns. These patterns may include backgrounds or other effects to be called up in the course of production. The processing of non-video information calls for the retrieval of old references out of an "electronic morgue" or the restructuring of scripts using word-processing techniques.

Generation Of Video Images Digital cameras are in the offing. A digital stream of "tagged" video coming from a camera will be a tremendous assist in "correcting" camera position, montaging signals, keying, etc. However, it will be difficult to capitalize on this facility until the rest of the plant is digital.

As mentioned in the prior section, graphics created from computer digitally-created video have by now become quite familiar. Generally speaking, an aesthetically pleasing effect results from dynamic modification of abstract geometric patterns. In more complex setups, graphic shapes may be generated, modified and varied depending upon the operating system that is being used with the computer. In all cases, the designer relies upon the intervention of a programmer when a requirement arises for a facility which is not in the existing repertoire of the machine. The procedures involved have generally been time consuming and expensive. Some computer set-ups produce video; others produce high resolution photographic slides. However, the writer is not aware of any such facility which is owned by and operated solely by a television broadcaster. This cost of the machines and the need for programmers generally means only separate production houses can go this expensive route.

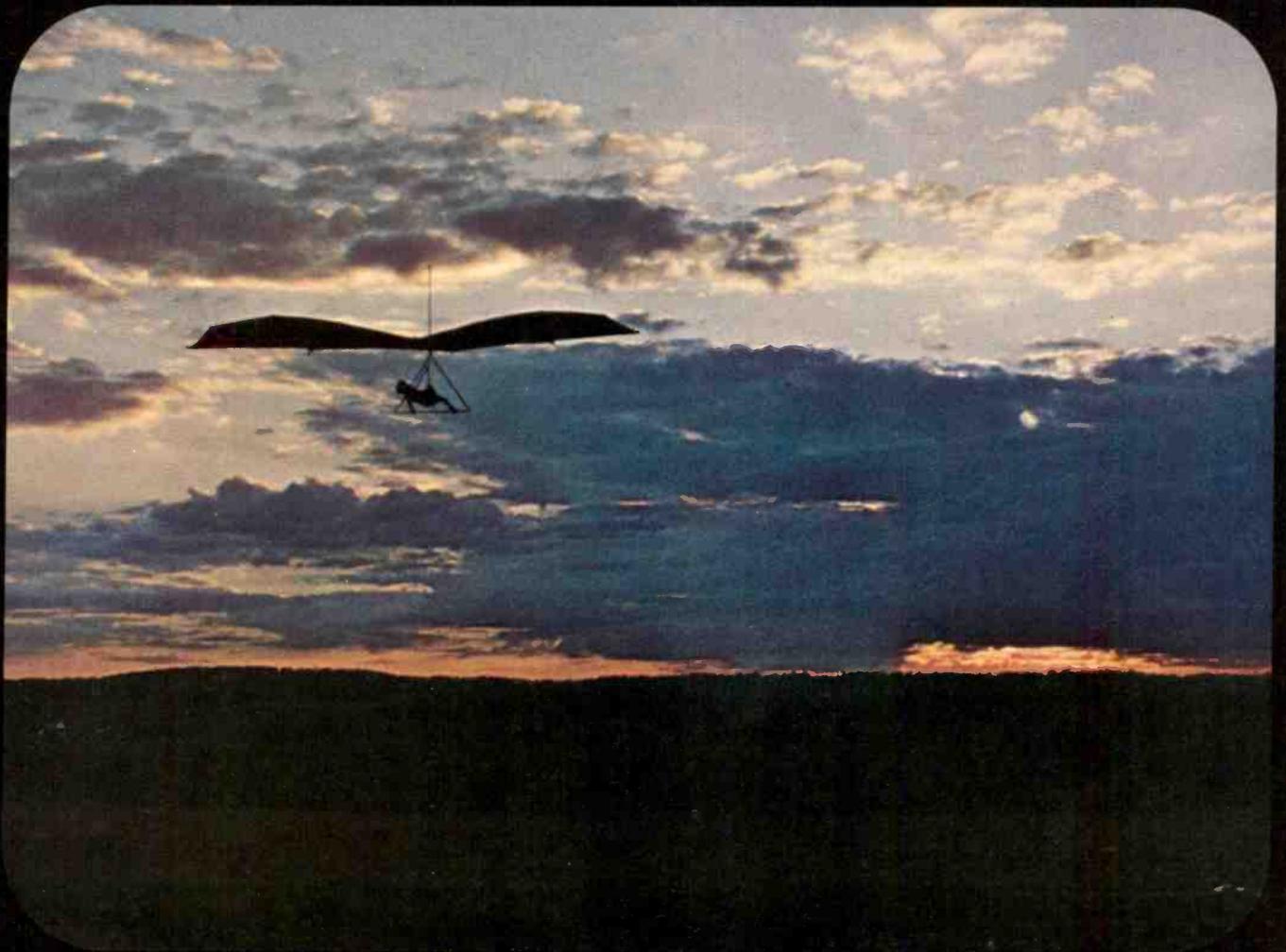
It is doubtful that either approach will predominate. On the one hand is the graphics generator in which initial shapes are created by an artist and transcribed to the video medium by means of digitization. On the other hand, we have computer generated graphics in which basic geometric relationships and the algorithms for generating them are stored in a high-powered digital computer. It does seem that with the present utility of character generators for news, promotional and titling purposes (plus the graphics add-ons where economically feasible) that the former approach makes more sense.

At Chyron, we are working in ever closer interaction with the designers, producers, directors and writers to provide graphic generating studio-cost equipment. A first solution has been the Dynamic Montage Unit which was introduced at the 1976 NAB convention. This is a new concept which offers creative interactive electronic assistance to the graphics designer and includes a great deal of animation capability. We can anticipate more devices of this sort. (See box, The Shape of Those Creative Tools, for a current update.) They will serve the director, the scenic designer, the lighting designer etc. However, this is one area in which the digital technologies and the creative artistic people must study together in order to determine the way in which the digital technique may be applied to the art.

Manipulation Of Visual Effects Proper system

continued on page 42

The reality of 5 footcandles.



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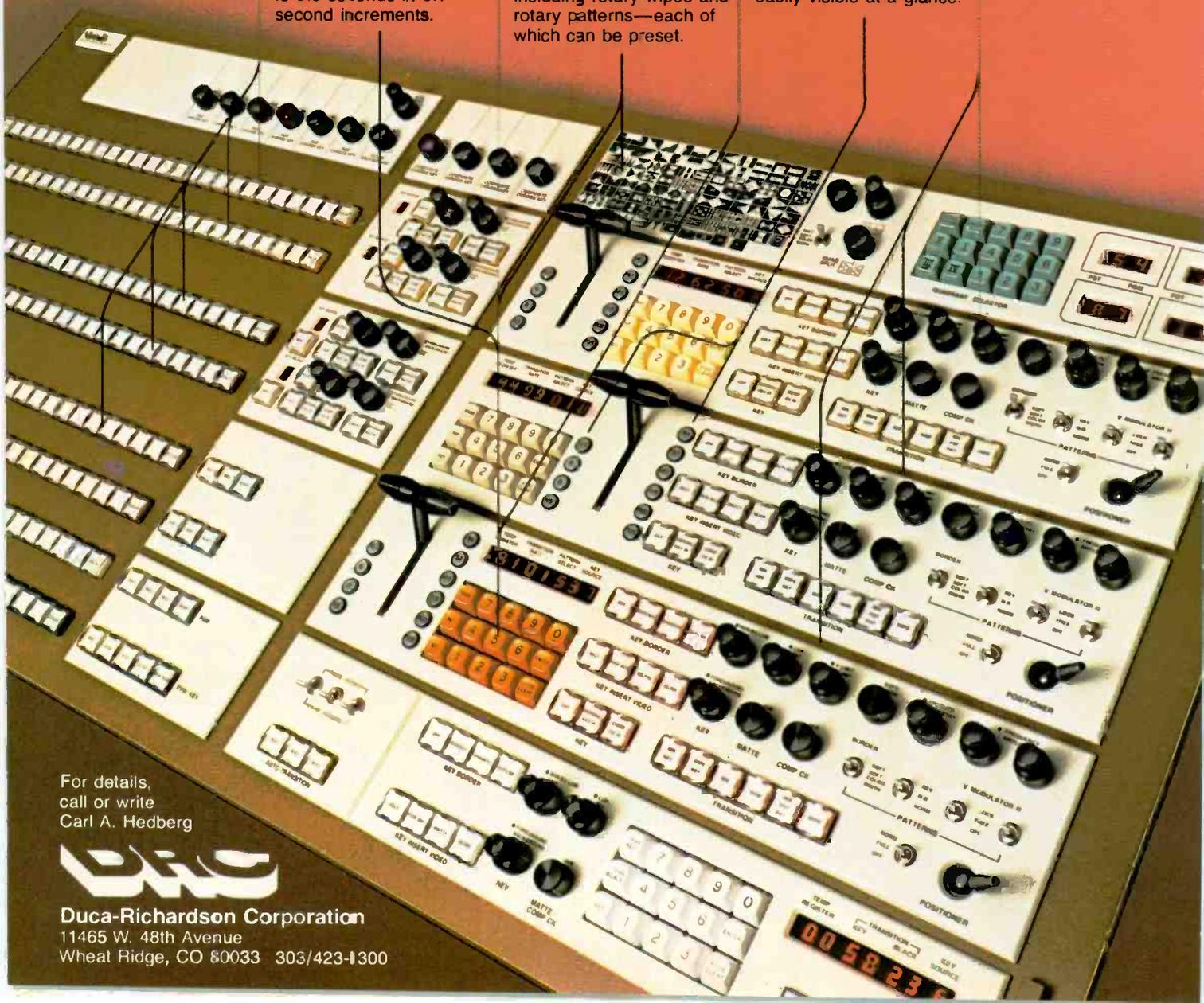
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Evaluating Memory Systems For Digital Video

Various memory devices are compared in Table I. Video tape and analog disc, which are the only ones employing analog techniques, have had their capacities restated in the standard digital unit—the "byte."^{**} The superiority of the moving picture information is clear from the "cost per bit" column. The cost of basic R transport equipment for many applications is dropping significantly.^{**} In Table II-A, the pre-eminent position of video tape is confirmed by calculating a figure of merit taking both equipment and media cost into account. However, work continues on digital recording for VTR applications and new de-

velopments may bring the VTR into digital fold.

Table II-B considers the other end of the spectrum—ability to manipulate the detail content of a picture. Here storage capacity is much less important than access time (speed to get to the element) and ability to manipulate content. In this case digital memories are superior.

^{*}A "byte" refers to eight bits of information (sometimes including a ninth bit for checking purposes). The American Standard Computer Information Interchange (ASCH) code uses 8 bits for all alphabetic, numeric, and transmission control purposes. The standard digitized video element also uses 8 bits.

^{**}Semiconductor memory chip design has taken shape according to the needs of the computer industry. The basic MOS or bipolar chip represents a single bit of the data stream so that 8 bits per byte require 8 chips in parallel. Development has proceeded from 1024 bits per chip to 4096 bits per chip with consequent reduction in cost per bit. Now 8192- and 16,384-bit chips are at hand. For MOS and bipolar chips, the cost per bit is pointing to 0.04¢ per bit at the chip level. Organized into a computer-oriented memory structure, the cost becomes approximately 0.1¢ per bit. CCD and magnetic bubble structures (particularly if organized for digital video purposes) promise significantly lower costs.

**TABLE 1 Memory Characteristics And Costs
(SEMI CONDUCTOR COSTS PROJECTED TO 1980)**

		Medium	Basic Equipment Cost \$	"Library Unit" Capacity Bytes(A)	"Library Unit" Cost \$	Cost per Bit for Library Unit ¢	Access Time Mill sec	Manipulability (B)	Developed for TV
Magnetic Moving Surface	Analog	Video Tape	70,000 to 200,000	3.9×10^{10}	100 to 150	4.8×10^{-8}	1.8×10^6	1	Y
		Analog Frame Store Disc	20,000	1.4×10^8	75	1.3×10^{-6}	500	3	N
	Digital	Computer "Mass Store"	500,000 to 1,500,000	3.8×10^{11}	10,000	2.1×10^{-4}	5×10^2	5	N
		Computer Tape	30,000	3.7×10^7	50	1.7×10^{-5}	9×10^4	5	N
		Slo-Mo Disc	70,000	3.6×10^8	—	2.3×10^{-3}	200	3	Y
		Computer Hard Disc	5,000	1.3×10^7	75	7.2×10^{-5}	200	5	N
Semi-Conductor	Frame Synchronizer	50,000	7.2×10^5	—	9×10^{-1}	30	7	Y	
	Bi Polar RAM	10,000	3.6×10^5	2200	5.0×10^{-2}	50×10^{-3}	10	N	
	Mos RAM	10,000	3.6×10^5	1800	4.0×10^{-2}	300×10^{-3}	9	N	
	CCD's Mag Bubble	10,000	3.6×10^5	300	7.0×10^{-3}	100×10^{-3}	6	N	
Exotic	EBAM (C) Holographic Laser	20,000 to 100,000 ?	3.6×10^5 ?	150 ?	3.5×10^{-3}	200×10^{-3}	8	N	

(A) "Library" Unit is the basic "Replaceable" storage unit (B) Estimate of speed and accessibility to any picture element (C) Electron Beam Accessed Memory

TABLE II Relative Figures of Merit For Memory Systems

Figures of Merit for two extremes are calculated:

B. Full Frame Full Color Picture Element Manipulation

A. Full Frame Full Color Motion Picture Storage

$$\text{Figure of Merit} = \frac{\text{Manipulability} \times 10^6}{\text{Basic Cost} \times \text{Access Time}}$$

$$\text{Figure of Merit} = \frac{10^6}{\text{Basic Cost} + \text{Unit Cost} \times 500 \text{ Equiv VTR Reels}}$$

VTR	5.7
Mass Store	7.7×10^{-2}
Computer Tape	3.8×10^{-3}
Semi-Conductor	1.0×10^{-5}

VTR	5.6×10^{-6}
Mass Store	1.3×10^{-2}
Slo-Mo	2.1×10^{-1}
Bi Polar RAM	2×10^4
Mos RAM	3×10^3
CCD Bubble	6×10^3
Exotic	2×10^3

Digital TV Systems

design will allow manipulating video by means of keying, montaging, and retrieving previously stored scenes. The storage mechanisms now available provide rapid access information retrieval. The expansion of digital technique to post-production editing is a straw in the wind. The technology demands that many operating aspects be studied and mastered. Based on the experience in other fields, the digital technique is so powerful, and immediate usefulness in fast response programming so important, that we can expect rapid development and exploitation of such systems. This is particularly true as the cost of providing multiple tapes of a given scene decreases (e.g., cheaper cameras and one-inch VTRs).

It is quite conceivable that the designer or editor will be able to use "tagged" video, so that he can identify specific areas of the display and manipulate them in previously unthought of ways. This will be accomplished by means of a set of manipulating rules which can be stated, and be programmed into a computer. A properly designed control panel will give direct and responsive control to the graphics or creative designer. For those cases where the rules are too complex or not sufficiently standardizable, the designer will have the ability to "free hand" (by means of light pen or similar device) the information desired into the digital store. There it will be held to allow manipulation of the video display to be produced.

Processing Of Non-Video Information For the processing of non-video information such as script-editing, standard devices presently exist and are being intensively used in legal and journalistic areas. A likely add-on for the benefit of the television writer would be access to files of prior scripts. The purpose may be to reuse information or to avoid plagiarism.

In addition to review of prior scripts, access will be required to prior sections of prior slides, films, video and audio tapes. At Chyron, we are developing an "electronic mouge" system. We are convinced that this and simi-

lar creative tools will be useful to both large and small broadcast organizations.

The creators of commercials and programs must produce competitively attractive material that will best suit the viewers and thus the sponsors. It is presently difficult for the local broadcaster to provide such creative material for transmission because of the high cost of talent and equipment. Therefore, a great part of the talent and equipment presently used must be provided by the networks and specialized production houses. What can be presently produced locally suffers when juxtaposed with the network output. Hopefully, the new creative tools such as our Graphics Generators will help smaller broadcasters to tap their own fast growing local markets.

Management Area

Turning to the management side, one can draw from experiences gained with retail and commercial digital systems. Fig. 1 shows the comparison between a standard commercial operation and the business side of a broadcast operation. The similarities become apparent. There is a marketing operation which must convert inventory to sales. There is a purchasing or production operation which must create inventory. Once the material has come in and is in inventory, the traffic department must organize the "picking" of the material for packaging into the appropriate time slot.

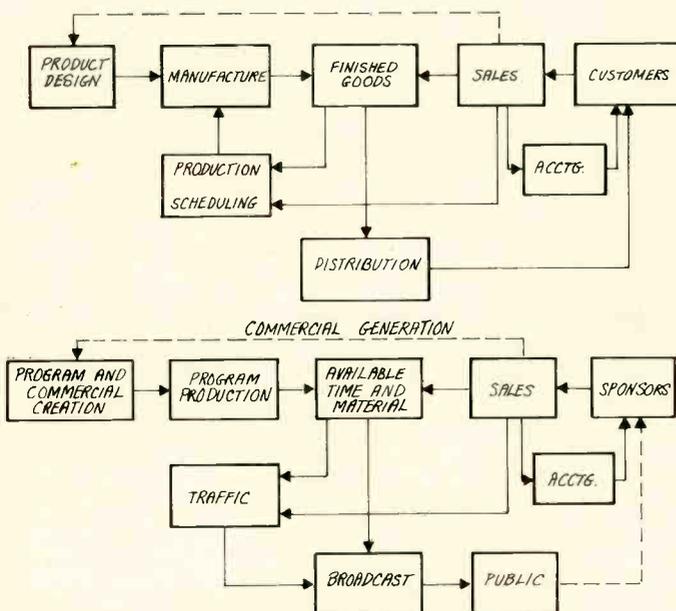
At this point, the management and operations areas must interact. Knowledge of available techniques must be meshed with overall business requirements to define a total and systematic approach.

For example, up to very recently, the only economical way of storing the program or commercial material was in the form of video tapes, audio tapes, slides or film. All of these mechanisms are basically analog and suffer from the problems of analog storage. Complex manual (or at the best semi-automatic "Rube Goldberg" type mechanisms) are necessary to store and retrieve the material.

In certain of these cases we are seeing an important change now as disc storage becomes more economical. It is now feasible to store audio spots and still frames in a totally digital form. The only significant differences between analog and video are in the analog-to-digital devices which convert original material into the digital format and in the digital-to-analog devices which convert the stored information back to the transmittable analog form. In between, the digitized information is readily manipulable, storable and retrievable. Above all, for management's purposes, it is absolutely identifiable and able, in a proper system, to generate the necessary billing evidence.

Given this system concept, some practical considerations arise. It is all very well to insist that the system shall be "state of the art." For example, to insist that every bit of information stored digitally shall always be accessible instantly irrespective of its frequency of use. This is a fine principle but applicable only if the true circumstances demand such total instant access. The facts of operation and the facts of economics indicate that this is not necessary. As has proved true in other commercial data processing applications, a *hierarchy of memory* systems gives the requisite economics and still retains the total accuracy and repeatability of the digital system. Management must enter actively into decisions

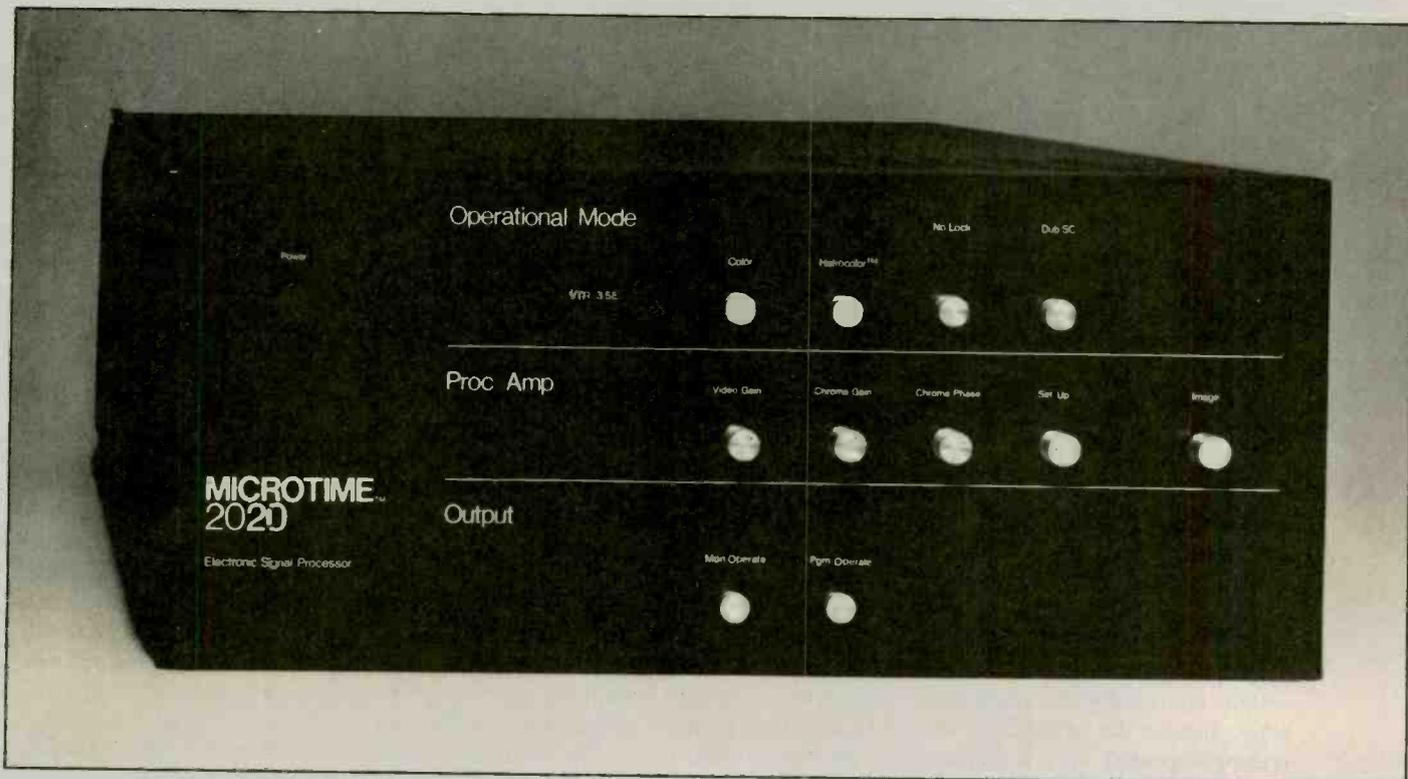
continued on page 44



Broadcast operation (bottom) compared to typical commercial business (top).

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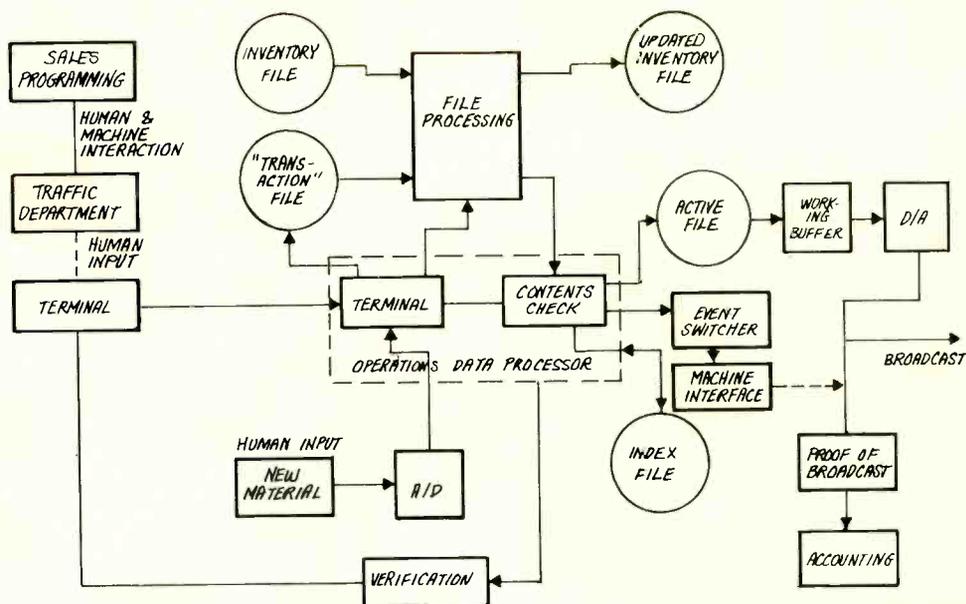
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Digital storage, update and processing arranged in a broadcast operation.

regarding equipment and systems in this area. For example, investigation with actual operations show that a total of 60 to 200 slides (out of a library of perhaps 5,000) available on instantaneous basis covers the daily and, indeed, the weekly requirements of practically all TV broadcasters. If this is the case, it is incorrect to pay enormous premiums for the ability instantly to access the total file of 5,000 slides. As shown in Fig. 2, a daily (or weekly) updating pass of the "inventory" file against the "transaction" file produces an "active" file. Only the active file need provide instantaneous access.

Such daily manipulation using operators may well provide the optimum system. People are always going to be necessary in the system and if a small fraction of their activity (on a daily or weekly basis) suffices to set up the active file for the next period of operations, there is no economic penalty even if that work is "routine." Given properly designed digital equipment, there is no potential error with respect to the material itself and the economics are advantageous.

An electronically stored slide is absolutely identified. It cannot be mis-registered, placed upside down nor accumulate fingerprints. The only chance for error is the human operator misselecting it for input that day. Here is where the conversion to a digital system approach pays off. Referring to Fig. 2, we see the basic requirement for any data processing involves a main file which is to be updated. New material is to be added or old material deleted and an activity file must be created. It is this latter file that does the day's business. If this is under manual control, there may be chance for error in the selection of items to be updated, or included in the file.

However, as shown in Fig. 2, when the system is expanded to include digital interaction between the updating process and the part of the system that generates the new data (in this case the traffic department), the possibility of error at the updating point disappears. The error potential now moves to the point in the traffic department where the schedule is composed. This is in keeping with best data processing techniques. It is always best to move the human activity to the earliest possible point in the process. In commerce and retailing, this has been manifested by the growth of "point of transaction" systems.

It simply means that there is more informed human intelligence available at the input point than there is further along in the system. Later on, an operator is dealing primarily with what appear to be meaningless numbers. Catching errors is difficult and generating errors is easy. The correct system approach requires more machine capability at the updating point. This is shown in Fig. 2 by the fact that an "index file" is also generated in addition to the active file.

The index file keeps track of the data in the main file as well as the data which has been moved into the active file. As we will see later, it also serves as an important source of feedback information regarding contents of the main file and active file and regarding the status of those contents such as: recent activity, generation of suggested purge lists, number of "make-goods," etc.

Fig. 2 shows the index file serving the very important function of being able to communicate with an event switcher which is also getting its information from the traffic department. The index file serves to assure the event switcher that the desired material is indeed available in the active file. The material will be there when the event switcher calls for it.

This allows "management by exception" in that the detection of an anomaly can occur long before the crisis point and corrective measures can be taken. Because of the need for corrective measures in any system, it is always necessary to have human beings monitoring the overall activity. The solution of an exceptional problem requires creativity and no machine can be creative.

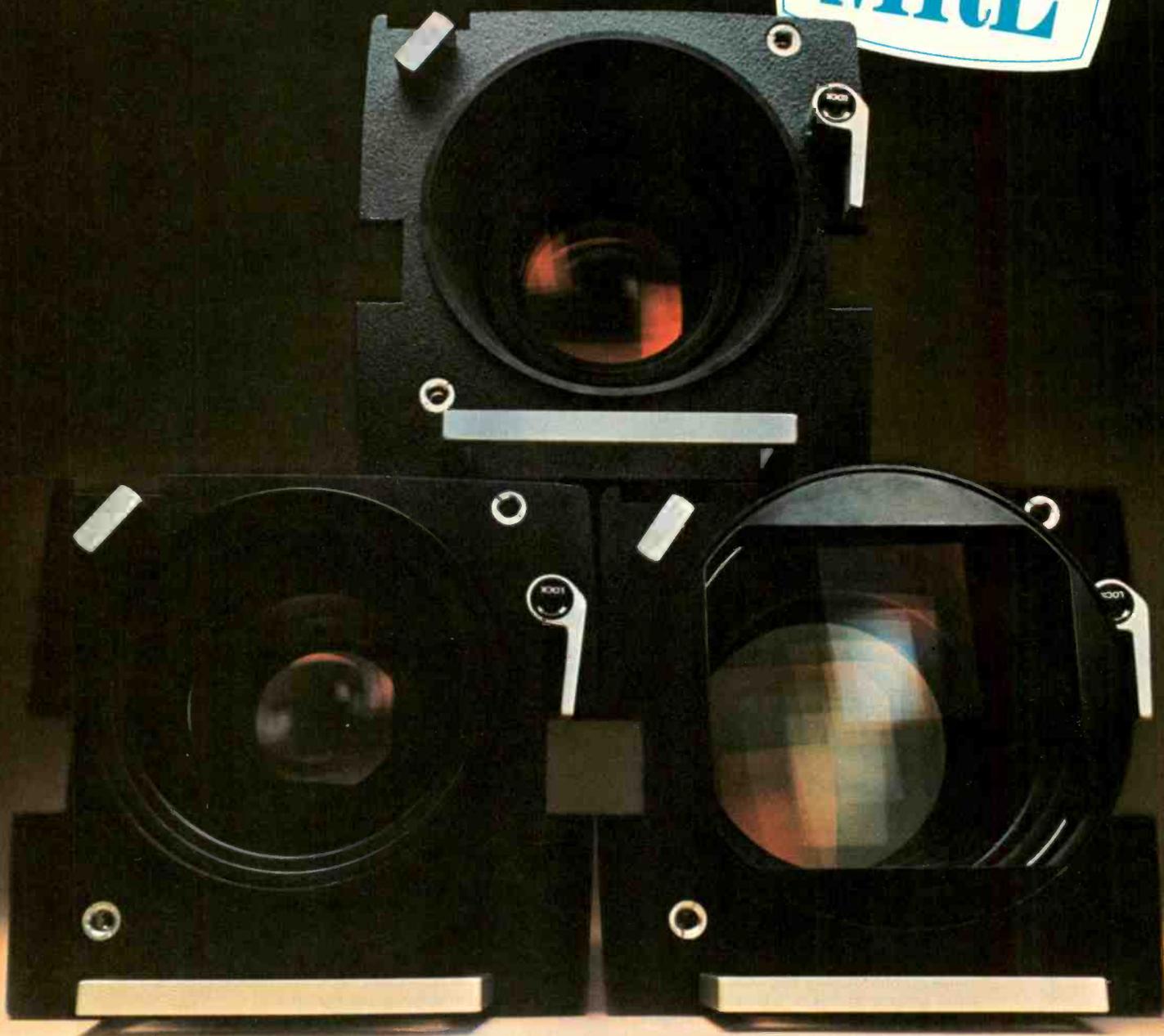
As a further check, when new material is added to the file (for example, when a slide is placed in an A to D converter and digitized so that it may be included in the update file), it is also vital that the proper "house number" be assigned to that material. An excellent way to avoid error in this case is to have the basic assignment process collected in the index file and then fed back to the traffic department to create the operating list of house numbers. As a result of this "closed loop" operation, the number associated with the material is inexorably linked to it by digital techniques. This link, also, is shown in Fig. 2.

The other interfaces between operations and man-

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Digital TV Systems

agement involving scheduling, reporting, etc. will have similar information-acquiring, storing, manipulating and reporting requirements. Digital systems will be devised and implemented to accomplish these needs. Similarly, systems involving interaction between the technical and artistic, the artistic and management and between all three will arise. In all of these, three aspects will become apparent.

1. Systems will prove themselves directly in proportion to the degree the broadcast groups direct the digital designs and not vice versa.

2. Systems will prove themselves directly to the degree that the three broadcast groups interact in the design of the system.

3. Humans will prove themselves as the systems go into operation by discovering new potentials for further improvement.

It is in this latter area that the digital and system discipline is most useful. It uncovers new opportunities. It allows modeling to evaluate the new opportunities. It forces people to extend their imaginations by demonstrating the power of that imagination.

Digital television will certainly grow but the key to that growth is stimulating our understanding and imagination. **BM/E**

The "Shape" Of Those Creative Tools

At NAB 1976, one could begin to see the direction in which the TV graphics industry is headed by observing the natural extrapolations being made by character generator manufacturers. Chyron, for example, showed how still frame video (and audio) storage and retrieval worked and how computer systems lent themselves to control of retrieval. Infinitely varying montaging of patterns was possible—all without a "middleman" programmer.

Starting with camera inputs for adding one's own graphics and sophisticated state-of-the-art font composing units, it is a small step to the next stages—mass graphic stores, working memory stores and sequence control units.

The latest in font composing units already permits positioning of characters within the edging and background colorization. Other capabilities such as more versatile shape control, more versatility in placement of shapes, a full range of hue saturation and intensity control are readily achievable. Variability of the display with respect to time is possible as a result of microprocessor sequencers.

Because the cost of memory has dropped, one can now store a vast variety of shapes—created simply enough by pointing a camera at a desired outline and scanning and digitizing the resultant image. It is as easy to build a library of shapes as it is a library of typographical fonts thanks to high capacity hard surface discs (fifth megabyte storage with removable cartridges) costing below \$5,000.

Using data compression, a full frame of crowded graphic data with individual areas identified (tagged) can be stored using less than fifty kilobytes. Part or all of such a frame can be extracted from the store and placed into a working memory (Chyron calls them "Multichannels") where the shape may be repositioned on the screen, assigned characteristic identify codes, and captured. Thus, by a succession of accesses to the library and transfer back into working memory a whole complex graphic display may be built up on the screen.

If the graphic designer is able to do this positioning and design from a library of graphic shapes, it follows that the sequence of events involving the succession of such designs can also be specified by the graphic designer.

This sequence should be built almost in a trial and error mode, i.e. sequence changes, modifications, and color variation should be made without regard to real time. Windows may be created which can be faded, zoomed or wiped.

The movement and sequence which is selected becomes part of the digital information which comprises the message. This process can be thought of as pre-production editing.

As a result of conferences with network engineering



Keyboard and joystick inputs are used in latest Chyron equipment.

and production people, Chyron learned of the need to generate SMPTE boundaries dimensioning and location grids for graphic design. Such a device is now available. Better aids in providing prompting information to the graphic designer are also in the works.

This information can appear on a separate CRT at each step of the design operation. It tells the operator what his options are, what modifications he can now put in, and how to accomplish them. The operator's input is through a "joy stick." The response is instantly seen on a color monitor.

All of this equipment is economically within the reach of the average station. It is all possible as a result of significant reduction in memory costs and in processing components.

So long as the producer does not need true motion, we envision the ability to generate modified gray scale variation and color variation, thus departing from the pure line drawing appearance.

What is clear is that as memory cost is decreased, the capability of generating video, rather than producing it via camera, will increase in inverse proportion. Once that is done digitally, of course, the ability to manipulate information increases vastly. We can begin to picture the day when scenery and backdrops can be eliminated. The whole thing can be done electronically. The background signal is geared to the movement of the camera as it zooms in and out, televising live players performing before a blank backdrop. This will allow the scene's perspectives and shadows to remain correct. The scenery designer would then work with the equivalent of some graphic electronic unit and a very large library of stored backgrounds.

You get a newsroom request for a photo of Wrong-Way Corrigan.



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The world's only Electronic Still Store system puts thousands of pieces of artwork at your finger-

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You'll probably buy your ESS system because it eliminates drawer after drawer of slides, and ends the whole business of cataloging and keeping them clean forever. You'll certainly appreciate the way ESS saves color video material permanently, without risk of loss, accidental damage, or breakage.

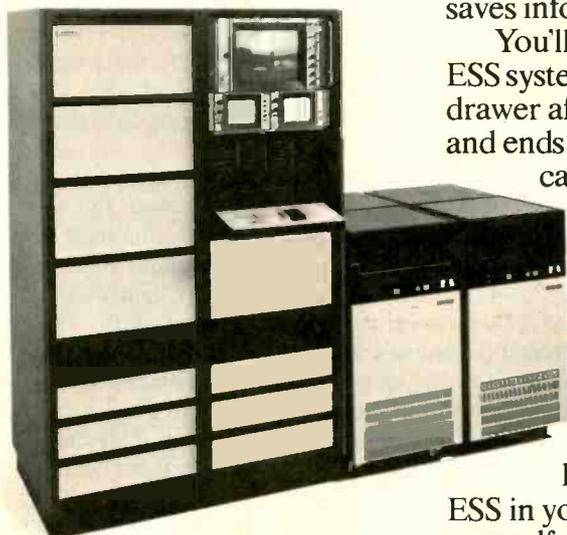
But after you have an ESS in your studio, you'll find yourself using it to store easel

cards, flat art of all sorts, and even isolated frames from video programs. Whatever's in the memory will play back at the touch of a keyboard command. If you have an automated station system, ESS is the missing link to your graphics library.

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An Introduction To Digital Television

Part I: A Digital Television Primer

by Robert N. Hurst

Editor's Note—We cannot urge too strongly that each of you—managers, engineers, producer alike—whether in radio or TV, read this article. As other reports in this issue manifestly show, the era of digital video and digital audio has begun. The adoption of digital techniques is going to have an influence more profound than that of transistors or ICs—or any other similar technical advance—on *how* we do things and what we are *capable* of doing.

If it was the vacuum tube that made radio broadcasting possible by amplifying a weak analog signal, it is digital devices that will usher in new concepts of message communication aurally and visually. Mr. Hurst does a superb job in explaining the basic principles back of digitizing information, be it a picture or something else.

THE BROADCAST INDUSTRY HAS, in the past few years, quietly entered an entirely new phase of its existence. Destined to be more far-reaching in its consequences than the transition to semiconductors of the late 1950's and early 1960's, this new phase is a result of our newfound ability to apply digital technology directly to our prime commodity—the television signal itself. And this marriage of digits and video—usually referred to as *digital television*—will not only change profoundly the equipment we use, but will also expand the equipment's capabilities into new and heretofore unknown areas, thereby opening new possibilities in the programs themselves. So the change which will be wrought in our industry by digital television is fundamental, far-reaching—and just beginning.

Of course, the use of digital technology in broadcast equipment is not new. For nearly a decade we have seen control circuits which used digital IC's to select modes in VTRs, cap lenses in cameras, control cross-points in switchers, and even generate characters and titles to overlay the video. But these are peripheral uses of digital methods, and are not properly included under the term *digital television*. The term, used correctly, signifies the conversion of successive elements of a television picture to a successive series of numbers, (with the number assigned to an element corresponding to its brightness), and the manipulation or transmission of these numbers in lieu of the normal analog television signal.

This technique itself is not new. Papers and patents on the number-encoding of a TV signal began appearing in the late 1940's. Engineers have for years been aware of digital television's potential for improved noise immunity, freedom from distortion, superior reliability, accurate reconstitution after transmission, and "tweak"-free operation. Communications laboratories demonstrated these advantages decades ago. Why the long delay between realization and application? And what was the catalyst that triggered the sudden upswing in digital television activity?

Digital television lay dormant for many years chiefly because its advantages were outweighed by its disadvantages. When realized with the technology of the 1950's and 1960's, a digital system could cost several times more than its analog counterpart, and would consume a commensurate amount of bandwidth. The improvements obtained were simply not worth the cost.

Then, in the early 1970's, semiconductor manufacturers began to make available, at low cost, large digital memory systems on a single chip. Television engineers quickly perceived that, using these memories,

Author **Hurst** is Administrator, Broadcast and Technical Training, RCA, Camden, NJ.



they could store and manipulate the TV signal in ways heretofore impossible. Time base correctors, frame store synchronizers, and even more advanced equipments were immediately envisioned.

Of course, there was—and is—a catch. In order to store a TV signal in a digital memory, it must be converted to a digital format. This, then, was the catalyst that re-kindled interest in digitizing the video signal. As engineers realized that the admission ticket to these digital memories was the digital encoding of the TV signal, they dusted off the old papers and patents on digital TV and began applying these techniques to the new chips and circuits. The result, as almost everyone knows, is a wave of time base correctors and frame store synchronizers; devices which use digital television technology to do things which before had been undoable or at least impractical. And these equipments are merely the fore-

Impact of LSI

As pointed out in the accompanying article, the reawakening of interest in the quarter-century-old techniques of digital television was triggered by the availability of low-cost, high-density LSI memory chips. These chips have made it quite reasonable to do things that would have been wildly impractical in earlier eras. For an amusing example of just how impossible some of our present accomplishments would have been using yesterday's technologies, consider what it would have meant to build a digital memory for a frame store synchronizer in 1950.

In a frame store, the basic element which stores the television picture is some type of binary storage element. In 1950, our choice of storage element would likely have been a vacuum-tube flip-flop, using, for example, the venerable 12AT7. Each 12AT7 could store one binary digit. But a television frame is comprised of 3,145,728 binary digits—even if we don't store the blanking intervals! This means that, for the storage alone, our 1950-model frame store would require 3,145,728 12AT7's!!

If your hair is slightly gray around the edges, you may recall that a 12AT7 requires 1.89 watts of heater power, and will typically draw another 1½ watts in its plate circuit, for a total of 3.39 watts per 12AT7. But for over 3,000,000 12AT7's this yields a power requirement of 10.66 megawatts . . . and this is for memory alone with no peripheral equipment!! And of course, you would need another 10 megawatts for airconditioning! With numbers like these, the starting point for the construction of a frame store would be the damming of the nearest large river!

The size of a vacuum-tube frame store would be equally outlandish. If you estimate that you could crowd 300 vacuum tubes into a single rack, then 10,485 racks would be required to house the memory. Allowing 9 square feet for each rack and its service space, over 94,000 square feet of floor space would be required—about the size of two football fields!

And cost? By the most conservative estimates, the price tag on such a monster would exceed \$200,000,000 each . . . if built in shop order quantities of 50!!!

By contrast, today's frame stores draw about 500 watts . . . not 20 megawatts; need 8¾" of rack space . . . not two football fields; and cost in the vicinity of \$50,000 . . . not \$200,000,000!

And this semi-miraculous accomplishment is directly attributable to the availability of 4,096 bits of storage (13.6 racks of 12AT7's) on a single 16-pin DIP package!

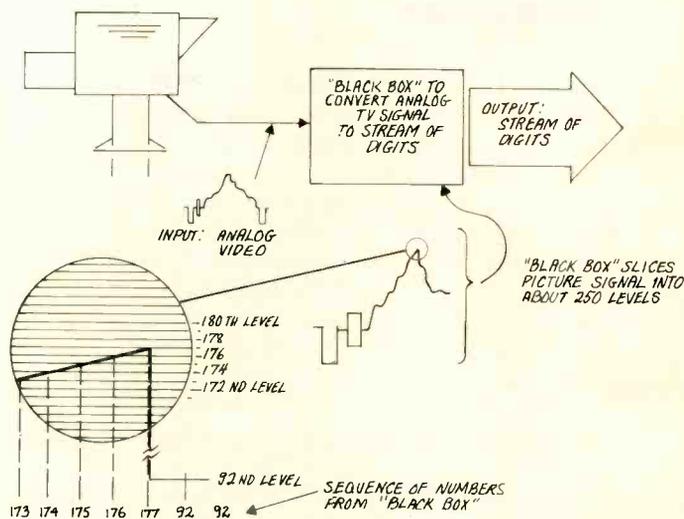


Fig. 1: The basic concept of digital television. A standard analog signal from a camera is passed into a "black box" which slices the signal into about 250 levels, assigning a number to each level. As the signal passes through these levels, the appropriate number appears at the "black box" output.

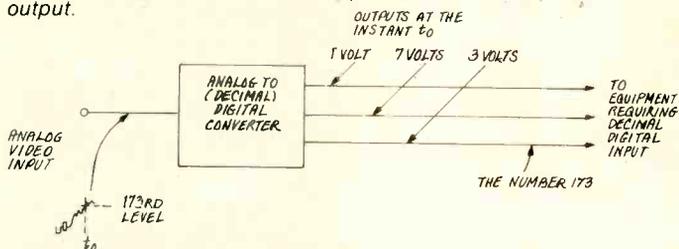


Fig. 2: A hypothetical decimal-based analog-to-digital converter, in which the three decimal digits are made to appear at the output in the form of voltages representing the magnitude of each digit. Three wires are needed, one for each of the three (decimal) digits.

runners of a great number of new devices based on digital television technology and its unique capabilities.

As these digital devices come into use, the people who use and maintain them must add to their store of knowledge a thorough understanding of digital television. It is to these people that this series of articles is addressed.

Basic Concepts: A Primer In Digital Television

The basic concept underlying the conversion of the familiar television analog signal to digits is illustrated in Fig. 1. In the figure, the television camera on the left supplies an analog signal to a "black box" whose task it is to convert the analog signal to digits. It does this by slicing up the signal into about 250 levels, assigning a different number to each level. As the signal passes through a given level, the "black box" causes the number corresponding to that level to appear at its output. For example, if the signal starts at the 173rd level, and passes slowly up to 177th level, and then drops sharply and holds at the 92nd level, the "black box" would produce the sequence of numbers 173, 174, 175, 176, 177, 92, 92, 92 . . . Since this "black box" converts an analog signal to a digital signal, it is known as an *analog-to-digital converter*, or *A-to-D converter*.

However, the idea of a "box" whose output is a number is a foreign concept to a great many television engineers. We conceive of currents and voltages as outputs; how do you envision a *number* as an output?

One way to make a box output a number would be as

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Digital Primer

shown in Fig. 2. If we wish to make the number "173" appear as an output from the A-to-D converter shown in the figure, we can bring three wires out of the box and cause 1 volt to appear on the top wire, 7 volts on the middle wire, and 3 volts on the bottom wire. These three wires could convey 173, or any three-digit number, to some subsequent equipment requiring digital input. But, although this would be a digital system, it would be a *decimal* digital system. Since the digital memories we wish to use are *binary* digital devices, the A-to-D converter should produce *binary* numbers at its output. For example, the number 173 in binary form is 1010 1101, and the block representing an A-to-D converter producing this number is shown in Fig. 3.

Note that while the *decimal* A-to-D converter supplied its digits on only *three* wires, the *binary* A-to-D converter requires *eight* wires to output the same (equivalent) number. Each of these eight wires conveys one of the *binary digits* of the number; that is, each wire

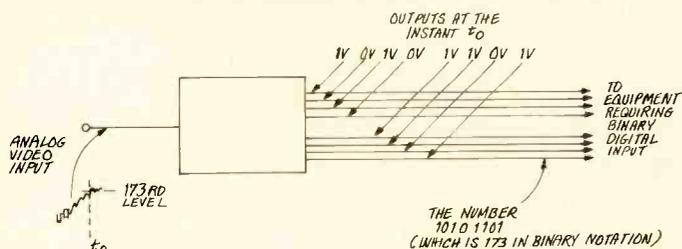


Fig. 3: An analog-to-(binary)-digital converter. Eight binary digits, and hence eight wires, are required to send in binary form the numbers needing only three wires in Fig. 2.

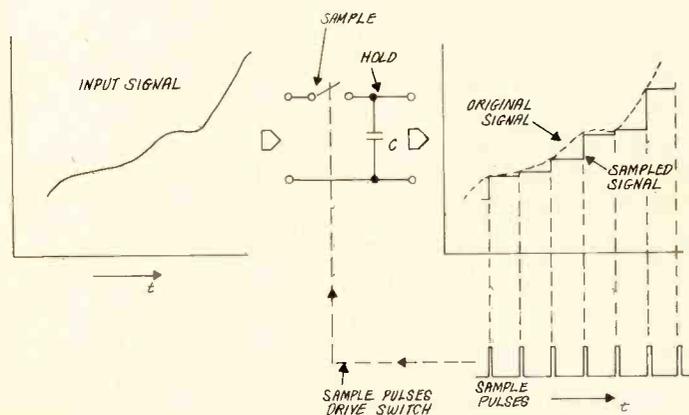


Fig. 4: A sample-and-hold circuit, which converts the smoothly-varying analog signal to a series of steps. During the "treads" of the steps, the A-to-D converter can get a good look at the signal, in order to perform its conversion accurately.

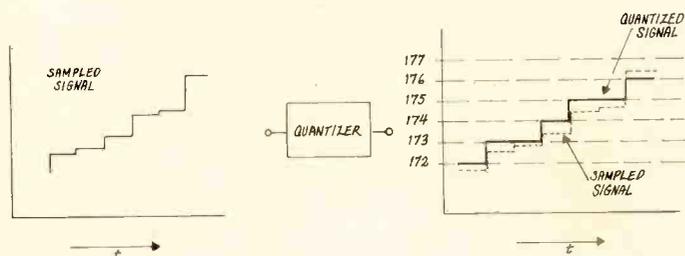


Fig. 5: Since only a finite number of levels are allowed in a digital system, a quantizer is employed to convert the random levels from the sampler to a sequence based on the allowable levels.

conveys a *bit*. With the eight wires, any number from 0000 0000 to 1111 1111 (that is, in decimal notation, any number from 0 to 255) can be delivered by this A-to-D converter. Since each number represents a different brightness level, an 8-wire (8-bit) digital television system can describe 256 (including zero) different brightness levels. Experience has shown that a typical picture passed through an 8-bit digital system gives a viewer no visible clue to its having been dissected into bits during transmission. We have therefore concluded that a brightness resolution of $1/256 = 0.39\%$ is more than adequate for present-day applications. Therefore, most present-day digital television systems are 8-bit systems.

An analog TV signal, being a smoothly-changing, continuous function, offers a theoretically infinite number of levels, or quantities, to the system using the signal. Digital television, by its nature, must limit these quantities to a finite number, such as 256. The act of slicing up the signal into these levels is called *quantizing*, and is one of the major functions of an A-to-D converter. Another major function is *sampling*, and, as we shall show, this function is absolutely as essential to digital television as is quantizing.

Sampling The Signal

The television signal emerging from a camera or other signal source is a smoothly-varying signal having an infinite number of possible levels. It is, in brief, a normal analog signal. An A-to-D converter given the task of quantizing such a signal is faced with a problem. Since the converter takes a definite amount of time to determine each brightness level and convert it to a number, it may become confused if the brightness level continues to change while it's trying to measure it for conversion. We therefore include circuits in our A-to-D converters which *sample* the signal at some instant and hold that sampled value while the A-to-D converter does its conversion. This is illustrated in Fig. 4.

The figure shows a narrow sampling pulse driving an electronic switch, causing it periodically to connect capacitor C to the input signal for a very brief period of time. While the capacitor is connected to the input, it charges very quickly to the value of the signal at the instant of switch closure, and holds that value during the time the switch is open. The result is the stepped or staircase waveform at the right of the figure. Since the signal is unchanging during the "treads" of the staircase, the A-to-D converter's quantizing circuits can easily perform their quantizing function during these non-varying periods, and the converter can convert the input signal at the time of sample to a definite number at the converter's output.

Sampling Rate

But, how often should we arrange to sample a signal? If we sample too infrequently, we may miss some of the rapid variations in the signal. On the other hand, if we sample too often, we will generate bits at such a high rate that the bandwidth required will be excessive, and the A-to-D converter and its ancillary equipment may become very difficult to make.

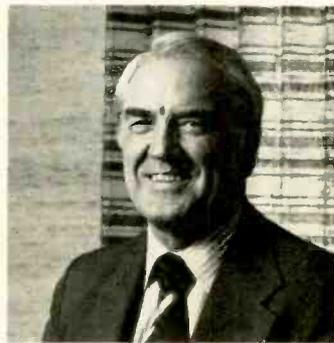
It has been shown, with mathematical rigor, that if a signal whose highest frequency is f is sampled at a rate of at least $2f$, then the original signal can be accurately

continued on page 52

WFRV-TV, Green Bay, Wisconsin goes Harris with two TC-80 live color cameras

"We wanted the most advanced live color camera on the market, and that's what we got with our TC-80s. Both cameras are performing beautifully, and the 'futuristic' design guarantees that they will not be outmoded in a couple of years. Also, with these cameras, we have the option of going triax if it's needed later."

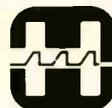
Robert O. Southard
General Manager, WFRV-TV



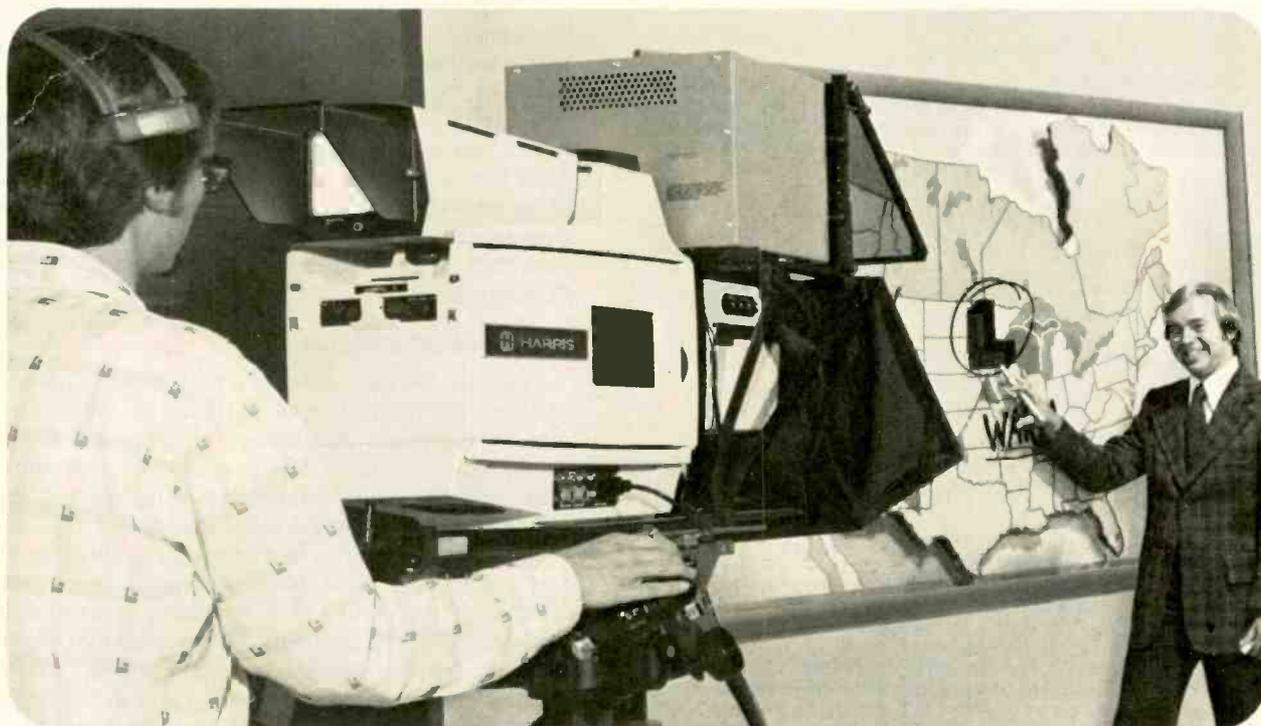
"A lot of things impress me about the TC-80. The excellent picture quality, of course. The stability. The colorimetry. And the way we can set up and control our TC-80s from the CCUs. I like the mechanical construction of the TC-80 head, too--the boards are large, on a vertical plane and run very cool. And the extender boards make maintenance a snap."

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reconstructed from the samples; that is, no information is lost in the sampling process. This means that if our familiar 4.2-MHz-wide television signal is sampled at an

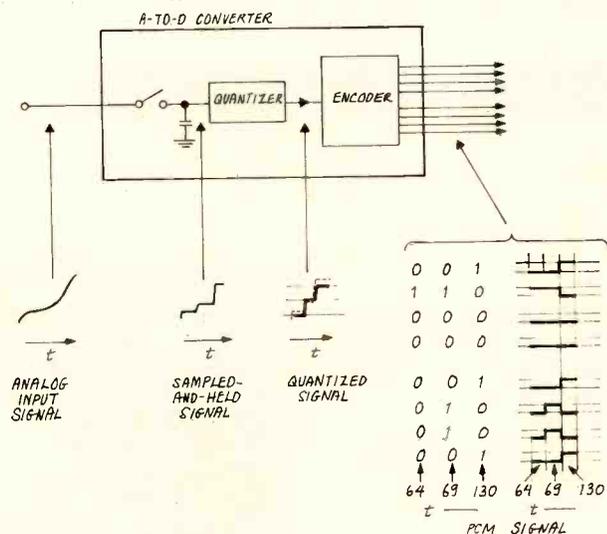


Fig. 6: A complete A-to-D converter, showing the signal at various stages in the conversion process. The resulting PCM signal is shown in both numeric and waveform formats. The sequence of numbers represented is 64, 69, and 130.

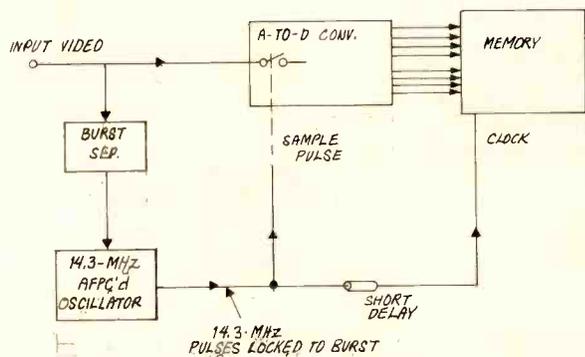


Fig. 7A: The input side of a digital time-base corrector using digital techniques. Since the sample pulse and the clock are both derived from the input signal, the pattern stored in the memory will be independent of jitter. See Fig. 7B.

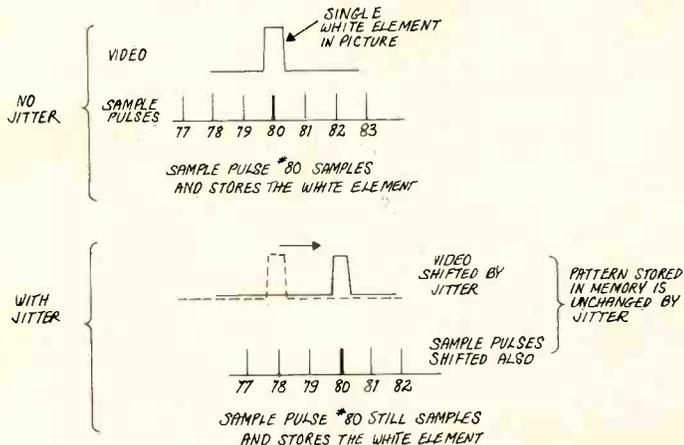


Fig. 7B: Since the sample pulses are tied to the video, any jitter in the video will be reproduced in the sample pulses. Therefore, any given element will always be sampled by the same sampling pulse, regardless of jitter, and stored at the same point in the memory. This constant memory pattern is the basis for time base correction.

8.4-MHz (or greater) rate, we can reconstruct from the samples every fine detail of the original signal. But, as with many matters purely mathematical, there is a difficulty. As we shall show more clearly later in this series, the reconstruction involves a careful filtering of the sampled signal, and when the sampling rate chosen is precisely the minimum required by the math, the filter used must have infinitely steep skirts! Since such a filter is a physical impossibility, it is normal practice to allow for the roll-off of a practical filter by increasing the minimum sample rate by about 20%. This raises the 8.4-MHz theoretical minimum to a practical 10^+ MHz minimum. We therefore conclude that the lowest possible sampling rate for a standard broadcast television system is just over 10 MHz, or one sample every 1/10th microsecond.

Subcarrier Considerations

When the signal to be sampled and encoded is a color television signal, there is a very strong 3.58-MHz component in the signal, arising from the color subcarrier and the chrominance sidebands. Experience has shown that the problems of sampling and filtering are considerably eased if the sampling rate for color television signals is made an integral multiple of the subcarrier frequency. Since twice the color subcarrier is only 7.16 MHz, we reject this integral-multiple sampling rate as being too low, but *three* times the color subcarrier is 10.7 MHz, which is just above the 10-MHz practical minimum discussed earlier. Consequently, many digital TV equipments have been built employing this sample rate. However, several well-known equipment manufacturers have recently begun supplying equipment operating at a sampling rate of *four* times the color subcarrier, or 14.3 MHz. Although this rate requires the use of more precise and exacting design techniques, the improved video performance is apparently deemed worth the extra effort by these manufacturers.

The sample-and-hold process, then, seizes a sample every 0.1 microsecond (in 10.7-MHz sampling) or every .07 microsecond (in 14.3-MHz sampling), and, holding this sample, presents it to a quantizer to have one of 256 levels assigned to it. The process can be depicted as shown in Fig. 5.

These quantized levels are then presented to an encoder, which converts them, in sequence, to a train of 8-bit binary numbers which are fed out from the converter on 8 separate wires. (See Fig. 6). When the television signal has finally been converted to this digital form, it is said to be a *Pulse Code Modulation* signal, or *PCM* signal.

Using The PCM Signal

Thus far, we have described only the generation of a PCM signal from an analog signal by the use of an A-to-D converter. At the time of writing, the most common use of this PCM signal consists of feeding the eight output wires in parallel into some form of digital memory, as shown in the block diagram of Fig. 7.

In this figure, we show a four-times-subcarrier (14.3 MHz) sampling pulse being generated by separating burst from the input video and using it to lock up a 14.3-MHz AFPC'd oscillator. The pulses from this oscillator are used to sample the input signal, and these samples are converted to PCM and sent to the memory. The same sample pulses are also sent to the memory (and

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Education In Digital Technology Available To Broadcasters

By Bill Long and Don Borchert. Long is Associate Professor, Dept. of Engineering, University of Wisconsin; Borchert is Director of Engineering, WHA, WHA-TV, University of Wisconsin.

Digital electronics—devices and signal processing techniques—is making a significant impact in the broadcast industry. Discrete components and analog circuitry are rapidly giving way to large scale integrated circuits (LSI), microprocessors, semiconductor memories (ROMs, RAMs), and other black box devices. Broadcast engineers are accustomed to having in-depth knowledge of the functional circuitry in their equipment, whether for specifying and purchasing or for maintaining this equipment. As equipment manufacturers incorporate more and more "black box" circuitry, the technology gap becomes increasingly troublesome to the user.

Concern about the effects of this technology gap prompted the engineering staff of WHA-TV, the University of Wisconsin-Extension television station, to approach the Electronic Media Programming Unit, Department of Engineering, University of Wisconsin-Extension, and request that a digital electronics course be developed to update their technical personnel. To assure that a course could be matched to the needs of the broadcast engineer, an advisory committee was formed comprising representatives from commercial and education stations, equipment manufacturers, and faculty from the Electrical and Computer Engineering Department, University of Wisconsin-Madison. This committee strongly felt that a widespread need for such a course existed. Several course formats were proposed, and 200 midwestern television stations were surveyed to determine their need for and willingness to participate in the project. More than half of the stations responded. In answer to the question "Do you find that you or your top level engineers/technicians have some difficulty with the new "digital technology" which is becoming predominant in the latest equipment?", 37 percent replied "Yes, quite a lot," 50 percent replied "Yes, some," and 4 percent replied "No, not at all." A strong preference was expressed for a video cassette correspondence study format with laboratory exercises. Many smaller stations commented that they were unable to send personnel to a short course held on campus, and thus only a correspondence course could be of use to them. The Broadcast Engineering Education Advisory Committee recommended that the course be developed, with all material to be approved by the committee. A pilot tape was distributed, and, as a result of the favorable response to the pilot tape, the entire course was developed and is now available.

Digital Technology for Broadcast Engineers comprises 24 half-hour color video cassette lessons, a three volume 740 page study guide including homework and laboratory exercises, a laboratory kit including a specially designed printed circuit board and 30 integrated circuits, and a computer-based grading system. The course is written and presented by Professors Donald L. Dietmeyer and Allan K. Scidmore, Electrical and Computer Engineering Department, University of Wisconsin-Madison. The tone of the lessons is conversational in nature, with demonstrations included to stimulate the student's interest. Emphasis is on the logical development of circuits, and mathematics are handled at a level which avoids calculus and derivations.

The course is divided into three parts, and an examination must be passed for each part. The complete course outline is as follows:

PART I—LINEAR AMPLIFIERS

1. Basic Transistor Amplifiers
2. Transient and Frequency Response

3. Characteristics of "Linear" IC Amplifiers
4. Applications of "Linear" IC Amplifiers
5. Frequency Response
6. Waveform Generation via RC Timing
7. Waveform Shaping

PART II—DIGITAL LOGIC

8. Digital Amplifiers
9. Logic Primitives: AND, OR, NOT, NAND, NOR
10. Boolean Algebra
11. Analysis of Combinational Networks
12. Karnaugh Map Simplification
13. Analysis of NOR/NAND Networks
14. Families of Digital Integrated Circuits
15. Binary Representations of Numeric Information
16. Encoding, Decoding and Multiplexing
17. Arithmetic Networks

PART III—MEMORY CIRCUITS AND DIGITAL SYSTEMS

18. Types of Flip Flops
19. Analysis of Synchronous Sequential Networks
20. State Models of Sequential Circuits
21. Counters
22. Registers
23. Memories
24. Digital Systems

The advisory committee felt that while the expressed need was for technical updating in digital electronics, the material on linear amplifiers in Part I was essential for two reasons. First, many broadcast engineers still work in a "Linear" world and need an understanding of operational amplifiers, active filters, waveform shaping, et al. Second, one can only appreciate the power of digital electronics by comparison with the analog circuitry of the previous generation. Interestingly, students find the material in Part II, Digital Logic, much easier than that of Part I.

A most attractive feature of Digital Technology for Broadcast Engineers is its cost effectiveness. The course fee is \$480 for the first student at a station or in a single-ownership group, and each additional student is \$170. The unusually low fee structure is achieved by having the broadcast stations copy the video material on their own tape stock and return the original cassettes to the University of Wisconsin. This cost compares extremely favorably with the per-student cost of an equivalent three-week on-campus course, \$1050 not including travel and living expenses plus time away from the job.

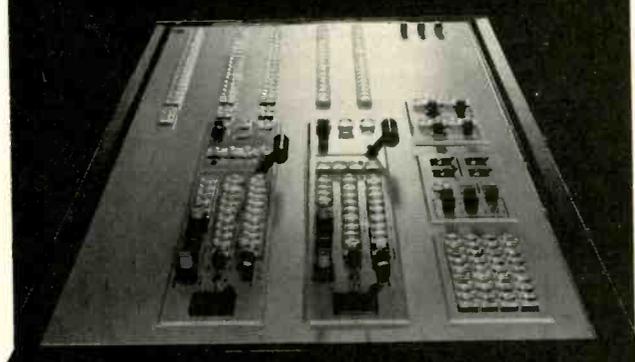
Response from the broadcast industry in the eight months that the course has been available has been very positive. Presently 80 stations have enrolled 300 students. The largest group, 30 students, is with the Jefferson-Pilot Broadcasting Company, Charlotte, North Carolina. The most remote station is KVZK-TV, in Pago Pago, Samoa. Radio stations and equipment manufacturers are also enrolled. Some of the students find the rigor of a structured course difficult to adjust to after many years away from school. But John Parker, WIS-TV, Columbia, South Carolina writes "I am enjoying this course very much. It covers a subject outside my previous experience even though I have been in broadcasting for more than 30 years and in television for the past 20. I expect to be able to put the knowledge gained to practical use soon as we will be getting a new transmitter in the near future."

Woody Crane, at WGN-Chicago, comments that he has particularly enjoyed the video cassettes, and that the lesson material is explained very clearly. Murray Clawson, a broadcast engineer with State Farm Insurance Company's audio visual services group, Bloomington, Illinois, is well into the third part of Digital Technology for Broadcast Engineers. He mentions that he has learned a great deal from the course, even though he has had considerable experience with digital electronics.

Further information about Digital Technology for Broadcast Engineers can be obtained from the Electronic Media Programming Unit, Department of Engineering, University of Wisconsin-Extension, 432 North Lake Street, Madison, Wisconsin 53706. A pilot tape, including excerpts from several lessons, and a sample study guide are available.

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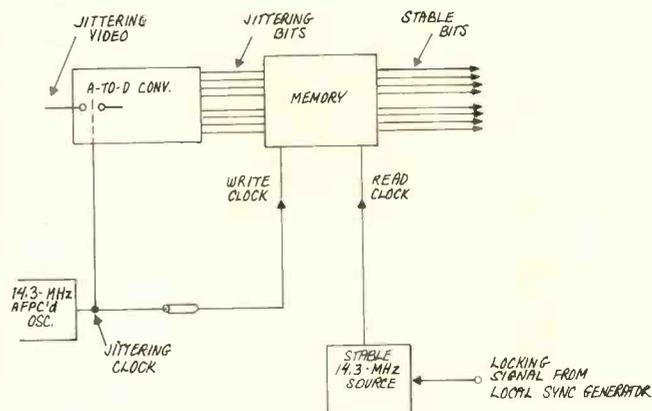


Fig. 8: Extracting the stored memory pattern with a stable clock results in stable video, regardless of the jitter which may have afflicted the input signal.

are then called *clock pulses*) to tell it to seize and store each group of 8 bits (called a *byte*) as these bits emerge from the A-to-D converter. The successive bytes are therefore stored in successive locations in the memory, by a means which we won't explore till later in this series.

The usefulness of this configuration becomes apparent when you consider what happens if the input signal is jittering. If we assume that the time constant of the AFPC'd oscillator is fast enough to allow it to respond to and follow the jittering input signal, the 14.3-MHz sample pulses and clock pulses will jitter in step with the video. This means that if an element or a line in a picture is, say, a little late in arriving, the sample pulses that sample it will be equally late. If the picture is early, the sample pulses will be equally early. Consequently, the picture elements are sampled identically, whether they are early, late or on time. The 8-bit byte coming from the A-to-D converter is the same, no matter what the jitter, and the bytes stored in the memory are therefore the same for jittering or non-jittering conditions.

If we now extend Fig. 7 as shown in Fig. 8, and read the memory with a stable, non-jittering 14.3-MHz pulse, the successive bytes read from the memory will be just as stable as the 14.3-MHz pulse which plucks them from the memory, *regardless of the input jitter*. What we have diagrammed and described, therefore, is a time base corrector, which can receive jittering video at its input, and provide non-jittering video at its output.

Converting Digits Back To Analog

Fig. 8 is somewhat incomplete, however, since the TBC's output was left dangling in PCM form, from 8 wires emerging from the memory. To complete this system, we must feed these wires into a box which will convert the digital signal back to the analog format. Such a device is called a *digital-to-analog converter*, or *D-to-A converter*. The addition of this essential element is block diagrammed in Fig. 9. In its simplest form, a D-A converter consists of eight resistor networks which attenuate the eight bits in accordance with their relative importance, or significance. This is shown conceptually in Fig. 10. The top-most, or most significant bit, is at-

tenuated 2:1; the bottom-most, or least significant bit is attenuated 256:1, with the intermediate bits being attenuated as indicated in the figure. The output of these attenuators is summed and becomes the re-created analog signal. The D-to-A converter is therefore the "numbers-in/picture-out" counterpart of the "picture-in/numbers out" A-to-D converter at the input to a digital system.

Next In This Series . . .

This far in this series we have done only what a primer should do, by presenting in very broad-brush terms the basic outlines of what digital TV systems are, why they are used, and what can be done with them. Subsequent articles will offer more detail. For example, the next article will dig more deeply into types of sampling, the

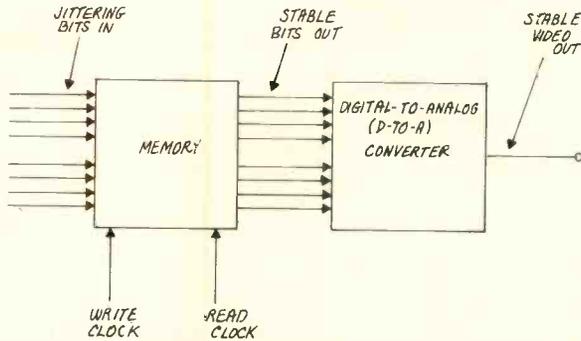


Fig. 9: Converting the bits from memory back to analog video, using a D-to-A converter. This box is the "numbers-to-picture" counterpart of the "picture-to-numbers" A-to-D converter on the input of the system.

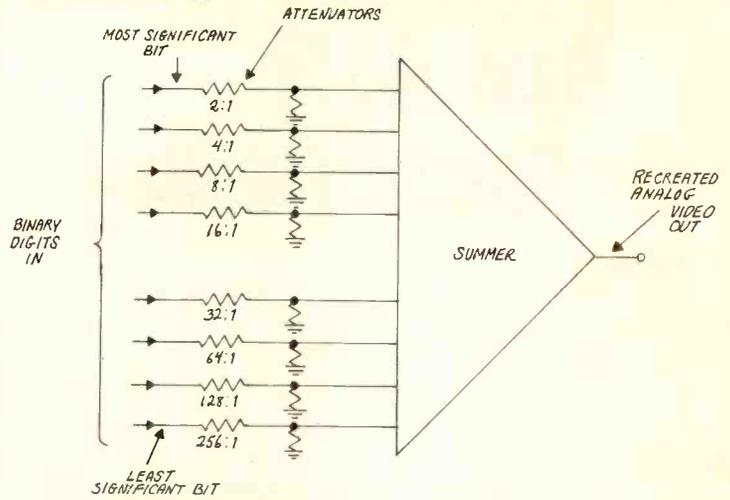


Fig. 10: Conceptual presentation of a D-to-A converter. Each bit is attenuated in accordance with its relative importance (significance) to the original signal, with the most significant bit (MSB) being attenuated the least, and the least significant bit (LSB) being attenuated the most. The sum of these attenuated bits is the recreated analog video.

spectra that they generate, and the frequency-response modification that results from sampling, and how it must be compensated. The same article will talk about A-to-D and D-to-A converters in more detail.

In the third and final article, the nature of the PCM signal will be discussed, memories will be explained, and a brief insight into digital filtering will be offered.

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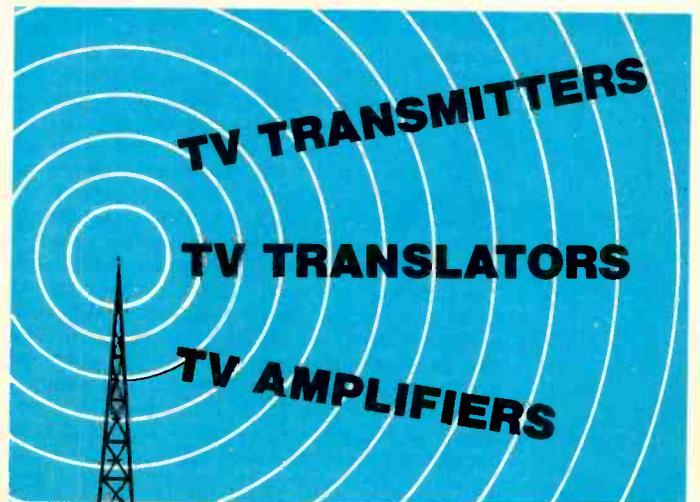
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New Audio Tape Machine Delivers "Digital Fidelity"

Some of the distortions still clinging to audio tape recording can be totally eliminated, nearly all the rest brought extremely low, by recording in digital form, using the latest, best A/D and D/A converters, sample-and-holds, and other very recently improved design elements. Here is how Soundstream, Inc. will do it in a machine reaching the market soon after this article sees print. Such a tape machine is an essential first unit in the all-digital sound processing system, a revolution moving surely toward us.

THE DIGITAL AUDIO TAPE RECORDER has been regarded for so long as "blue sky" that we are in danger of not paying close attention to its actual arrival.

That would be a serious mistake because the real digital audio tape recorder, right now about to come on stage, does apparently deliver the advances that have long excited us as possibilities.

What seems to be the first machine of the type aimed to fit right into professional recording and lift the fidelity to the full digital potential will be marketed early this year by Soundstream, Inc. of Salt Lake City, according to that firm. Here are some important characteristics claimed which will quickly give meaning to "digital fidelity":

Harmonic distortion: Unmeasurable (below noise floor) from DC to 5 kHz; typically -86 dB from 5 kHz to 30 kHz.

Signal-to-noise: Typically better than 86 dB, DC to 30 kHz.

Wow and flutter: Unmeasurable—time base reestablished in playback by a crystal clock (see below).

Frequency response: Really flat from DC (if wanted) to 15 kHz, 18 kHz, 20 kHz, user's choice, (with trade-off in slightly increased overall bandwidth).

Modulation noise: Unmeasurable.

Print-through: None.

Cross talk: Unmeasurable DC to 2 kHz; typically -85 dB or better relative to clipping level to 13 kHz.

continued on page 58

The Door Is Opening Wide To Digital Audio

Designers of video systems are moving to digital technology for compelling reasons, beautifully outlined by Robert Hurst in his introductory tutorial article elsewhere in this issue. Designers of audio systems are moving rapidly to digital techniques with virtually the same powerful motivations. Digitizing audio will bring advances fully comparable to those Author Hurst foresees for video technology and will also bring startling new ways of exploiting and handling audio program material, impossible with signals in analog form.

Freedom from noise and distortion, superior reliability, accurate reconstitution after transmission, "tweak-free" operation, the "prizes" Robert Hurst describes as drawing video designers into digital technology, are precisely the ones that audio designers expect to win through the successful digitizing of audio systems.

And the way has been opened for them, as it has for video designers, by the availability of large-scale, inexpensive memories in LSI form. These and other advances in solid-state techniques have, within the last two years or so, made what we can call "main stream digital audio" seem practical at last. The solid-state revolution has led audio system designers to attack the complex problems of analog/digital and digital/analog converters for audio signals of the highest fidelity. Digital audio at the top quality levels is far from easy, but its rewards are tremendous; the following articles outline those rewards in several areas of audio technology.

For example, the digital tape recorder described in the accompanying article, expectantly the first machine of that kind to reach the market, aimed directly at the

professional recording of music, embodies an old dream—getting rid of the inherent ineradicable noise and distortion of magnetic tape. Imagine what a technique that does not add up noise from one tape generation to another can mean to the recording industry! The system has other outstanding advantages as set forth in the article. The machine is promised for early this year; we can be certain that other digital tape machines will follow.

One reason for this assurance is the increasing availability of D/A and A/D conversion of highest fidelity quality. This is presently far-out designing and the industry is just getting mastery of it. Computer Labs, Greensboro, NC and Three Rivers Computer Corp., Pittsburg, are popular suppliers.

A cause for the difficulty of this art, and a prime difference between digital video and digital audio, is the much higher number of sampling levels needed in digital audio. As Author Hurst and the other writers on digital video point out, an 8-bit system, providing 256 sampling levels, gives acceptable video fidelity. An audio system needs 15 to 16 bits; the table in the following article on the tape recorder shows how the number of sampling levels and the dynamic range go up with the bits in the coding system. Essentially the difference lies in the ear's demand for noise and distortion to be 85 to 90 dB below the signal, whereas the eye is fully satisfied with a signal-to-noise/distortion ratio around 40 to 50 dB.

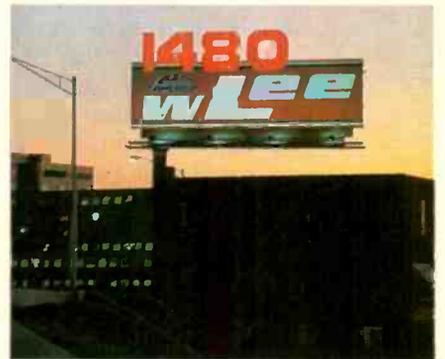
It is not an exaggeration to say we are headed toward a big revolution: the complete digitizing of audio, opening the way to handling, processing, altering, enhancing recorded sound in many ways that are now beyond our powers.



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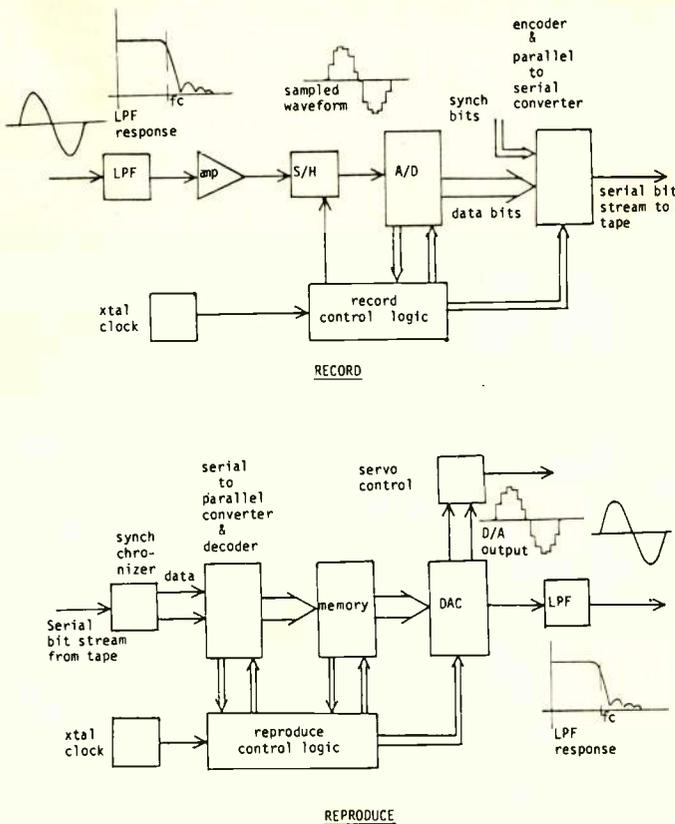


Fig. 2. Simplified block diagram of a single-channel digital tape recorder shows the record electronics (above) and reproduce electronics (below). Recent improvements and cost reductions in memories, sample-and-holds, etc., have made technique practical.

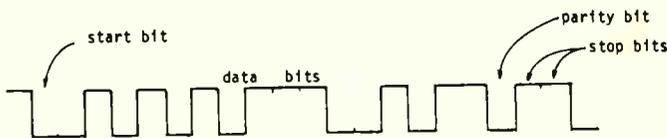


Fig. 3. Pattern of bit stream in digital tape recorder, showing start bit, data bits, parity bit and stop bit in one "word" of code.

That eyebrow-raising set of specs is claimed, of course, for a machine no one has had his hands on (as this is written) except the maker. But the logic of digital technology is such that we can be quite confident such performance, or something very close to it, is attainable today. Soundstream (and in particular its president, Thomas Stockham), has for a number of years been well established as a developer of digital audio techniques for specialized purposes. This gives preliminary plausibility to their breakthrough into professional recording.

How is it done? Digital audio technology is not easy—the system described by Soundstream is *far* more complex than a straight analog machine of best quality, and the design requires high sophistication in handling a dozen different requirements that do not exist in an analog system. For a detailed account of the main design considerations (which includes an excellent set of basic background references) *BM/E* strongly recommends a paper given by Richard Warnock, chief engineer of Soundstream, at the November, 1976 Audio Engineering Society Convention in New York, and available from the Society (60 East 42nd Street, NY 10017) as "Preprint No. 1169."

Here *BM/E* presents a very brief outline of the techni-

cal story, with emphasis on the *kinds* of things we must look out for, as other digital tape machines come along. But first we need a quick look at the question: Is all the effort worth it? "Unmeasurable" wow and flutter, for example, is considerably lower than what we have long thought of as "inaudible wow and flutter" (traditionally, somewhere around 0.02% to 0.05%). The same brand of thinking applies to several of the other specifications.

We can't get a conclusive answer to this kind of question for some time. Extremely few people have heard a top-grade digital audio system so far. Those that have say the sound has a "crispness and clarity" they never heard before. Guided by past audio history, we may guess that there *are* one or more factors in digital's super-low distortion that can be "heard" once we have that kind of sound to teach us how to listen. It will be fascinating to try to analyze what those factors are, once digital recording is widely available.

The digital fidelity level will be important in professional recording in another way: it will, for all practical purposes, eliminate the "generation gap." Programs can go through a number of tape generations with imperceptible quality loss. Noise does not build up at all; the signal-to-noise margin is created afresh each time the signal goes through the D/A converter. This should make digital audio strongly attractive to the recording industry.

For a longer future, a top-grade digital tape machine is an essential unit in a larger operation, the all-digital sound processing and handling system that we can see on the way. All-digital editing will have ease, flexibility and sureness leagues beyond the razor-blade-and-tape system we have all grown up with. Digital mixdown (not just digital control of analog mixdown, but full conversion of the signal to digital form) will also outdistance by far, in ease, and resourcefulness, the systems of today. Processing of the audio signal in a dozen different ways becomes easy, efficient.

All these operations, and others, depend on the ease with which signals can be handled once they can be digitized and *stored*, for instant call up as wanted. The rapid development and cost reduction of high density storage systems, and the explosion of microprocessor technology for control, have made the all-digital audio handling system a surety for the fairly near future.

Coming back to the tape recorder we have now (or will soon), we note that a first basic for extremely low distortion is A/D and D/A conversion with a high enough bit rate. Soundstream uses 15 bits per sample, and this a *necessary* (though not a *sufficient*) factor in the distortion and noise specifications. The lower the bit rate, the higher the distortion and noise, as has been pointed out often in recent years.

The reason is readily understood. Each coded pulse is at its own discrete level and there will usually be a difference between the nearest coding level and the actual level of the analog signal when a sample is taken. As noted in the introduction to this series, this "quantization error" is inherent in the digital process; it produces not only "quantization noise" but intermodulation distortion. It can be brought low by using a large number of sampling levels, that is, by using a large number of bits

continued on page 60

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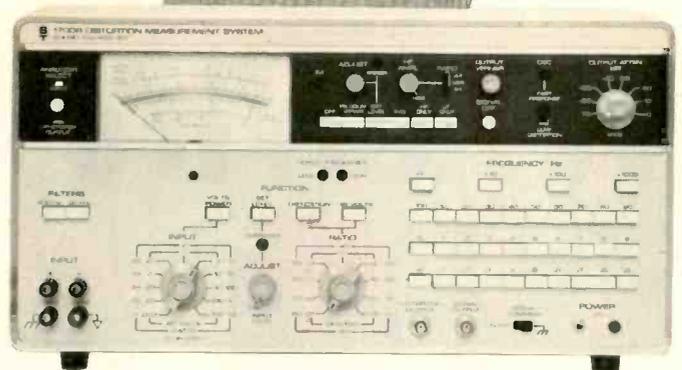
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Digital Audio

in the coding system.

The number of sampling levels goes up by two with each bit added to the coding system, as the following table shows:

Bits	Sampling Levels	S/N Ratio (dB)
8	256	48 +
9	512	54 +
10	1024	60 +
15	32768	90 +

Soundstream's 15-bit coding, in other words, supplies a basic, "digital" S/N ratio of over 90 dB, and distortion is similarly minimized.

Such a high bit rate does have a penalty. The overall bandwidth has to be very large. It depends in part on the coding system. The "non-return to zero" code used by Soundstream ends up by taking about 600 kHz on the tape. This bandwidth is assured by using an instrumentation-type recorder, with the tape moving at 30 ips. According to Soundstream, the recorder used makes it without strain.

Also contributing to the overall bandwidth is the *sampling rate*, another fundamental parameter of digital conversion. In theory, the signal will be perfectly transmitted through the system if the sampling rate is twice the top frequency in the pass band, or 30 kHz for a 15 kHz band. But this requires low-pass filters with infinite cut-off at the top frequency, the "Nyquist" frequency. To allow the use of realistic filters, Soundstream's sampling rate is around 20% higher than the theoretical minimum.

It is important to note that this is longitudinal recording, with the bits laid down serially in tracks along the tape. It is possible to use a videotape transverse system for audio. A machine of this kind is in an advanced stage of development by Nippon Columbia. Soundstream chose to use longitudinal recording mainly for compatibility with present day recording industry technology.

Although the tape is moving fast, physical size of the recording for a given amount of program is actually lower than in many analog professional recordings. The reason is that digital recording can be laid down to very narrow tracks, down to about 25 dB of signal-to-noise ratio, without compromising the fidelity. As already noted, digital recording is "regenerated" in the playback process and starts out fresh as far as signal-to-noise goes. Thus Mr. Stockham points out that his system easily puts eight tracks on a 1-inch tape, with full maintenance of fidelity. A 10½ inch reel gives four stereo passes of 30 minutes each. With careful design, the system could put up to 40 high quality tracks on 1 inch tape.

The converters need not only the high bit rate, but conversion time in the range of 4 to 10 microseconds. Such converters have been available only in the last few years. The sample and hold unit, which is essential to proper conversion, must also have extremely fast action.

The time base correction is accomplished by dumping the digits into a memory as they come off the tape in playback, and then "strobing" them into the D/A converter with a crystal clock, which has the same frequency as the original clock used in sampling. Thus the playback

When it's time to switch



timing depends, not on tape motion, but on the much more precise clock frequency.

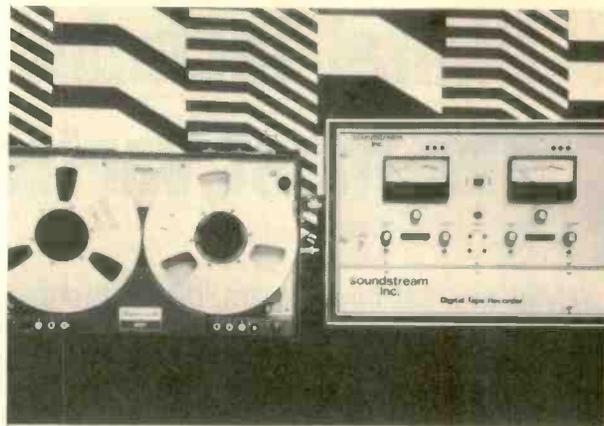
Modulation noise in audio tape recording is the result of small variations in tape to head spacing because of dirt on the head, and small variations in the thickness of the oxide, which vary the amplitude of the playback signal. These variations have no effect in digital reproduction because the amplitude off the tape depends on the coding; the amplitude of individual pulses is irrelevant as long as it is large enough to "trigger" the continuation of each pulse.

Phase distortion does not exist in the digital operation itself. It can be closely controlled in the analog sections at the input and output. Thus phase distortion is kept extremely low in the overall system.

Digital recording on tape is vulnerable to errors from tape imperfections, the principal one of which is "drop out." This is a serious source of distortion consisting largely of clicks and pops, and drop-out compensation must be used to keep it low. The Soundstream machine incorporates drop-out compensation.

There are a score or more of other specialized design requirements for a top-grade digital recorder as outlined by Soundstream, and these make the system, as already noted, much more complex than an analog recorder. However, there is one simplification achieved by the digital machine: it does not need a special noise reduction system, since the noise level starts extremely low and stays there.

This freedom from special noise reduction also has a bearing on the comparative cost of the system. Soundstream has told *BM/E* that the first "hand-made" two-channel machines will cost the buyer on the order of

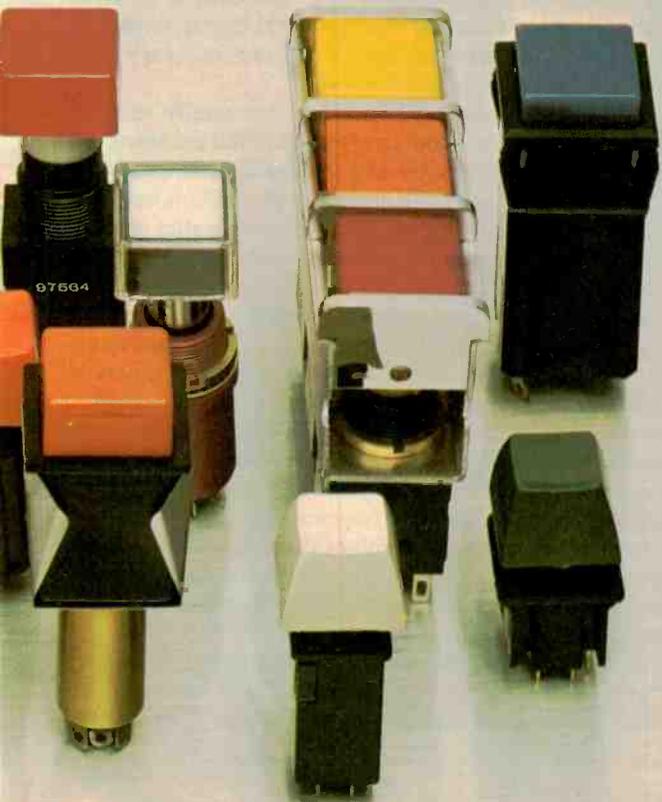


The new digital audio recorder from Soundstream eliminates the need for noise reduction systems as part of its digital benefits.

\$65,000; but that later models, with systematized electronic production, will be competitive in price with top-grade analog machines when noise reduction is added to them.

Finally, it is worth noting again that the system, as a longitudinal recording system, with the digits laid down serially, is fully compatible with present day audio recording, mixdown, and editing techniques. Soundstream says that all the main characteristics have been chosen to make the machine immediately usable by the recording industry. **BM/E**

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Digital Techniques Easily Produce The Most Varied Special Effects

By Richard Factor

In the last three years, digital techniques have tremendously widened the range of the "special effects" systems; today they can "twist" a sound into an endless variety of new forms. This article describes the main special effects devices, how they can give a broadcast "sound" a distinctive character, as well as grab listener attention, as needed, with the far-out and strange.

IT ISN'T UNUSUAL for a recording studio to spend 10 hours or more "mixing" a recording that will fill around four minutes of a broadcaster's air time. Mixing a whole album may take days.

Why? Because getting a "unique" sound is recognized as a vital objective in today's music merchandising. Listen to a good handful of the most popular recent records: each one is most likely to have some musical feature that makes it different. It may be an extremely catchy "hook" or special style of the performers or a section electronically processed to produce a startling effect, to make that record stand out from the thousands of auditory stimuli a listener gets every day.

Broadcasters are recognizing more and more that this principle applies in spades to the sounds they put on the air. A unique sound, a station "character," has become a widespread objective. "Special effects" are not only handy when a broadcast station is producing its own programs, but can also be used directly on the air—they can be applied with little or no time penalty.

If for program material, why not use them for DJ voices and station promotional material as well? And they are especially helpful for spots the station produces for local advertisers: a distinctive sound can go a long way in convincing a reluctant auto dealer or restaurant owner that he is getting something for his advertising dollar.

It is necessary to note that "special effects" covers an extremely wide range, from really far-out sounds—good for attention-getting, but not necessarily for day-in, day-out use—to subtle effects that can enhance a signal subliminally. And a valuable secondary function is the ability to vary the tempo (length) of material without affecting the quality: those 62-second spots can be put in their place.

The secret of much of this new signal processing technology is the use of digital techniques. In digital form, the signal can be stored, delayed, and processed in various ways without the distortion inherent in multiple passes through analog circuitry, and with versatility permitted by the ability to manipulate the time dimension as well as the more familiar amplitude and frequency manipulations of limiters and equalizers. This article is a brief compendium of some of the techniques, found interesting and valuable for production applications, which are particularly appropriate to broadcast use.

Perhaps the oldest, and certainly the most common of the special effects is the infamous "jet plane" sound prevalent in vocals, drum breaks, guitar solos, and soon, perhaps, entire orchestral recordings. "Flanging" is pleasant to listen to, distinctive, and fairly easy to produce. It is generated by the addition of a signal to its time-delayed replica. This introduces a periodic fluctuation in the frequency spectrum dependent upon the relative time delay—long delays cause many peaks and valleys in the spectrum, short delays generate few peaks.

Because these peaks are harmonically related, the effect can null a note and a whole series of harmonics, while leaving adjacent notes untouched. Varying the delay manually or periodically with musically rich material generates an unpredictable but almost always interesting variation on the original material.

In the prehistoric past (say, 2 years ago), the only method of flanging was the use of two tape machines running at slightly different speeds to produce the differential delay required. Flanging could also be simulated by *phasing*, a process employing analog phase-shift networks, but phasing is not as pronounced or as musically effective since the mathematical characteristics of the phase-shift networks assure that the frequency nulls will not be harmonically related.

Because the phasing effect was not totally satisfactory, and the tape flanging effect required extensive set up and multiple machines often unavailable in small production rooms, use of flanging for production has been limited, and use on the air (with the personality actually in control of the process) virtually nonexistent.

But flanging units are now available which can be connected directly in series with program material and allow real-time control over the effect. Packaged flanging units offer other effects as well: time delay variation, again under manual or automatic control, but without mixing with the original signal, produces a doppler shift, which can range from a gentle vibrato for enhancing musical material to a very good simulation of a 45rpm record a half inch off-center on the turntable. Feedback-flanging also involves variable time delay, and signal addition, but in this case the time-delayed signal is added to the delay line input so that the signal is recirculated through the delay line.

As the loop gain increases, the signal gets very "pingy" and hollow. This effect has not been as over-used and is not as instantly identifiable as flanging, and

continued on page 65

Mr. Factor is vice president, Eventide Clock Works.

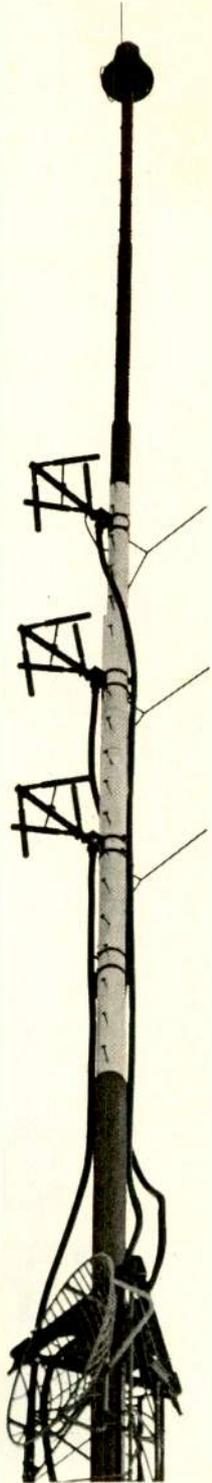
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Special Effects

can be used along with filters or equalizers as a "telephone voice" imitation, and a flanging variation. Other uses will suggest themselves to you when you've heard the effect.

It should be noted that many commercial flanging units use a hybrid technology: the charge-coupled device or so-called "bucket brigade" delay line to achieve the delay required. Bucket brigades resemble analog circuitry in that no digital conversion is required, and resemble digital circuitry in that discrete samples of the signal are stored in the integrated circuit, and these samples are "shifted" from one location to the next by a high-frequency clocking signal. The delay is determined by the shifting rate and the number of samples stored.

Because the signal is still in an analog format, there is a small deterioration of the signal as it passes through the IC, and the degradation increases as the number of stages increases. Thus, bucket-brigade technology at the present state of the art is excellent for the short delays inherent in the flanging process, good to poor for discrete delays and "doubling" signals, and woefully inadequate for long-term storage such as electronically replacing 7-second tape loop delays.

Delay

Flanging is the first of many examples of a control over time allowing one to modify audio signals. Flanging requires delays typically from 0 to 10 milliseconds. At these short delays, the ear does not perceive the repetition of the signal.

As already indicated longer delays need full digital techniques. As the delay is increased past 15-20 milliseconds, the listener is aware that the same information is being presented multiple times. This awareness can be conscious and deliberately induced, or it can be subliminal yet very effective in creating the illusion of spaciousness. Applications include the following:

Increasing Reverb Effectiveness: Many stations use reverb, either on all program material, or on the air personality's voice. This reverb is usually at a low level to prevent the listener from being consciously aware of its existence, but loud enough to create the illusion that the speaker is in a warm, reverberant room rather than an anechoic studio. The illusion can be enhanced by delaying the signal to the reverb unit by about 30-50 milliseconds. This simulates the natural reverb of physical rooms in which the first sound reflection takes about that long to arrive, after which the number of reflections builds up rapidly.

Increasing Vocal "Density": Delaying a signal and adding it to the original without reverb produces the illusion of multiple sources of the same signal, or more than one speaker, musician, etc. This illusion is particularly effective when used in conjunction with stereo transmission, as the "sources" can be separated in space as well as time. This effect is used in recording to convert a pair of violins to a complete string section, and can just as easily convert a single jingle singer to a chorus.

Generating "Pseudo Stereo" From Monaural Sources: It is possible to split a monaural signal into two compatible "stereo" channels using a small amount of digital or bucket-brigade delay and a very simple mixing network. The direct signal is fed into the left and right channel. The delayed signal is fed in-phase to, say, L,

and fed out-of-phase to R. You will recall from the discussion of flanging that this produces a periodic frequency response, and because of the phase reversal between L and R, signals that are out-of-phase and thus cancelled in the right channel will be in-phase and enhanced in the left channel.

Thus, a hypothetical swept frequency would appear successively in the left and right channel in the receiver. Since music is not normally composed of swept frequency tones, the source appears to vary between the left and right speaker depending upon frequency, presenting a broad front instead of a point source. It must be emphasized that this is *pseudo-stereo*. Individual instruments are *not* localized to L or R, but the signal sounds quite different from monaural material coming from two speakers. The beauty of this technique is that it is perfectly compatible. If L and R are added together, the delayed signal is added to itself 180 degrees out-of-phase and is completely cancelled, while the original signal is in-phase with itself and remains untouched.

Discrete Echo, "Tunneling": The digital delay line can produce more blatant effects such as discrete echo and "tunneling." Digital delay lines like the Eventide 1745M can delay the signal over a continuous range of 0 to 320 milliseconds (or more with reduced frequency response). It is thus possible to produce a discrete repetition of the input at a rather substantial delay. (If you don't think 320 milliseconds is a lot, listen to your voice after the delay and try to read a commercial without stumbling!).

"Tunneling" is a rather amazing effect obtained when a signal is recirculated through a digital delay line and the delay is cycled from maximum through zero. It is rather difficult to describe in words, but it combines in one effect all the characteristics of discrete echo, reverb, and flanging in a continuous sequence. Unlike flanging, it is very easy to overuse, but it is extremely distinctive and can be a cornerstone of a station identification program.

The unique ability to vary the delay over the whole range comes from the use of random access memories to store the digital signal. Tape delay parameters are limited by physical factors. Random access memories may store signal up to their full capacity but can be tapped anywhere, a process analogous to having an infinite number of heads along the tape path.

Pitch and Tempo Variation

Delay, a relatively simple process, does not show the full versatility of digital technology. After all, our computers wouldn't be very useful if, every time we put a number into them, they thought about it for a while and then gave us the same number back. Would they? No. In the delay line, we put in a number and get it back a bit later.

Let's try going one step further: put in memory a sequence of numbers representing a 30ms sample of signal. We can read them out at a different rate from the entry rate, raising or lowering the pitch of the readout. By reading out extended or overlapping segments of memory, it is possible to change pitch without changing timing.

And you can change timing without changing pitch, by speeding up (or slowing down) a tape for the read-in and then varying the read-out pitch in a precisely compensatory manner.

continued on page 66

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- * Direct replacements available for all diode rectifiers — no rewiring necessary.
- * Repairable — any component can be replaced easily.
- * 200% Safety Margin on Voltage — 300% on Current.
- * Fully Guaranteed.

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(215)497-5100

Circle 141 on Reader Service Card

Special Effects

The digital Eventide Harmonizer is one instrument designed for this application and it can vary pitch continuously over a full octave up or down. Doing this digitally eliminates all the familiar problems of mechanical systems for tempo and pitch change. Because the circuitry used for pitch changing duplicates most of the circuitry used for the less complicated delay function, it also acts as a dual channel digital delay line, or performs both functions simultaneously.

The possibilities of pitch changing/tempo variation are enormous. Recording/production applications include the automatic generation of parallel harmonies, doubling and thickening vocals with less precision and thus more naturalness than the fairly mechanical sounding delay line, getting separately recorded instruments in-tune with their mates, returning vocalists to the fold, and answering Alvin and the Chipmunks records. Broadcasting-oriented applications include the perennial problem of forcing spoken messages, both commercial and editorial into a 60 second time-slot. Promos can be sped up substantially, both to give the station a faster pace and to allow more time for music and paid commercials. With enough chutzpah, you should be able to cram about 25 hours into any given broadcast day!

Another unique set of special effects can be created with pitch change units: robotlike or extraterrestrial voices can be conjured upon demand. An air personality can talk to himself in two or more different voices. Feedback around a pitch change loop can generate musical or microtonal sounds from atonal sources.

Unfortunately, no pitch changer is perfect, and certain aberrations or "glitches" can be introduced into the processed signal. The severity and acceptability of these glitches are influenced by several factors, including the pitch ratio (smaller ratios work better), the nature of the program material (speech and fast-paced material is better than gospel vocals or organ recitals), and presence or lack thereof of additional material (correcting a single instrument in a multi-track mix is less obvious than correcting the completely mixed final product). For these reasons, it is impossible to predict the success of pitch changing in any given application. However, it works in enough applications to be very useful, and *always* works as a unique special effects unit.

Earlier in this article, I alluded to the use of digital delay to replace a 7 second tape loop. The reason there aren't a bunch of manufacturers offering such a device is that it is too expensive. Making one isn't the problem. At the present state of the art, you could get a broadcast quality (15 kHz) response unit with about 1.5 second delay for about the same price as a console model tape machine. You could get a 7 second voice bandwidth unit for about the same price. But if you need 7 seconds and full bandwidth, count on spending over ten kilobucks.

But tape machines will continue to creep up in price, while digital storage will galumph down. Coming up in 1977 and 1978 are 100 kilobit charge-coupled shift registers and magnetic bubble memories which may well be practical for long audio delays. It seems likely that the 7-second digital delay of broadcast quality will, before too long, be in the medium cost range. **BM/E**

In addition to the Eventide units mentioned, other major manufacturers are Lexicon, Inc., (who offers a variable speed change of recorded speech without a pitch change), MXR Innovations and EMT 250 Reverb System.

The 1480 Waveform Monitor looks like your faithful 529... Until you examine the features

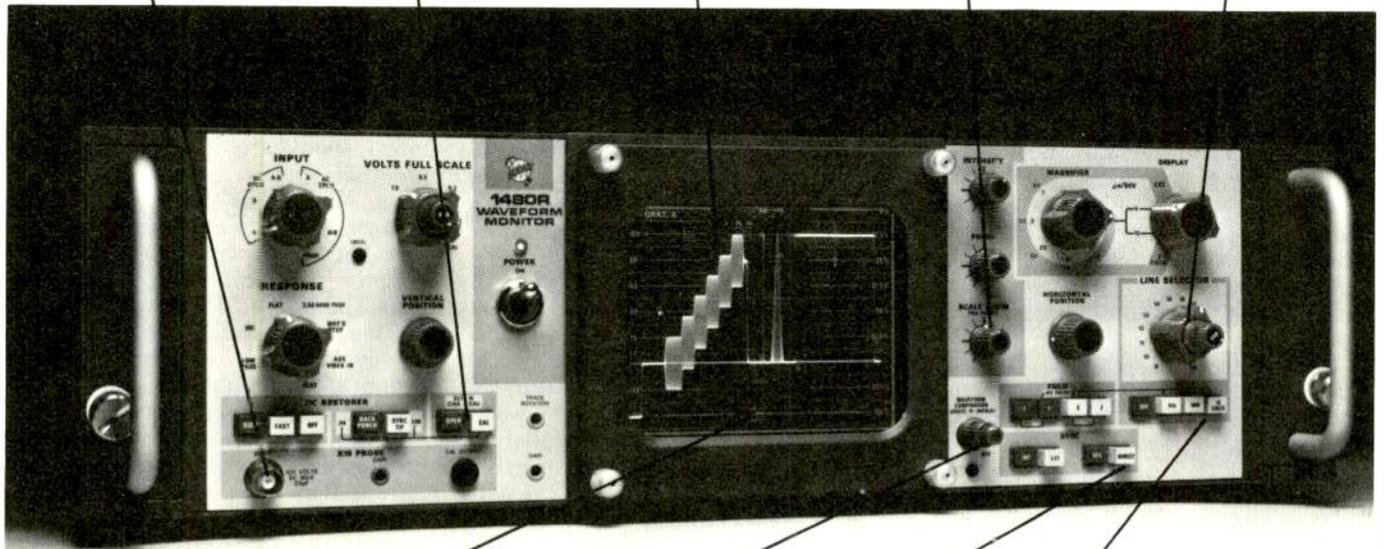
Probe Input option For high-impedance test points.

Display offset For level setting accuracy approaching 0.2%, offset the display of your signal with 1480's very accurate calibrator.

Bright CRT Bright enough to examine VITS without dimming the lights.

Two graticules Your choice of an internal or an external graticule is made with the scale illumination control.

Digital line and field selection For positive identification of signals displayed.



Automatic intensity change When you select a faster time base from the two-field mode, optimum intensity is maintained.

Comparison modes The 1480 will overlay portions of a signal for easier and more accurate comparison of levels.

Direct or AFC Sync Eliminates display jitter or displays jitter.

15 Line display This 1480 feature permits head-by-head VTR signal examination.

on rear panel

Auxiliary video input A special input/output circuit allows you to measure chroma/luminance gain and delay without disturbing your signal and for the use of special filters for unique measurements.

Line strobe In addition to having an auxiliary strobed video out for identification of individual lines on picture monitors the 1480 will strobe individual line vectorscope displays.

The TEKTRONIX 1480R Waveform Monitor does look like the TEKTRONIX R529; just as the half-rack width 1480C looks like the 529. But, there are differences. Some of them subtle, like the sharply focused trace on the bright CRT, others more conspicuous, like the optional input for use of a high-impedance probe. Some features won't be noticed until you examine the rear panel, like the line strobe output for strobing a vectorscope. This is a technique for intensifying individual line displays.

Yes, the 1480 Series Waveform Monitors are different, just as your measurement needs are different. Different from your needs in the sixties, when the 529 series was the high-performance monitor.

Write us, or you use the reader service number to get a series of application notes on the 1480. Better yet, contact your Tektronix Television Field Engineer.

He will be glad to show you the 1480 and its benefits.



TEKTRONIX®

committed to
technical excellence

Circle 142 on Reader Service Card

Plenty To See And Hear But Finding It Is Difficult This Year

Getting to the right place at the right time poses a problem at the '77 NAB Convention since activities spread to three hotels.

THE NAB ANNUAL CONVENTION has outgrown Washington D.C.—the traditional meeting place in presidential inaugural years. Thus taking in the 55th Convention, convening March 27 and running to March 30, will take some effort—and preplanning on the part of visitors. The nearly 200 exhibits are spread out over three hotels—the Shoreham, Sheraton Park and Washington Hilton (a bus ride away).

So that no one location gets favored over the other, the program sessions are divided up among the three hotels. That means you've got to plan your day with a little care or you're bound to miss something.

As we prepare this issue, it is a bit too soon to know what the convention holds in store in terms of specific speakers, specific new products, etc. We'll cover all that in our March issue (and in *BM/E's* special Washington D.C. Survival Guide that is being readied for distribution at show time). Nonetheless, we can alert you to a few things right now—likely hot products

and generally where they'll be (see exhibit maps).

In radio:

Automatic Transmitter Systems. Means of meeting the new FCC ATS rules will be stressed. Harris says this will be a key aspect of their exhibit. We can bet that others will do likewise.

Solid State Transmitters. Look for more companies to be offering all solid state transmitters.

Automation. With the advent of microprocessors anything and everything falls in the realm of possible. Look for more flexible, inexpensive approaches to automation. IGM will show a 1000-cartridge storage system made feasible through microprocessor technology.

Audio Processors. There are more limiters, compressors, limiter/compressors, reverb units, and special effects devices around than you can shake a stick at. We're certain next month's rundown of exhibitors and their products will turn up many you'll want to inspect.

In television:

More ENG. There will be modifications to existing cameras shown (new model numbers) and some brand new models. Philips is introducing a new modularized approach to camera design that is expected to impress broadcasters and the competition alike. Hitachi promises some surprises. GBC will be a new exhibitor featuring that unusually compact Toshiba camera that toured the U.S. in early 1976.

Rank will show its new Varotol Multi-Role Lens (MRL), meaning the same lens can work with both studio cameras and ENG cameras.

Digital Devices. To be sure, there will be the familiar TBCs and frame synchronizers but this year there will

be more. Grapevine has it that Grass Valley and NEC have teamed up to do something special. Special effects possible through manipulating digitalized video should be in the fore. Vital promises to wow us in this area and we're sure Digital Video Systems will be back with 3-D effects and more.

A hot new product employing digital processing will be a Noise Reducer from Thomson-CSF. This product will be the commercial version of the "Snow Remover" used by CBS Television at the Republican and Democratic Conventions this last summer.

Production Switchers/Post Production Editors. Last year saw a lot unveiled in these categories. Expect more this year. Last month Duca Richardson took an ad telling people to visit 529 at the Shoreham to see the Series 4000 switcher, "simply the most advanced production switcher ever created." Both switcher and editor manufacturers will put on good shows.

One-inch VTRs. Last year the surprise of the convention was the unveiling of quad quality one-inch helical machines by Bosch Fernseh, Ampex and Sony. This year IVC joins the ranks. This type recorder will get close scrutiny by visitors.

Microwave Advances. ENG applications keep the microwave pot boiling. We know Nurad has something new to show. You can expect more.

A lot of what will be shown at the Washington NAB will be production versions of last year's prototype surprises. *BM/E* takes a special look at how some of last year's innovations fared in the last 12 months in the section below. NAB Chicago '76—One Year Later.

Buyers interest high

What equipment are engineers and managers interested in? In television,

Relevant Programs

Technical sessions will include four very topical morning workshops in addition to dialogue with the FCC and the usual papers on technical advances. Mon., Audio Processing; Tues., AM stereo and ENG Labor Relations; Wed., SMPTE special.

There will be management workshops, too, on sales, promotion, EEO and a radio special run by RAB in addition to regular sessions. Will you be able to greet President Carter? There's been no confirmation regarding his appearance as we go to press.

it is still the ENG camera but portable recorders and videotape editors are only slightly behind. See Tables. The intensity of interest in ENG cameras is high since that was the single most frequent item written in on our questionnaire as of *greatest interest* in 1977. Cameras led by 2 to 1. After them came switchers and VTRs. Helical VTRs are of more interest than quads. Our table doesn't show it but engineers singled out helical/segmented types for close scrutiny (56%). There's high interest this year in still store devices and frame synchronizers.

Engineers seem somewhat blasé about character generators—only one-third mentioned them—but management is keen to study them more closely. Seven out of ten ticked off character generators of interest. Busi-

ness automation seems to be of minor interest but that is because the figures are skewed by engineers. One out of every three management types going to NAB is interested in business automation.

In radio, the standout product category is audio processors—perhaps *BM/E's* report in November hyped the interest. Whatever the impetus, when panelists wrote in the specific radio product of greatest interest, it was the processor, equalizer or a "good" limiter. A lot of managers mentioned FM equipment. Several were AM radio stations managers who have FM applications pending. Although the table of overall interest shows a declining interest in automation (presumably because so many stations already have such equipment), automation was

singled out by many as the single most interesting area to them.

Tape recording equipment and cartridge players are of high overall interest as in previous years. The only product to drop significantly in interest is EBS gear. This is to be expected since everybody has had to buy this equipment to satisfy FCC requirements. Perhaps it's significant that 10% will be looking at such equipment in Washington. Could be they don't like what they have . . .

Attendance to be down?

Despite the attractions planned by exhibitors and the program coordinators, attendance at Washington is not likely to match the record set last year at Chicago. Only 63% of *BM/E's* panelists said they were headed for the

Shoreham Americana



Exhibit Hall (75)

Exhibitors	Booth No.	Exhibitors	Booth No.
Amcomp	558	Datatek	553
Andrew	523	Datatron	531
Anixter-Mark	569	Dielectric Comm.	544
Audi-Cord	565	Digital Video Systems	513
Audio Designs & Mfg.	550	Duca Richardson	529
Automated Processes	509	Echo Sciences	536
Berkey Colortran	507	Eigen Video	563
Beston	504	Electrohome	512
BJA Systems	572	Electro Impulse	568
Cablewave	518	Electro Voice	546
Camera Mart	505	ESE	557
Cinema Products	503	Farinon	502
Communications Technology	559	Flash Tech.	554
Computer Magnetics	535	Gotham Audio	527
Comrex	570	IGM	538
Convergence	517	Ikegami	508
		Industrial Sciences	552
		Interand	560
		JVC	530

Exhibitors

Kings Electronics	555	Townsend Assoc.	519
Kirkpatrick	567	UMC	562
Laird	551	Video Aids	511
Lightning Elimination Assoc.	510A	Video Tape Co.	516
David Lint Assoc.	571	Ward-Beck	515
LPB	520	Wilkinson	500
L-W	566		

Ambassador Room (25)

MCI Inc.	562A	Audio Sellers Inc.	607A
Merlin Engr.	534	Beaveronics	610A
MixMix	547	California Switch and Signal	607
NEC	533	Comark	614
Rupert Neve	541	Concept Productions	615
Nortronics	522	Dolby	602A
O'Connor Engr.	573	Drake-Chenault	613
Orban Assoc.	539	Garner	616
Pacific Recorders	549	Leitch Video Inc.	613B
Paperwork Systems	542	Lipsner Smith	622
Potomac	524	Microprobe Electronics	613A
QEI	548	Nagra Magnetics	606
Ramko	564	Optek	603
Robins Broadcast	545	Otari	617
Rosco Labs	556	Philips Test & Measurement	605
Russco	514	Sansui	602
Scientific-Atlanta Inc.	526	Sescom	620
Sintronics	537	Shintron	601
Eric Small	540	Spindler & Sauppe	600
Sony	506	Technology Service	618
Sound Tech.	561	Telescript Inc.	611
Stanton	521	Tentel	604
Willi Studer	543	Terra Com	608
Taber	525	Trace Inc.	609
Telecomm.	510	Winsted Corp.	612
TV Equip. Assoc.	528		
TFT	501		

Washington Hilton

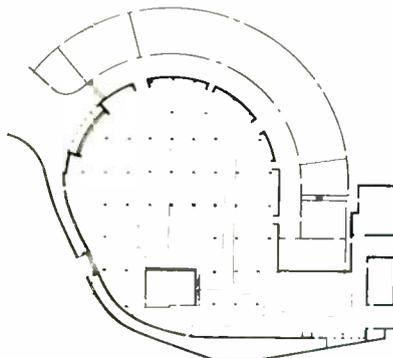
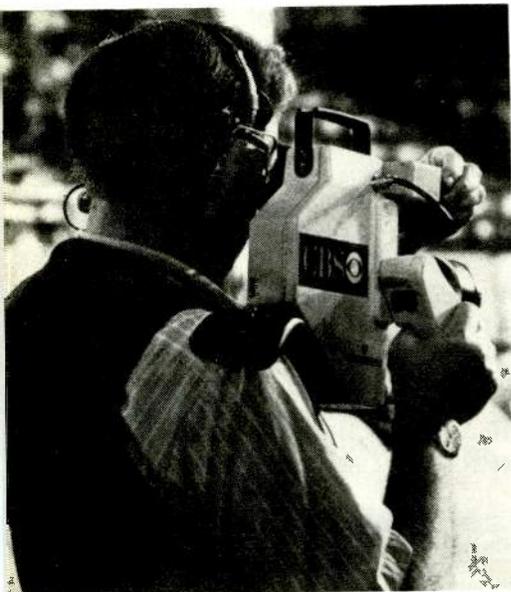


Exhibit Hall (36)

Exhibitors	Booth No.	Exhibitors	Booth No.
Angenieux	402	Olesin	423B
Asaca	424	Phelps Dodge	439
Auditronics	435	Q-TV	419
BCS/Kaman Science	425	Quick Set	421A
BIAS	422	Rank	409
Christie Electronics	433	RCA Broadcast	400, 400A
Cine 60	443	RCA Electro Optics	445
Colorado Video	437	Recortec	423
Computer Image	430	Strand	408
Conrac	404	Storeel	441
Cox Data	407	Tele-cine	423A
Dynair	403	TeleMation	421
Dynasciences	426	Telemet	415
Fernseh	413	Vital	406
Fujinon	428	World Video	427
IVC	401		
Jampro/Cetec	417	The Lincoln & Monroe Rooms	
Jefferson Data	429	Ampex Corp.	
Kliegl Bros.	431	The Military Room	
Kodak	405	Panasonic	
3-M	411		

NAB Convention



Production versions of the Thomson-CSF Microcam will be on hand.

nation's capitol. Last year, 69% went to the Windy City. Washington is too distant for most radio chief engineers and only one out of four polled is going. Two out of three radio managers will be going. Poor radio engineer's attendance is what pulls the average down. Actually managers and engineers for TV stations will be going to Washington *in force*.

Most of our TV panelists were going in person—75% of all managers and 83% of all engineers. At least one management-type will be there *from every station* represented in our poll and in only 10 percent of the cases did we find a TV station that would not be represented by an engineer. Thus from the viewpoint of TV equipment manufacturers, Washington should be as good as Chicago.

NAB Chicago '76— One Year Later

EVERY NAB CONVENTION produces a bumper crop of new products that demonstrate the energy and ingenuity of those who manufacture the where-withall for broadcasting. This year, in Washington, will be no exception. But before we all get caught up in the excitement of this year's show, we thought it would be a good idea to see how the products introduced last year have fared.

So, we inquired with the manufacturers of last year's most significant innovations and asked them to tell us

how they have progressed. Not everyone replied in time for this issue but those that did provide a fairly good gauge of what turns the industry on.

New format VTRs gain some converts

Last year, in the television area, ENG type cameras and VTRs with one-inch formats created considerable excitement. The Bosch Fernseh BCN system was licensed for manufacture to IVC, Phillips, and RCA, and IVC, at least, is expected to show its version of the BCN series at this year's NAB. An unconfirmed report indicates that the first BCN system has been delivered by Bosch Fernseh to an AT&T training department. The equipment was used at the Olympics.

Initial deliveries of the Ampex VPR-1 helical videotape recording systems were made in December. Ampex reports that the system has been particularly well received in its PAL/SECAM versions that were introduced to the European market at IBC in London.

The Sony BVH-1000, termed "Sony's answer to quadraplex," began reaching customers last month. Sony has high expectations for the VTR which includes "movieola like" control. Since its introduction, some cosmetic changes have been made and the control panel has been re-designed. A fully portable version of the machine is expected to be shown this year.

Cameras have been the rage

The ENG camera line-up in Chicago was truly impressive with entries from Thomson-CSF, RCA, Ampex, NEC, Ikegami, Hitachi, and Asaca. The Thomson-CSF Microcam, which received a lot of attention because of its bantam class 8-pound weight, (11-lbs. with belt pack) was at that time a proto-type or as a company spokesman put it, "a handmade pre-prototype." Now, eight months later, Thomson has delivered the first six production line models to CBS. Thomson expects to be producing about 25 cameras a month and has bona fide backorders for 200 units. This year, the Microcam will be back and Thomson promises a low-light level performance demonstration that will impress broadcasters.

RCA's backpackless TK-76 was a little further along in development when it was introduced at NAB and since then more than 250 of the cameras have been delivered to customers in the U.S. and overseas. The TK-76 was in wide use by the networks at the national political conventions and saw heavy action during the Olympics.

Some 30 to 35 SK-80s, from Hitachi-Denshi, have been sold pri-

marily as production cameras. Since Chicago, the camera has been modified to provide modular servicability, a 2-lb. weight reduction (now 14.7 lbs.) and improved registration by using new deflection coils and circuits. A wideangle lens has been added to the viewfinder and the grip angle has been made adjustable. Genlock has been added as an option as has a power zoom lens.

Though we do not know how many of the HL-77 or HL-37s have been delivered by Ikegami, we do know that the HL-77 saw plenty of action at the political conventions and Summer Olympics.

Introduced prior to NAB '76 were two cameras from Philips Audio Video Systems, the LDK-11 and LDK-25. It was not until the Chicago show, however, that Philips really got their product launched. The company reports that since then many of the cameras have been delivered and are in service around the nation. The LDK-11 has found its way into some interesting situations such as at KFME, Fargo, North Dakota, where the station uses it to produce statewide documentaries.

LDK-11s are shared at some stations such as WBTV, Charlotte and WLWT, Cincinnati where news crews, commercial production teams and creative production units all use the cameras for their special needs.

Although the LDK-25 is not an ENG camera, it was designed as a studio camera with field application features. KTVX, Salt Lake City, which claims to be the most modern television facility in the Southwest, and perhaps the nation, has purchased 3 of the cameras. CKVU, Vancouver has bought 6 and Advertel Production Co., Toronto has bought one for use in its mobile unit.

Two other studio cameras from NAB class of '76 which we received reports on were the RCA TK-46 and the Harris TC-80 with Triax. Deliveries of the TK-46 began in May of last year and the camera seems a likely successor to the TK-45 and 44. The Harris TC-80 automatic live color camera has been delivered to group and independent stations across the country and is operating "on-air," remotes and in production. The Triax cable option has been demonstrated throughout the year and Harris intends to highlight it at the NAB this year.

Quad has not stood still

There were some changes last year for the quad VTRs too. Ampex introduced the AVR-3 which it called the world's first "intelligent" VTR. The system provides both super high band pilot and high band formats for recording as well as automatic selec-

continued on page 74

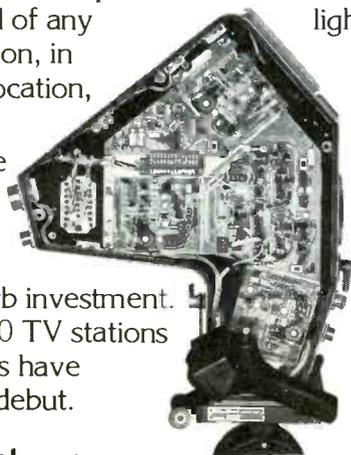
Get your hands on the TKP-45 from RCA.



TKP-45 versatility gives you complete control, inside and out.

A lightweight camera is a good investment only if it can put you in full control of any production situation, in the studio or on location, inside and out.

On that basis, the go-anywhere, shoot-anything TKP-45 camera system is a superb investment. As more than 100 TV stations and teleproducers have learned since its debut.



- Scene contrast compression that compensates for strong lights and heavy shadows
 - Built-in contour enhancer with coring and comb filter
 - Chroma key outputs
 - High sensitivity
 - P-ismatic bias light

The one-camera camera system.

TKP-45 adaptability to any production challenge is enhanced by a wide choice of

matching accessories for powering, viewing, supporting and shooting. They turn the TKP-45 from a quality camera into the one-camera camera system.

For power, plug in our battery- or AC-powered Minipack for ultra-portable application.

For viewing, choose from two tiltable, interchangeable viewfinders, 3" and 7".

Either is suitable for location or studio use.

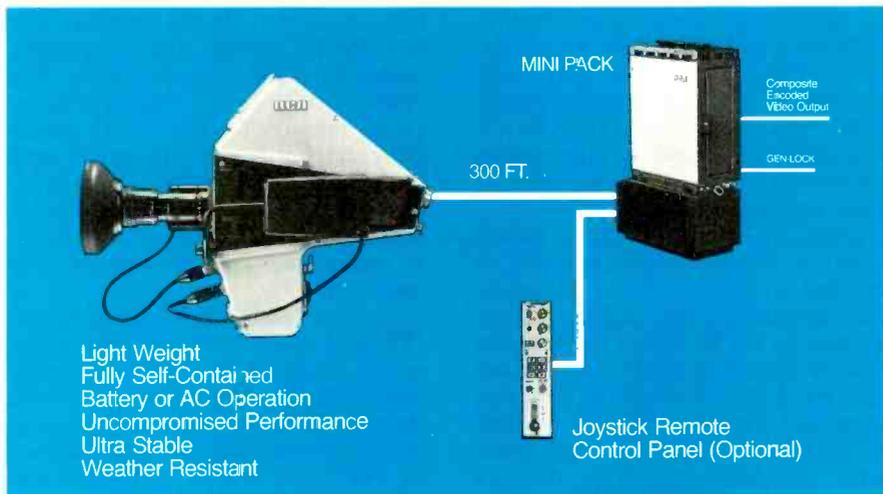
Support is made easy by a

Big camera features.

Here are the blue-ribbon features—all standard—that make the TKP-45 camera a standout:

- Shock-mounted optics
- High Performance input amps with full level video outputs
- Quick-change wedge plate and lens mount
- Automatic white balance, black balance, iris control, pulse advance, voltage regulation

LENSES	Zoom Range	Focal Length	Hor. Angle of View	Aperture	Minimum Obj. Dist.	Weight
ANGENIEUX 6 x 13 D1 	6 to 1	13-78 mm	52.4°-9.5°	f/2.2-4/3	0.45m 18 in.	1.1 kg 2.4 lbs
ANGENIEUX 10 x 16 T-1 	10 to 1	16-160mm	43.6°-4.2°	f/2	1.4 m 54 in.	3.1 kg 6.9 lbs
CANON PV 10 x 12 B 	10 to 1	12-120mm	55.4°-6°	f/2-4/3.1	0.45 m 18 in.	2.3 kg 5.5 lbs



fill any production, commercial and news assignment with an unmistakable stamp of quality. And its ability to go almost anywhere and shoot almost anything assures you of maximum return on your camera investment.

Learn more, now.

To see how fully you can control any picture situation with the TKP-45, you are invited to contact your RCA Representative or simply send us the coupon.

Then, get your hands on a TKP-45 yourself. You'll see why the one-camera camera system is doing so much for so many.

Why not test it at our NAB Hands-on Headquarters?

wide variety of tripods, unipods, shoulder mounts, and studio camera bases. As for shooting, the TKP-45 accepts the zoom lenses on this chart—plus a fixed lens adapter which accommodates a wide variety of fixed focal length lenses ranging from fisheye to multiple-image.



The full-sized TV camera. You get big camera capability when the TKP-45 includes a Minimax adapter that accepts a range of full-size lenses for studio and field production. Minimax allows longer zoom

ranges, higher lens speeds and unexcelled optical quality. With Minimax, the TKP-45 handles like a full-sized TV camera (below).

The versatile investment. The TKP-45 and its accessories form a true building block camera system that can



BM/1/77

RCA BROADCAST SYSTEMS
 Building 2, Front & Cooper Sts.,
 Camden, N.J. 08102

I'd like to see just how the TKP-45 meets my need for quality and versatility. Please contact me; no obligation, of course.

 Name

 Title

 Firm

 Street

 City, State

 Zip Telephone

Test a TKP-45 at our NAB Hands-on Headquarters, the Washington Hilton, March 27-30, 1977.

RCA
 The Dependables

NAB Convention

tion of speed and carrier format in playback. Since '76, 40 AVR-3 systems have been delivered to customers including three to ABC. The units have also taken hold in teleproduction houses on both coasts.

The R-MOD (Reel-Servo-Modification) kit for quad VTRs completes its first year since introduction with a healthy backlog of orders. All Ampex VTRs, including the AVR-2, have been modified by this upgrade kit. R-MOD kits for TR-22 and TR-70 have been installed in late '76. The intervening months since last March have produced a new feature for R-MOD, called "Auto-cue." Essentially, the Auto-Cue feature permits

the operator to identify, permanently, a cue position for the VTR's memory.

The Video Spot Assembler from Recortec is also doing well. Broadcasters who can't afford a full blown automatic video cart machine system can assemble spot reels to get some of those automated benefits.

Sony, of course, made a splash when, in addition to new products, it unveiled a new corporate division, Sony Broadcast billed as Sony's commitment to the broadcast industry. Its premier line of products included not only the 1-inch BVH-1000, but also broadcast versions of its cassette recorders and some other new products. The Sony Broadcast package consisting of the BVU-1000 portable cassette recorder, BVU-200, cassette editing recorder, and BVE-500, edit-

ing console, has already found a home in some 60 stations and is currently backordered for more customers. The system will be further expanded to include the BVT-1000, TBC which Sony did not begin delivery on until last month. This is a 4H-window TBC with line-by-line velocity compensation, DOC, and full processing. It incorporates Sony patented A/D converters.

As we remarked last year, Sony and JVC still seem to be the only major entries in the ¾-in. cassette recorder market though Ampex and RCA both showed ENG systems incorporating ¾-in. cassette machines manufactured by JVC. The Ampex VPR-4400 and VPR-8300 editors are reportedly doing well as are the RCA labeled models.

continued on page 76

Overall Interest in Radio Equipment

	Percent Interested 1977	Percent Interested 1976
Tape Recorders/Players	64%	55%
Cartridge Players	58%	48%
Audio Processing Equipment	58%	43%
Consoles, Mixers	56%	54%
Microphones, Accessories	52%	38%
FM Monitoring Equipment	40%	33%
Remote Pickup & STL	38%	38%
Noise Reduction Systems	34%	36%
FM Transmitters	34%	25%
Automation Equipment	32%	40%
AM Transmitters	29%	27%
AM Monitoring Equipment	27%	27%
Business Automation Systems	12%	N.A.
EBS Equipment	10%	51%

Overall Interest in TV Equipment

	Percent Interested 1977	Percent Interested 1976
TV Cameras, Portable (ENG)	77%	70%
VTRs, Portable	64%	50%
Video Tape Editors	62%	28%
Time Base Correctors	61%	61%
Still Store	45%	N.A.
Character Generators	45%	47%
Picture Monitors	45%	38%
Frame Synchronizers	40%	N.A.
Test Equipment	40%	47%
VTRs (helical/segmented)	40%	N.A.
VTRs (quad)	38%	33%
Microwave for ENG	36%	40%
Audio Consoles	34%	27%
TV Cameras (top-of-line)	34%	26%
Routing Switchers	34%	19%
Switching Automation	32%	21%
Production Switcher (large)	30%	25%
Production Switcher (small)	30%	25%
Master Control Switcher	30%	24%
Film Chains	26%	24%
Transmitters	23%	25%
Remote Control Equipment	19%	28%
Business Automation Systems	17%	N.A.
TV Cameras (medium price)	17%	18%

Sheraton Park

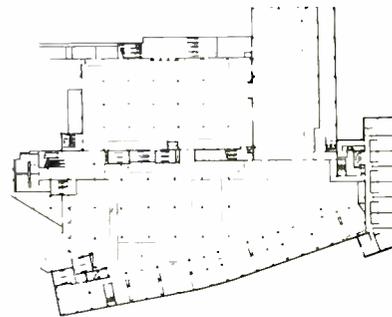


Exhibit Hall #1 (11)

Exhibitor	Booth No.
American Data	101
Boston Wire	108
Central Dynamics	104
Di-Tech	109
Electronics, Missiles, Comm.	110
Kliegl Bros.	107
Marconi	106
Memorex	105
Mole-Richardson	102
Philips Broadcast	100
Thomson CSF	103

Exhibit Hall #2 (32)

Acrodyne	202
AEL	216
Alford	212
Broadcast Electronics	206
CCA	201
Ceco	204
Cetec Corp.	227
Collins Radio	217
Commercial Electronics	222, 222A
Consolidated Video	224
Continental Electronics	220
Fidelipac	218
Fuji Videotape	225
Grass Valley	209
Harris Corp.	205
Hitachi Denshi America	228
Intl. Tapetronics	229
McMartin	200A
Marti	207
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LOOK who's bought OPTIMOD-FM

ABC Bartell	Bonneville International CBS	Christian Broadcasting Metromedia	Plough Broadcasting SJR Communications	Sonderling Susquehanna			
AL Birmingham	WVOK	LA Houma	KHOM	NY Ithaca	WEIV	TN Memphis	WQUD
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CA Los Angeles	KNX	MA Boston	WCOZ	NY New York	WCBS	TX Houston	KOUE
CA San Francisco	KCBS	MA Boston	WEEI	NY New York	WKTU	TX Pasadena	KIKK
CA San Francisco	KDFC	MD Chevy Chase	WJMD	NY New York	WNCN	UT Salt Lake City	KSL
CA San Francisco	KIOI	MD Baltimore	WCAO	NY New York	WNEW	VA Fairfax	WEZR
CA San Francisco	KOIT	ME Orono	WPBC	NY Westchester	WBIW	VA Portsmouth	WXRI
CA San Francisco	KSAN	MI Detroit	WDRQ	NJ Bayville	WOBM	WA Seattle	KEUT
FL Miami	WMJX	MI Detroit	WRIF	NJ South Belmar	WADB	WA Seattle	KISW
FL St. Petersburg	WSUN	MI Detroit	WWWW	OH Cincinnati	WBBN	WA Tacoma	KTNT
GA Atlanta	WKLS	MN Minneapolis	KQRS	OH Cincinnati	WLDA	DC Washington	WASH
GA Atlanta	WLTA	MN Minneapolis	WCCO	OH Cleveland	WCLV	DC Washington	WHUR
GA Atlanta	WPLO	MN St. Paul	KSTP	OH Cleveland	WQAL	DC Washington	WKYS
IL Chicago	WBBM	MO Columbia	KFMZ	OH Toledo	WLDK	DC Washington	WMAL
IL Chicago	WDAI	MO St. Louis	KMOX	PA Bal. Cynwyd	WY3P	DC Washington	WMOD
IL Des Plaines	WJJD	MO St. Louis	KSLO	PA Holland	W3BA	DC Washington	WWDC
IL Oak Park	WBMX	NC Charlotte	WROQ	PA Philadelphia	WCAU	Ont Toronto	CFRB
IL Skokie	WCLR	NC Fayetteville	WQSM	PA Philadelphia	WDAS	Man. Winnipeg	CJOB
IN Indianapolis	WFMS	NH Laconia	WLNH	PA Philadelphia	WMGK	Man. Winnipeg	CKY
KS Manhattan	KMKF	NY Bristol Center	WMIV	PA Philadelphia	WMMR	Que. Hull	CKCH
KS Shawnee Mission	KMBR	NY Buffalo	WDCX	TN Memphis	WMPS	B. C. Vancouver	CKLG
KS Wichita	KEYN	NY Cherry Valley	WJIV				

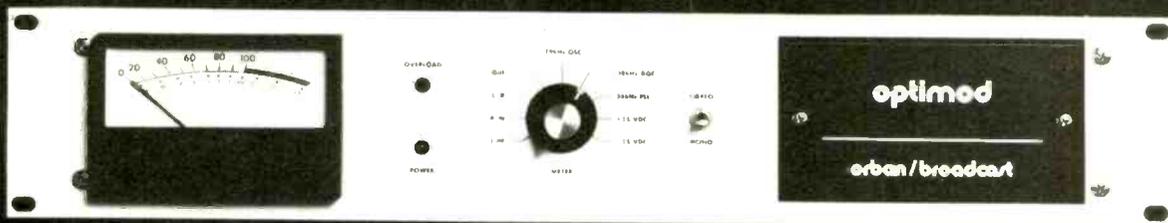
And that's only a fraction of the several hundred OPTIMOD-FM's already purchased. These sophisticated broadcasters have realized that OPTIMOD-FM is the first real breakthrough in FM signal processing in fifteen years. By combining compressor, limiter, and stereo generator in one integrated system, OPTIMOD-FM has given these stations 2 to 3 dB more loudness, absolute peak modulation control, tight bass, detailed midrange, and an open and transparent high end.

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NAB Convention

Slo-mo moves quickly

The Eigen slow-motion disc recorders introduced last year have since been used primarily by NBC sports. NBC's first encounter with an Eigen machine was at an Oakland Raiders/Kansas City game after which the operator concluded that the machine was up to standards for network sports. The machines have been used regionally for college sports and in ENG applications to extend short segments of tape to meet audio timing requirements during the editing process. Some improvements to the systems have been made and they will be shown at NAB '77.

Ampex took the opportunity last year to introduce an advanced version of its slo-mo machine, the HS-100C. Its first real test came during the Olympics and passed with flying colors. More than 30 of the HS-100Cs have been sold since last year. This year look for the ESS system developed by Ampex and CBS for still storage.

The EFS-1 Field Frame-Store recorder introduced last March by Arvin is now in use at nearly 50 stations in the top markets as well as at ABC and NBC nets. Three major

Canadian stations also use the system. Nearly 70 of the machines have been shipped and its appearances read like a copy of "Sports Illustrated's" editorial schedule: The Summer Olympics, The Kentucky Derby, The Indianapolis 500, ABC's Monday Night Baseball, NFL Football, The Rose Bowl, and The Super Bowl. The Arvin machine also saw a lot of news action during the conventions, on election night, and is used for ENG work and weather reporting. In straight production, EFS-1 is used on the Today Show, and The Merv Griffin show, among others.

Character generator got election boost

In anticipation of the Presidential elections, character generators got considerable play and the reports getting back to us indicate that 3M, TeleMation, and the Thomson-CSF Vidifont all did very well.

Much of what Chyron is currently doing to extend the concepts behind the Dynamic Montage Unit shown last year is revealed in the box, "The Shape Of Things To Come," within the article, "Digital TV Systems Can Unleash Creativity, Improve Control and Reduce Errors," elsewhere in this issue.

3M has since introduced a digital

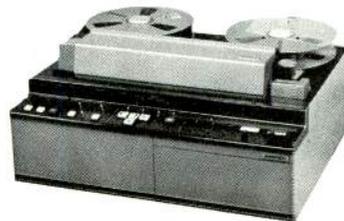
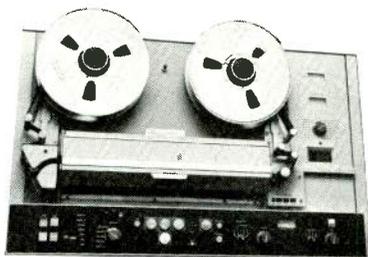
cartridge storage unit for use with its Datavision D-2000 and D-3000. This is a random-access cartridge memory device called DCS-1 that stores up to 300 character pages per cartridge and will search through them at 10 pages per second. This device will certainly be in Washington.

The Vidifont Mark IV with changeable fonts and font compose introduced by Thomson-CSF, has enjoyed a good 1976. TV stations seem attracted by the changeable font feature which gives them great graphic arts features. This feature has also made the Mark IV available internationally. Recently, a machine was demonstrated in the Soviet Union for possible use at the 1980 Olympics.

No one loves an election more than a character generator manufacturer and if you happen to have special election software to go along with the machine, you're as happy as TeleMation with its Compositor I Titling/Graphics System and TED (a special election reporting option). Since last year, the Compositor I has been installed at WOTV, Grand Rapids; KING-TV, Seattle; KTVK, Phoenix; WTMJ-TV, Milwaukee; KRON, San Francisco; KGW, Portland; KTAR-TV, Phoenix; and Consolidated Industries, L.A. Six of these clients bought the TED option

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R-MOD ⇒ INTELLIGENT VTR



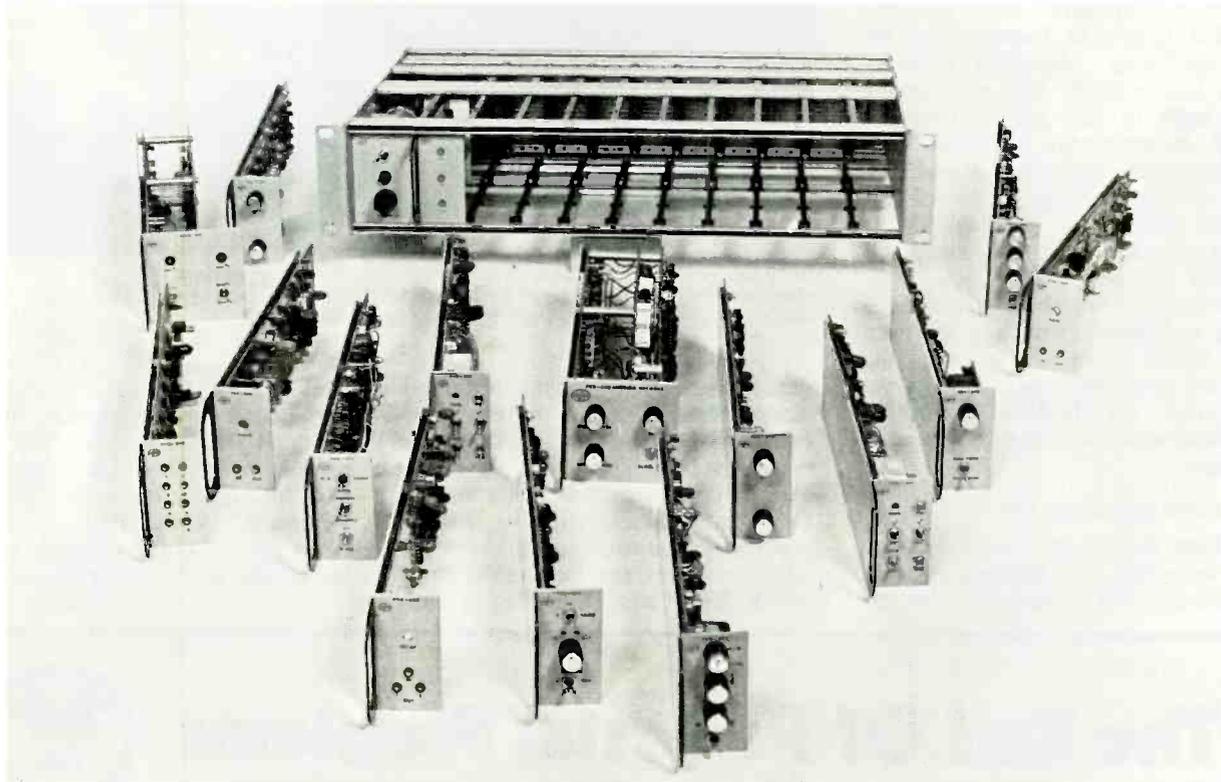
R-MOD now provides *AUTO-CUE*

R-MOD is the Reel-Servo Modification kit that makes old quads handle tape like the latest "intelligent" VTRs. Now with AUTO-CUE, R-MOD has the ability to remember, with frame accuracy, a cue point selected when the HOLD button on the timer is pressed. When the HOLD button is pressed again, anytime the VTR is not in play mode, R-MOD will search automatically and stop at the preroll position. Cost? This new feature is available at no increase in price to all R-MOD customers—past and future!

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PCB-320 NTSC Color Bar Generator

PBB-321 Black Burst and Color Background Generator

PBD-322 Bar Dot and Visual Reference Generator

PMB-323 Multiburst and 12 MHz Sweep Generator

PSS-324 Stairstep and Ramp Generator

PPD-325 Sin², 20T Pulse and Window Generator

PSD-340 System Delay Module

PPA-346 Pulse Distribution Amplifier

PSA-346 Subcarrier Distribution Amplifier

PVA-350 Video Distribution Amplifier

PVD-354 Video Delay Amplifier

PRC-360 Processing Amplifier

PRC-361 Processing Amplifier with Sync Generator

PCD-363 NTSC Chroma Decoder

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PSW-366 8 x 1 V.I. Switcher

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NAB Convention

as well. The software for Compositor I has been greatly expanded since 1976 and we suppose we'll learn more about that next month.

Knox demonstrated a low-cost high resolution character generator last year and since then, the machine, the K128, has done quite well. Broadcasters reportedly like the customizing that can be accomplished. Knox has also added a number of features over the year including additional memory units, (the machine will now handle from eight to 300 pages of instant access information), automatic centering, independent program and preview channels. Eight pages of additional memory are available in an option called MOD 8 introduced this past fall.

The only sad reports we heard in the titling and graphics area were from RCA which chose to get out of the field and from 3M which has not yet perfected its D-8000 graphics generator which it had at the show in Chicago.

Edit controllers roll on

A large part of the '76 NAB show was dedicated to electronic editing controllers. TRI, Datatron, Conver-



Sony will be displaying the BVE-500 editor and BVU-200 editing recorder (being shown above by Dave MacDonald to European visitors) and the new one-inch tape recorder, BVH-1000.

gence, and Spectra Vision all demonstrated their machines to very interested audiences. Since then the machines have spread to just about every television station in the nation. One survey indicates that at least 75 percent of television stations now use edit controllers for their ENG operations. Bob Cezar, president of TRI,

likes to point out that 2½ years after introducing its first product they are doing \$4 million in sales. TRI is now entering what they call "Phase II." The machine that will introduce "Phase II" in Washington will be the EA-6 edit controller utilizing a modular design and microprocessor based

continued on page 80

The End Of Pedestal Problems



The P-50 shown here is an extremely flexible television camera pedestal that allows an unprecedented range of vertical motion. From 21" low to 57" high (measured at the pan head mount), the P-50 provides 36" of height range.

This superior range is achieved by the use of a patented pneumatic counterbalance system. The principal design has been proven in use by the major networks for over twenty years.

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operation made possible by dual eight inch wheels, overall light weight and smooth camera balance. Maintenance people enjoy the sealed ball bearings, permanently lubricated wheels and low maintenance requirements of the annual, one-point lubrication.

Available with a wide variety of options (shown here with cable guard side skirts), the P-50 is the ideal instrument for the modern television studio.

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*PV25x20B is 20-1000mm in 25mm format.
P25x27B is 27-1350mm in 30mm format.
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TV ZOOM LENS PV25x20B 25-500mm 1:1.8
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NAB Convention

technology.

Convergence has also had a dynamite year and its ECS system along with a series of recently introduced add-ons, like tape timers and keyboard editing programmer, can be found in television stations across the country.

Datatron's Tempo '76 system is also doing well though we have not received any details on their progress.

TBCs—no time like the present

Along with the ENG boom, or visa

versa, NAB '76 produced a large number of TBCs. We'd like to believe that most of the manufacturers were too busy to respond but the fact remains that we heard from only three. Sony was mentioned earlier for just recently beginning delivery on its TBC. CVS, on the other hand, has been delivering the CVS 520 for some time. By the time broadcasters meet in Washington next month, CVS will have delivered nearly 150 of their ultra compact (3½-in. high × 19-in. wide) TBCs designed to work with quad, segmented, and helical VTRs. The compactness may be one of the 520's chief attractions. CVS has taken to



IVC's version of the BCN VTR series.

No other tape cartridge machine can do so much for so little



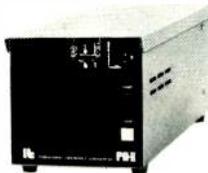
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- Direct-capstan, 450 RPM, hysteresis-synchronous drive motor—with an electrolyzed shaft—minimizes wow and flutter. Eliminates need for rubber belts and separate flywheel assembly.
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- Features latest solid state components, even for switching applications. No relays. Printed circuit cards plug in.



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supplying the units complete with fiberglass carrying cases.

CVS also introduced a low-price TBC for the education and CATV markets, the CVS 510. This machine, at about \$5,000 has received good attention in the non-broadcast markets according to CVS.

The Microtime 2020 with an image enhancement feature based on the Yves Faroudja Crisp Matic image enhancer, also exhibited at Chicago, got a lot of attention at the show, especially for its effect on U-matic cassette recordings. Its beneficial effect on this type recording has not gone unnoticed and 2020s are fairly common across the country. All three of the major webs have placed multiple orders with the Connecticut manufacturer. The Crisp-Matic image enhancer, subsequent to the NAB show, was licensed for manufacture exclusively to Microtime which now produces the machine under the trade name, Image-Ex.

Before the device was licensed to Microtime, several units were sold to the U.S. Army, Sony, CBS, AFRTS, Stover Broadcasting, The Lincoln Center, and others. A PAL/SECAM version was introduced (and is still manufactured by YFI) at IBC and has been assigned to a British firm for European distribution.

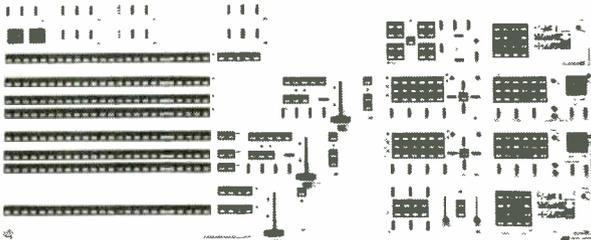
Among video signal accessories three manufacturers we've heard from include: RCA, MicMix and Video Aids of Colorado. RCA introduced a digital video frame synchronizer, the TFS-121, and expects to begin deliveries this month. MicMix introduced units called the "C" series Master-Room Reverberation Chambers. These units have been used in broadcast application as a means of increasing the effective modulation level by smoothly filling in the "holes" and avoiding excessive limiter action.

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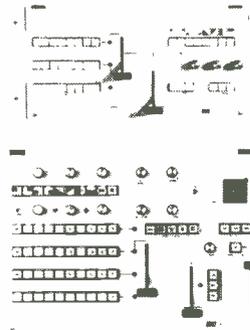
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Video switchers.



New, Super Powerful CD 480 The Smart Switcher

Revolutionary modular switchers with unprecedented production power. They outperform the largest conventional switchers, yet are extremely simple to operate. Their power and ease of operation are due to CDL's new Sequential Effects (SFX) Amplifier, which can cut, mix or wipe between two Background Sources and two separate Key Sources either individually or in any combination. Models with one or two SFX Amplifiers provide all the standard and optional features you need, including Rotary & Random wipes, RGB Shadow keys, Hard and Soft Color Border wipes, Color Border keys, Quad with Color Borders, Encoded Chroma keying, Key Mask generator, and 16, 24 or 32 inputs. A variety of modular accessories will continue to keep your switcher smarter than the rest as new technology develops.



VS-10

An inexpensive broadcast quality 8-input switcher that features flexibility and ease of operation. Self-contained electronics for rapid installation in ENG and other small mobiles.

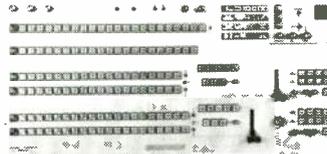
VS-14

Sophisticated enough for large studio production, yet compact and inexpensive enough for small mobiles. Soft wipes and keys — even a Downstream keyer — are standard. Self-contained and remote versions available.

VSP-1260S

An amazing value

Now the smallest station can afford a conventional 20-input mix/effects switcher of the highest quality and reliability and get it in under 30 days! All features, including an Encoded Chroma keyer and Bordered keys, are standard (not optional, as is often the case). And the price is astonishingly affordable.



Ask about the AFM-10 Audio Mixer/Switcher — an ideal companion to the CDL VS-10 and VS-14 video production switchers.

Automation.



System 100

Computer controlled automation system for Technical Operations that communicates directly with a Business Computer System. Stores and retrieves the schedule with entry error checking, makes automatic time corrections, performs complicated audio/video switching sequences (including dissolves, fades, wipes and keys), assigns machines, verifies material, and prints the "As-Aired" log.

Master Control Switchers

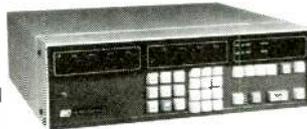
Ranging from CDL's new CD 480 MC to a 2 Bus MCS-829 or a 3 Bus MCS-770. All 3 can be interfaced to System 100 Technical Automation System.

Tape editing systems.



PEC-120 Video Tape Editor

A computer editing System with easily operated control panel and CRT display for rapid and precise control of VTR's & Switcher. CDL's unique Self Learning Cueing Software Program is a new feature.



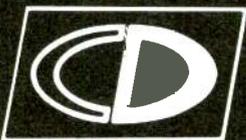
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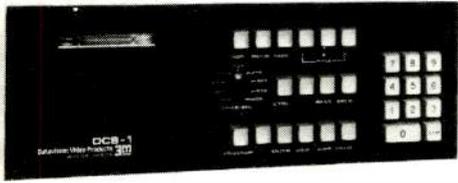
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NAB Convention



Digital cartridge storage unit DCS-1 from 3M (Datavision).

These units are smooth enough to be placed in the audio line after the limiter.

In production work, the "C" series devices are used particularly in live programs to give a "natural" sound to the audio portion. The basic "C" series will be continued but MicMix will be bringing to Washington a new "Super C" unit.

Video Aids of Colorado introduced the Video Line Isolator for remote video feed applications where a differential between two AC 120 volt power receptacles exists. Primary use of the VLI has been when 60 Hz is superimposed on the video signals

with greater than 10mV noise.

Digital switchers catch on

One of the big developments in switchers last year was the application of more digital techniques to the problem of switching and special effects. The big three, CDL, Grass Valley, and Vital, all introduced models with increased digital control and effects features. All three manufacturers have done well with their respective systems. CDL which brought out what it called the first "smart switcher," CD 480 SFX, is said to be ready to move with its first installation at KSD-TV, St. Louis. Vital has shipped 80 of its VIX-114 production switchers, several of its VIX-115 master control switchers and installed a number of the VIMAX-200 Automation systems, a few of which have been interfaced with various Business Automation systems. Vital also promises this year to shake-up the industry with some startling advances in digital video creative manipulating devices.

3M brought out a small, low-priced Model 1114 production switcher last year which has gained a place in broadcasting applications in mobile vans, in secondary positions as backup or in connection with VTR editing. Most of the other sales of the Model 1114 have been to CCTV and CATV users.

The RHL VPM 3000 series of switchers shown by Richmond Hill Laboratories are now employed by major TV broadcast studios and networks in Canada, Australia, Germany, and Nigeria. In keeping with RHL policy, product improvement and modification kits have been provided to owners of the switchers as the advances are made.

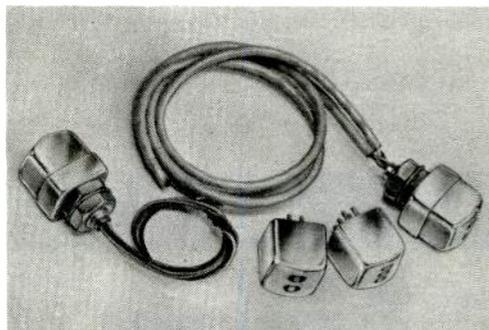
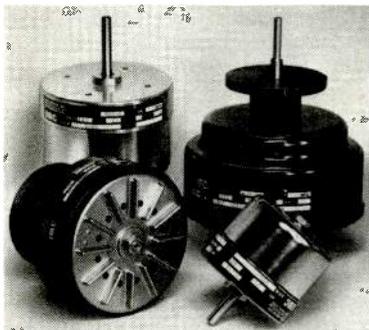
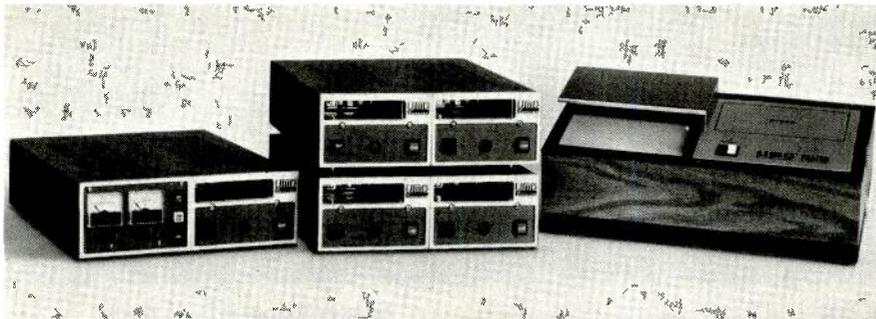
Wireless microphones are seeing more and more action all the time. This past football season saw at least one wireless mic on every head referee in the NFL, and collegiate bowl game. The Thomson-CSF 950 MHz Diversity Wireless Microphone since its introduction into the field last year has received good reaction. Thomson uses a five-channel system and has since expanded the line to include single- and dual-channel systems which are portable and battery operated.

Refinements in radio

While revolution has been the byword for developments in television technology, evolution continues to describe the engineering design philosophy in radio. Last year's NAB was no exception as the real story for radio was produced not so much by the advances in radio technology as by the increased interest in manufacturing for the radio market. Many new companies have entered the market and

continued on page 84

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Our introduction of Beucart® audio cartridge tape machines in 1976 was one indication of our dedication to solving problems and simplifying operations for the broadcaster. But we don't want you to forget our Beau hysteresis synchronous drive motors, Beucart splice finders, or Beau audio tape heads, either. Our product line is expanding and we know you'll be excited by the new products we'll be adding shortly.

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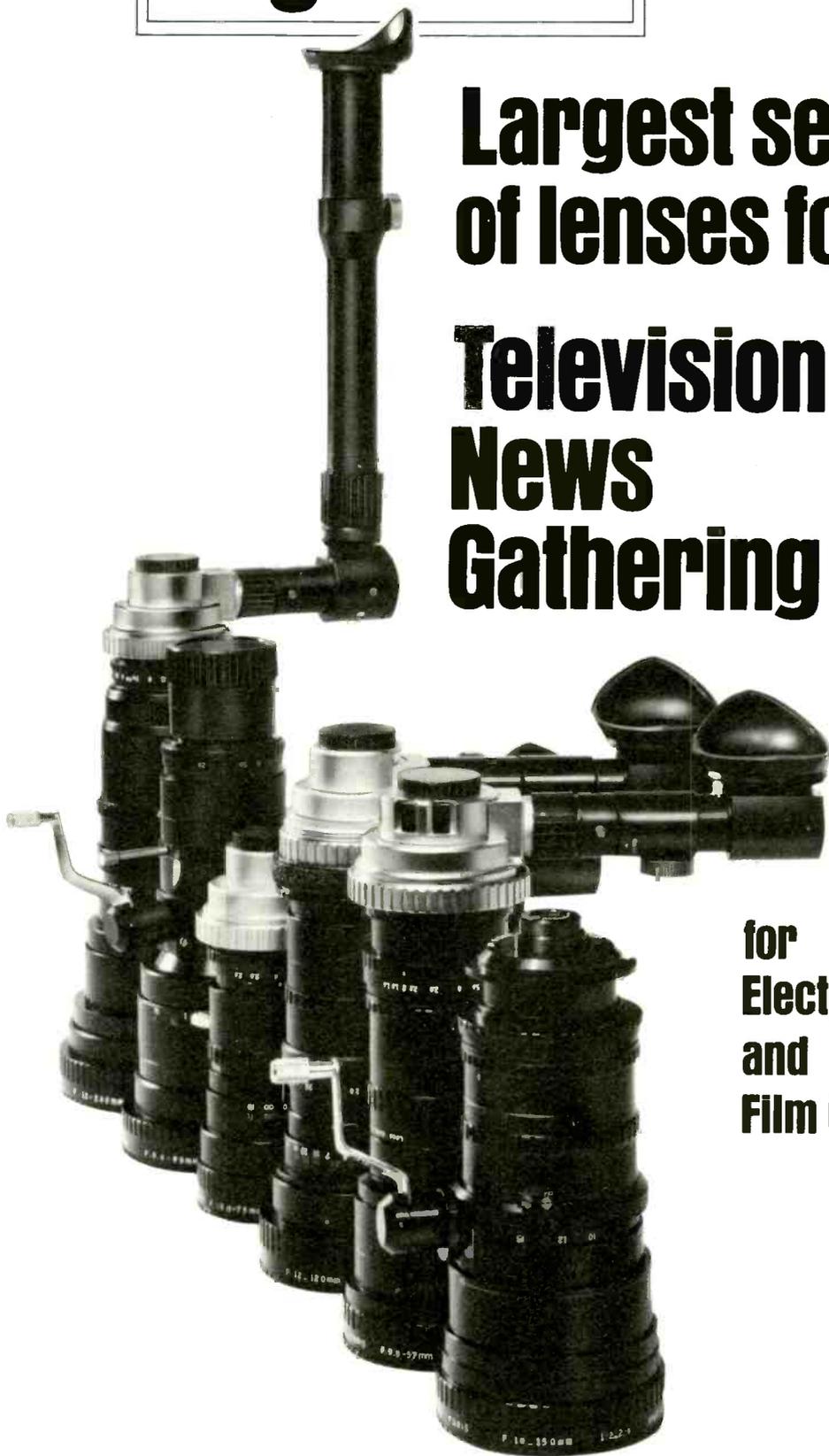
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NAB Convention

many of the older firms have deepened and widened their product lines to become full-line suppliers.

The transmitter is a case in point. Whereas there has been a trend toward solid state transmitters, the rate of changeover has been relatively slow. The point is radio broadcasters recognize that today's transmitters are vastly superior to yesterday's but yesterday's are still serviceable. The greater reliability and decreased maintenance requirements for solid state transmitters will lead to a gradual transition by

broadcasters to this new type. FCC approval of ATS and the continuing trend towards greater automation creates pressure in the industry to take more serious advantage of economies that can be achieved through the application of solid state technology. But radio is a highly competitive field and the ability to control costs is a greater factor in profitability for radio stations than it is for the TV broadcaster. Equipment tends to stay on-line longer before it is traded in and replacement tends to take place, in many instances, as part of a link-by-link process in the radio broadcast chain. This makes compatibility a cherished character-



Thomson-CSF two-channel diversity microphone system.

Recording quality that speaks for itself

Scully's versatile 280B/284B series offers professional recording features, including constant tension and pitch control...but total performance tells the real story; the reliability and quality that have made us the leading supplier of professional recorders.

Scully speaks for itself through more than 200 sales and service dealers worldwide. For full information, contact Scully Recording Instruments, Division of Dictaphone Corp., 475 Ellis Street, Mountain View, California 94043 (415) 968-8389 TLX 34-5524

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istic. So with the nature of the radio market in mind, here is a series of brief reports from some of the manufacturers who are contributing to the development of the radio industry:

CSI Electronics Inc., which introduced a complete line of AM transmitters ranging from 4 watts through 25kW and a complete line of FM transmitters from 10 watts through 25kW intends to continue these lines essentially unchanged through 1977.

Sparta Division of Cetec Corp., staked out a strong position in the solid state transmitter field with its SS AM series. The SS-1000A, a 1kW AM unit, was promised for the summer of '76 and the first delivery was made to radio station KCHS, Truth or Consequences, New Mexico, just prior to the close of last year. More shipments are due in February and a substantial backlog of orders exists—some dating back to NAB. Sparta states that the SS-1000A has had far greater test time—both in plant and in the field—than any Sparta transmitter to date. The company expects a great year for the SS-1000A.

Microprobe introduced a Model 100-A programmer last year for the small and medium size radio station. David Collins of Microprobe said, "I think that 1977 is going to be a much better year for us because stations are going to need to make their changes and we probably represent the lowest price automation system in the market." Already, the Model 100-A has been placed at stations WATI, Indianapolis; KFMB, Oklahoma City; WKBV, Richmond, IN; WQXE, Elizabethtown, KY; WGTS, Tacoma Park, MD; WQXM, Clearwater, FL, and WGEN, Geneseo, IL. Collins thinks one of the main attractions of the system is that when and if a station is ready to go for a big automation

continued on page 86

Why do we have over 200 orders from customers in 20 countries on 5 continents for BCN VTR's?



BCN 50
stationary

BCN VTR's are superior:

They combine quality of Quad's with economy of 1 inch VTR technology and portability.

BCN VTR's are proven:

Thousands of hours of operation at many customer sites, in studios and outside broadcasting.

BCN is really portable:

The light-weight version BCN 20 operated successfully in boats, helicopters, cars and during the Olympic's in Innsbruck and Montreal. BCN 20: 69 min tape reel, 80 min battery, 23 kg light-weight, auto-take assemble.

BCN is the advanced solution:

3 high-quality audio tracks continuous recording – no gap, adaptable to digital recording, single frame display, cassette operation.

BCN is available:

4 leading broadcast equipment manufacturers supply you with the BCN VTR's for NTSC, PAL, PAL-M and SECAM. You don't have to wait . . .

For further information contact your local Bosch-Fernseh representative.

BCN 40
mobile



BCN 20
portable

BOSCH FERNSEH

Robert Bosch Fernseh-Division in D-6100 Darmstadt/West-Germany, POB.

Circle 152 on Reader Service Card

NAB Convention

system, like a Shaffer 902, most of the components acquired with Model 100-A can stay right in place.

Time & Frequency Technology Inc., introduced the 753 AM Modulation Monitor last year and it has become very popular in the more competitive markets since it permits comparison of modulation levels between stations with the single push of a button. The company has high expectations for its Model 7600 digital

remote control system especially since the FCC has moved off dead center on ATS.

Belar Electronics Laboratory, Inc. introduced an AMM-3 AM Modulation Monitor it had designed especially to meet ATS requirements and it, too, expects good results from the FCC move. The AMM-3 has outputs provided to digitally set negative and positive peak modulation and outputs provided to alarm and control transmitter modulation. Product design life is anticipated to be 10 years.

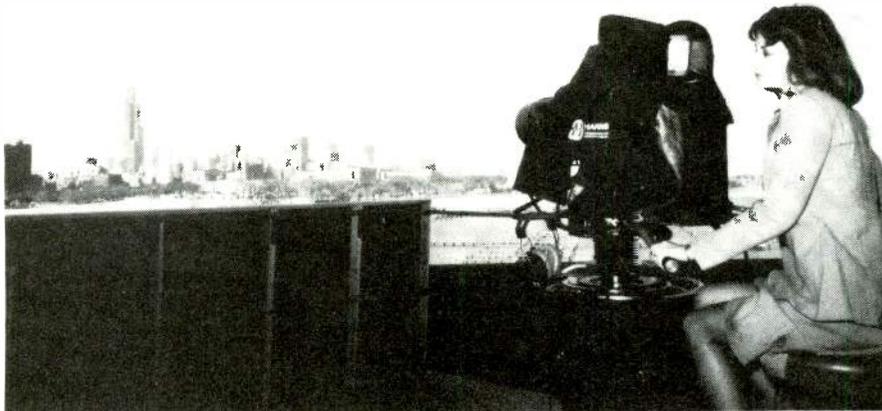
Orban/Broadcast supplied the fol-

lowing information on their Optimod-FM compressor-limiter-stereo generator which they brought out in Chicago. "Since NAB '76, nearly 400" of the systems, "have been shipped to FM stations in the U.S. and Canada. Some of the group owners who have elected to go Optimod-FM are CBS, Bartell, Park, Plough, Bonneville, CBN, Metromedia, Sonderling, and SJR." According to the Orban/Broadcast statement, Optimod-FM is the only audio processor in operation at most of the sites. The system is being used with virtually every model of FM exciter or STL system and is Dolby compatible.

Along the same line, FM audio signal processing, Thomson-CSF said this about their Model 4101/4111 FM Volumax introduced last year: "Today's new recording techniques, higher quality transmitting equipment, and increased listener awareness mandated," the development of this system. With an ear to the future, Model 4101/4111 FM Volumax is Dolby, SQ, QS, and discrete quadraphonic compatible.

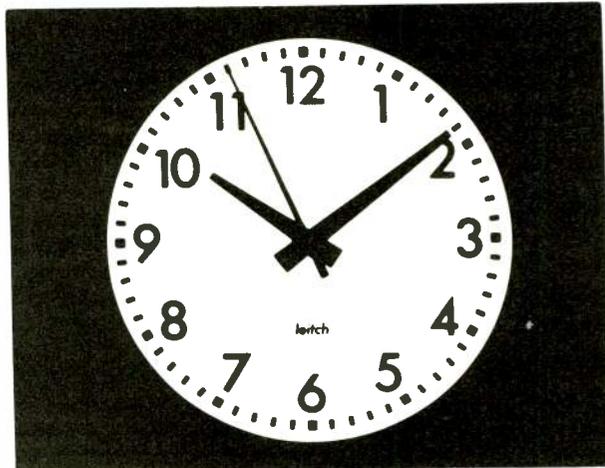
The Shafer 903E Extended Memory Automation System, introduced last year, is now the mainstay of the Shafer line from Cetec Broadcast Group. Over 35% of the entire year's

continued on page 88



Harris TC-80 Triax color camera unveiled at Chicago last year will be back.

It's the right time to try the new Leitch Precision Impulse Clock featuring Videglo.*



The Leitch Precision Impulse Clock has been developed by the craftsmen at Leitch Broadcast Products Limited to provide accurate time for broadcasters who demand precision time control with cool illumination. It will not upset the carefully controlled lighting of control room equipment.

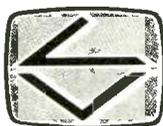
Each clock is equipped with Leitch's "Videglo" self illumination system that brightens the clock face without spilling over light into the control room.

Silent operation, compatibility with existing impulse master clock systems, American servicing and clean, attractive lines are just a few of the reasons for switching to Leitch.

Contact our representatives for a free trial. Your Leitch Precision Impulse Clock will be on its way to you in a matter of days.

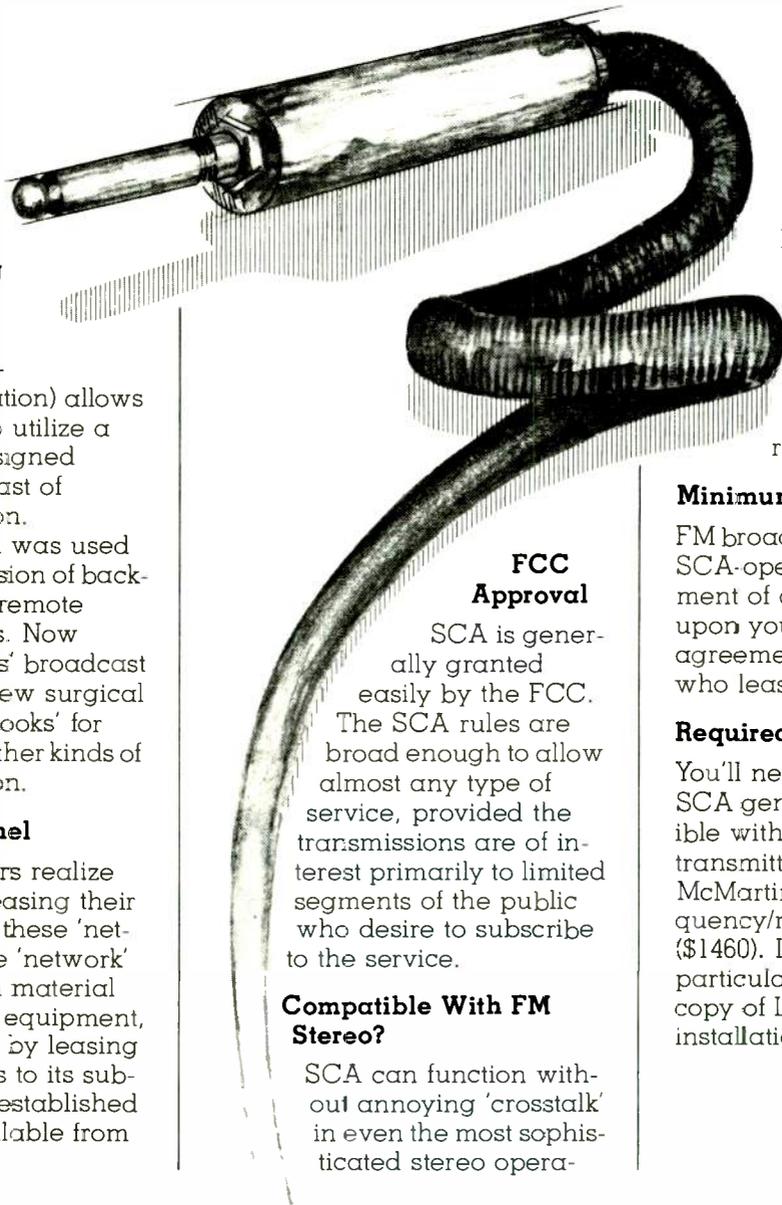
Clocks are available in a full range of sizes: diameters measure 16", 12", 8" and 5 1/2" (console mount).

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PLUG INTO PROFIT WITH SCA



SCA offers a unique opportunity for FM broadcasters to utilize existing equipment for additional profit.

SCA (subsidiary communications authorization) allows an FM broadcaster to utilize a subchannel of his assigned frequency for broadcast of specialized information.

Until recently, SCA was used primarily for transmission of background music, or for remote transmitter operations. Now special SCA 'networks' broadcast commodity reports, new surgical techniques, 'talking books' for the blind, and many other kinds of specialized information.

Lease Your Subchannel

Many FM broadcasters realize significant profit by leasing their subchannel to one of these 'networks.' Generally, the 'network' provides the program material and audio generation equipment, and makes its money by leasing special SCA receivers to its subscribers. A list of the established SCA networks is available from McMartin Industries.

FCC Approval

SCA is generally granted easily by the FCC. The SCA rules are broad enough to allow almost any type of service, provided the transmissions are of interest primarily to limited segments of the public who desire to subscribe to the service.

Compatible With FM Stereo?

SCA can function without annoying 'crosstalk' in even the most sophisticated stereo opera-

tions. McMartin's SCA specialist, Leonard Hedlund, has prepared a publication which details the procedures for crosstalk-free stereo broadcasting WITH SCA. A copy is yours free when you mail the reply coupon from this ad.

Minimum Investment

FM broadcasters can generally be SCA-operational for an investment of about \$2,100, depending upon your equipment and the agreement you make with those who lease your subchannel.

Required Equipment

You'll need a McMartin B-113R SCA generator, which is compatible with almost any modern transmitter (\$660). And the McMartin TBM-2000B SCA frequency/modulation monitor (\$1460). Installation is easy, particularly when you have a copy of Leonard Hedlund's SCA installation guide.

PLUG INTO MCMARTIN

McMartin Industries 4500 S. 76th Street
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- Send Leonard Hedlund's SCA Guide
- Send Information On McMartin's SCA Equipment Line
- I'd like a call from a McMartin Sales Representative

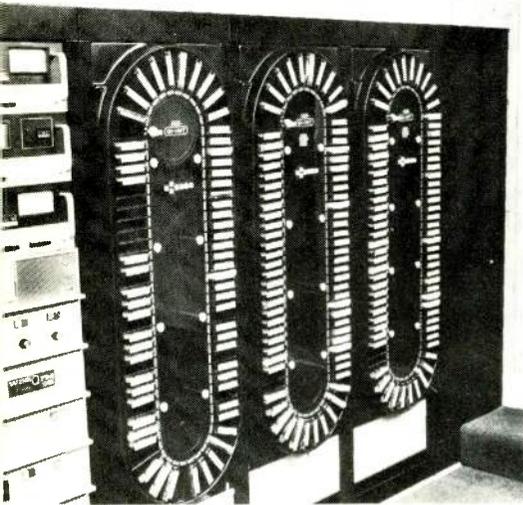
Name _____
Title _____
Station _____
Address _____ City _____
State _____ ZIP _____

Talk SCA with Leonard Hedlund and see our equipment: Booth 200A, NAB

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NAB Convention

WDZQ FM 95



The IGM Go Cart Model 78 as installed at station WDZQ.

shipments were 903s, according to the Shafer statement. One has been delivered to Australia with others contemplated there. No changes have been made in the features or design of the 903, nor are any planned. The

system will be at NAB '77 in Washington.

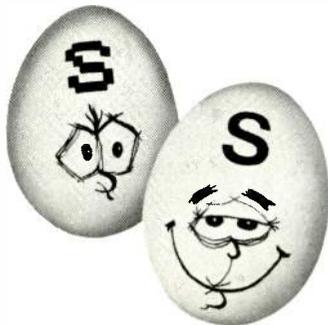
UMC, a new entry into the stereo cartridge machine market last year with its Beaucart series, reports that the acceptance of these machines by the broadcaster for the reproduction of commercial spots and music has been excellent. During the year a number of features have been added to the machines, mostly at the request of the broadcaster. Some of these have been special audio switching, motorized azimuth control, and modifications to meet the need of remote broadcasters. The basic product line is being expanded and introduction of new products this year is expected. The basic unit will continue through 1977 and into the foreseeable future. More than 100 of the machines are now in use.

IGM has had an interesting time of it with their Go-Cart cartridge systems. The First 42-cartridge Go-Cart was shown in static form at the '75 NAB. By NAB '76, the 42-cart Go-Cart was in production and IGM showed a fully operational model at Chicago. Some of the broadcasters who viewed the machine suggested a bigger model and IGM began to design and build a 78-cart model. While the 42-cart version is still going strong, IGM has already built and delivered eight of the 78-cart, Go-Carts. In-

quiries by customers led IGM to consider dual play positions for the Go-Carts but after some investigation it was determined to stick with the single play head approach and recommend to clients that for back to back plays they can get best results by using two Go-Carts. A recent IGM ad incorrectly stated that dual play heads were available and IGM has apologized for the misstatement.

IGM also brought out a Marc VII Manual Assist Remote Control device at NAB last year. The Marc VII is now in full production and the first one has been installed at KTNT-AM, Tacoma, Washington. The Marc consists of an entry keyboard onto a CRT readout accommodating 18 one-line events, interfaced to call upon as many as seven audio inputs, each with the capability of addressing 99 sub-sources. Used with cartridge handling systems or conventional sources such as reel-to-reel players, the Marc VII permits the operator to schedule ahead.

Next month *BM/E* will, of course, be providing the most comprehensive preview of what's new for '77. We feel that this follow-up on last year's new products will help broadcasters gain perspective on what is happening and get a pulse on the trends in broadcasting before the next wave of new products. **BM/E**



Datavision D-3000 Generates Characters ...Smooth on the Curves!

The most significant feature of any character generator is the quality of the characters it generates. Simple. Character quality shows in the smoothness of curved letters and numerals. An obvious "stair-step" tells you that the manufacturer skimped by using less elements in the matrix.

The Datavision D-3000 has 1120-element character resolution, as good as the most expensive equipment on the market, and at significant cost saving. Plus, the D-3000 is loaded with other features: two character sizes; two independent output channels; 3 speed roll and crawl; character edging; word flash; automatic centering; and optional D-4000 Random Access Storage System.

For all the facts, and a free on-site demonstration, phone (301) 948-0460 or write: Datavision Video Products, Mincom Division, 3M Company, 15932 Shady Grove Road, Gaithersburg, MD 20760.



D-3000...you're a smoothie!

Datavision Video Products **3M**
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Hitachi FP3030



Hitachi SK-70

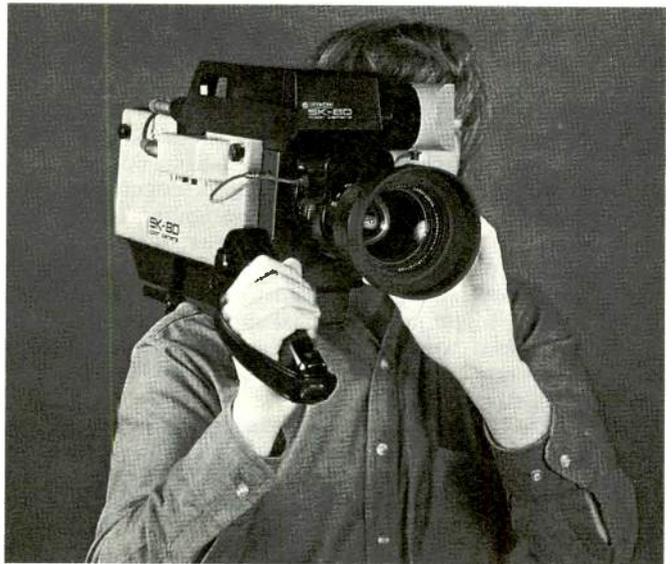
Three Different Ways

The addition of the new Hitachi SK-80 camera to our existing line, now gives you three top performance Hitachi ENG cameras to choose from. Each camera also has the versatility to be applied to other non-ENG operations.

Hitachi FP3030 A low cost and lightweight (7.7 lbs.) completely self-contained portable color camera with built-in battery that is ideal for broadcast capability in ENG, as well as a variety of industrial applications. The FP3030 also features excellent colorimetry and sensitivity with registration-free tri-electrode single tube.

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Hitachi SK-80 Totally self-contained ENG camera whose exceptional design and features are sure to be appreciated by broadcasters. Features three 2/3" Saticon tubes. Optional Gen-Lock available, as well as many other fine built-in features.



Hitachi SK-80

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INTERPRETING THE **FCC** RULES & REGULATIONS

Further Changes In FCC Technical Rules

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

THE COMMISSION TOOK ANOTHER STEP in its reregulation of radio and television broadcasting by amending, updating and deleting portions of its technical rules¹. The changes relate to authorizations for continuing equipment tests, special field tests, remote control, special antenna equipment tests, as well as to changes in antenna systems and equipment and operating power determination and maintenance.

The rule changes became effective December 13, 1976.

Continuing Equipment Test Authority

In the past, AM stations have had a problem in conducting weekly or monthly field strength measurements² and, for stations operating directional antennas by remote control, annual antenna proof of performance measurements³. Skywave signals from co-channel stations sometimes adversely affect the accuracy of measurements made during nighttime hours. Taking measurements at nighttime also proves difficult in many cases. For these reasons, many stations request special temporary authority (limited to 90 days⁴) to broadcast with the nighttime directional antenna during the *daytime* at reduced power to make the required measurements. This causes interference with nearby daytime stations, in some cases.

The Commission acted to ease its administrative workload imposed by repeated processing of requests for special 90 day temporary authorizations. The Commission amended its Rules⁵ to provide for *continuing* equipment test authority. Henceforth, AM stations may submit an informal application for this type of authorization. The Commission will review the application to determine if interference to daytime stations will occur. If interference is not substantial, an authorization will be granted for a specific time period or indefinitely. The Commission may cancel or modify the authorization at any time. The authorization must be posted with other station licenses.

¹Order, FCC 76-1062, adopted November 16, 1976; released, December 3, 1976.

²Sections 73.68, 73.69 and 73.93(e) of the Commission's Rules.

³Section 73.66.

⁴Section 1.542.

⁵Section 1.544.

⁶Section 73.36.

⁷Section 73.40.

Special Field Test Authorizations

The Commission clarified its Rules⁶ relating to special field strength (and other) measurements. Henceforth, field test stations need *not* comply with all provisions of the Emergency Broadcast System (EBS) rules. The rationale underlying this rule deletion is that field test stations do not transmit public use programming. Requiring these stations to (1) maintain signal encoding and decoding equipment and (2) transmit EBS test messages, is superfluous.

AM Transmitter Construction and Installation: Safety

The Commission remains concerned over safety to station personnel working in and around the transmitter building and the entire transmitting system area. The possibility of accidental contact must be eliminated. Where possible, radio frequency power coupling devices should be installed in positions where station operating personnel will not come into contact with them. Devices can be installed above individual reach. Alternatively, these devices should have protective enclosures with locks or interlocks (switches that cut off power when the enclosure is opened).

In the same vein, walkways to meter monitoring locations must be made as safe as possible. The Commission considers such walkways to be a part of the transmitting system. As such, construction and installation safety requirements apply⁷.

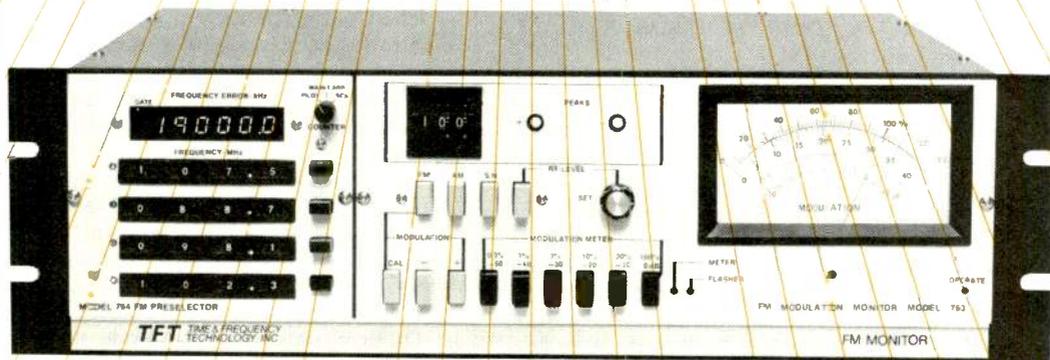
The Commission also clarified Section 73.40(b) (3) of its Rules to require that keys to (1) the protective fence around antenna towers and antenna tuning houses and (2) protective cabinet locks, be available at the transmitter site.

In those cases in which a station's antenna tuning unit cabinet is located within the fence base, a *separate* lock is not necessary for the tuning unit enclosure.

The Commission made one additional clarification of Section 73.40. The term "carrier shift" is often confused with a shift in the "frequency" of the carrier wave. More appropriately, the "carrier shift" may not exceed "5 percent for any level of modulation up to 100% as measured with a 400 Hz tone." To avoid future misunderstanding, the Commission substituted in its Rules the more correct term "carrier-amplitude regula-

continued on page 92

No-Risk High Modulation For FM Stations



Now TFT gives you FM modulation monitoring that's so precise you can modulate your FM transmitter to the absolute legal limit—in absolute confidence. TFT monitors give you fast, unambiguous readings with an accuracy of one percent. And they can be tailored to your needs and budgets.

Our Model 763, for example, is an economical way to get precise measurement and make proof of performance measurements. It connects directly to your transmitter. Or, if you want off-the-air capability, add our optional Model 764 Preselector. It gives you frequency synthesized tuning and digital readout of carrier and sub carrier frequency errors. And, our Model 765 gives you everything the Model 764 does, except frequency readouts.

What's more, both Preselectors give you a fast, precise fix on how your modulation measures up to the competition. With either one, you can tune in other FM stations, one-at-a-time, and monitor their modulation off-the-air.

In addition, the Model 764 gives you the ability to preprogram up to four stations via thumbwheel switches. One of them can even be yours. Then, by simply pushing a button, you can monitor any one of the four off-the-air.

No matter which kind of system you choose, you'll get all the quality features that have made TFT the industry standard.

- Stereo and SCA add-on capability
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- 50 μ v sensitivity
- Two RF inputs for local or remote use
- Digitally settable peak flashers
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- FCC Type Approval Nos: 3-236 (FM), 3-237 (Stereo), 3-238 (SCA)

For a demonstration of how TFT can take the risk out of high modulation, ensure full FCC compliance and give you a calibration of your competitive position, call or write.

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FCC Rules And Regulations

tion," defined as:

The change in amplitude of the carrier wave when the modulation is applied under conditions of symmetrical modulation.

Reference to "carrier shift" is retained in the rules parenthetically because of continued widespread use.

Remote Control Authorizations

The Commission removed the one-year stability showing requirement for directional remote control applications if the station has (1) a type-approved antenna monitor and (2) a sampling system meeting Section 73.68 approval specifications⁸. Conformance with these two criteria eliminates the need to show satisfactory operating experience for a full year prior to obtaining remote control authority. Hence, the burden of employing an operator on duty at the transmitter site for a full year prior to remote control authorization serves no necessary purpose and is eliminated. AM's with directional antennas are now treated the same as other AM's and all FM's.

The Commission amended Section 73.114(a)(9) of its Rules to ease the requirements regarding the reading and logging of particular antenna meter and monitor indications. Previously, AM stations using type approved antenna monitors with directional antenna systems were permitted to log the above-noted indications every second day if the station was not using remote control. This has proven impractical to many stations that had only third class operators on duty on weekends, and would have to have first class operators on duty sometime on Saturday or Sunday to log the "every other day"

indications.

The Commission remedied the situation by changing the reading and logging requirement to "three times per calendar week." Specifically, logging entries must be made for each directional radiation pattern "at least three days of each calendar week with readings taken at least 44 hours but not greater than 76 hours apart." Further, the Commission extended this rule to stations using directional antenna systems that are *operated by remote control*, if type approved antenna monitors are also used.

Alternate Main Transmitter

The AM rules do *not* require that an alternate main transmitter for an AM station have the same power rating as the licensed main transmitter. The FM and TV Rules⁹ do contain such a requirement. There is no reason for such a requirement as long as the alternative transmitter is capable of *operating* at the licensed output power. Therefore, the Commission deleted the identical power rating requirement for FM's and TV's.

Changes in Equipment and Antenna Systems

The Commission adopted an informal application procedure for licensees who desire to upgrade program service quality by modernization of transmitting equipment. Previously, a formal construction permit (CP) application had to be filed for many equipment improvements.

An informal application may now be filed if a station seeks to replace a transmitter (1) stereo generator unit or (2) FM exciter unit with a type unit *other* than that which was included in the transmitter as type accepted. The replacement must await specific Commission authorization even though the application is deemed "informal."

Other changes may be made without specific Commission authority if the station gives the Commission notice of the changes within 30 days.

Determination and Maintenance Of Operating Power

The direct method of power determination is more accurate than the indirect method, but requires additional calibration equipment. (The indirect method is less accurate because the efficiency factor is taken from information supplied by the manufacturer to the Commission for type-acceptance purposes; time and external factors sometimes cause substantial discrepancies between the manufacturer-determined efficiency factor and the station equipment's actual efficiency factor.) The Commission amended its Rules to permit FM's to utilize the most accurate efficiency factor determination available, rather than just the manufacturer's instruction book measurement data.

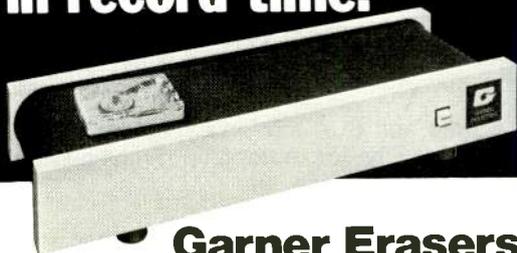
A TV station that uses the direct method of transmitter output power determination must record the required calibration in its maintenance log. FM stations were not required to do so; as a result, FM's were sometimes unable to document transmitter transmission line calibration. The Rules are revised to require FM's to log these measurements, including a brief description of the methods and results utilized in taking the measurements.¹¹

Conclusion

These Rule changes will more uniformly conform the AM, FM and TV services Rules. Although quite technical in nature, station personnel should study the changes in detail. Significant personnel time and money may be saved by taking advantage of the newly relaxed Rules.

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⁸Section 73.66.

⁹Sections 73.256(FM) and 73.637(TV)

¹⁰Section 73.267(a)(3).

¹¹Section 73.284.

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The new 169 mixing console in combination with the also new B67 tape recorder provides the remote recorder with the highest quality capability in an easy to move package.



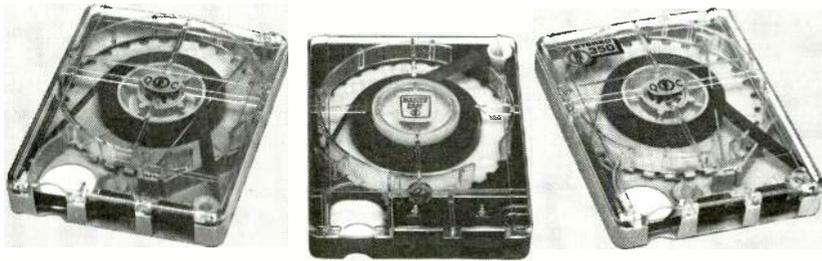
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Speak Out

our stations.

You and I were raised in the belief that our sole means of support is time sales. Certainly, advertising will continue as our primary revenue base, but now may be the opportune time to explore the potential we have long overlooked.

Many of our own people have already successfully tested diversification. Consider the radio station which operates a cable TV system. Here are two operating centers, each providing a source of profit for the corporation.

Our challenge is to fully develop this concept, finding logical directions in which to expand our financial base.

Look at what your fellow broadcasters are already doing.

I recently learned of a mid-west station which was into direct mail advertising as a profit center, affording the sponsor a choice of media. It's an appealing idea when we consider that nationally, direct mail draws in twice the advertising dollars of radio.

Audio equipment and record sales are up. A southeastern station turned an unused studio into a stereo shop as a profitable profit-center.

Your engineering department need no longer be a financial liability. Create an asset by meeting the demand for electronics service required by the growing list of home and office equipment.

Your business office can be a profit-center. One station purchased data processing equipment, then sold service to other corporations in their community.

Our opportunities are unlimited; there is a wealth of untapped profit potential waiting to be harvested.

Added to our present time sales, these new centers of profit provide the financial stability which I believe will be necessary for radio's continued prosperity in the changing economic environment of the coming decades.

The alternative is to persist in investing all our "eggs" in the advertising time sales' basket. This formula has sustained us for a half-century and seems the most secure route into the immediate future, but change has a talent for exploding security.

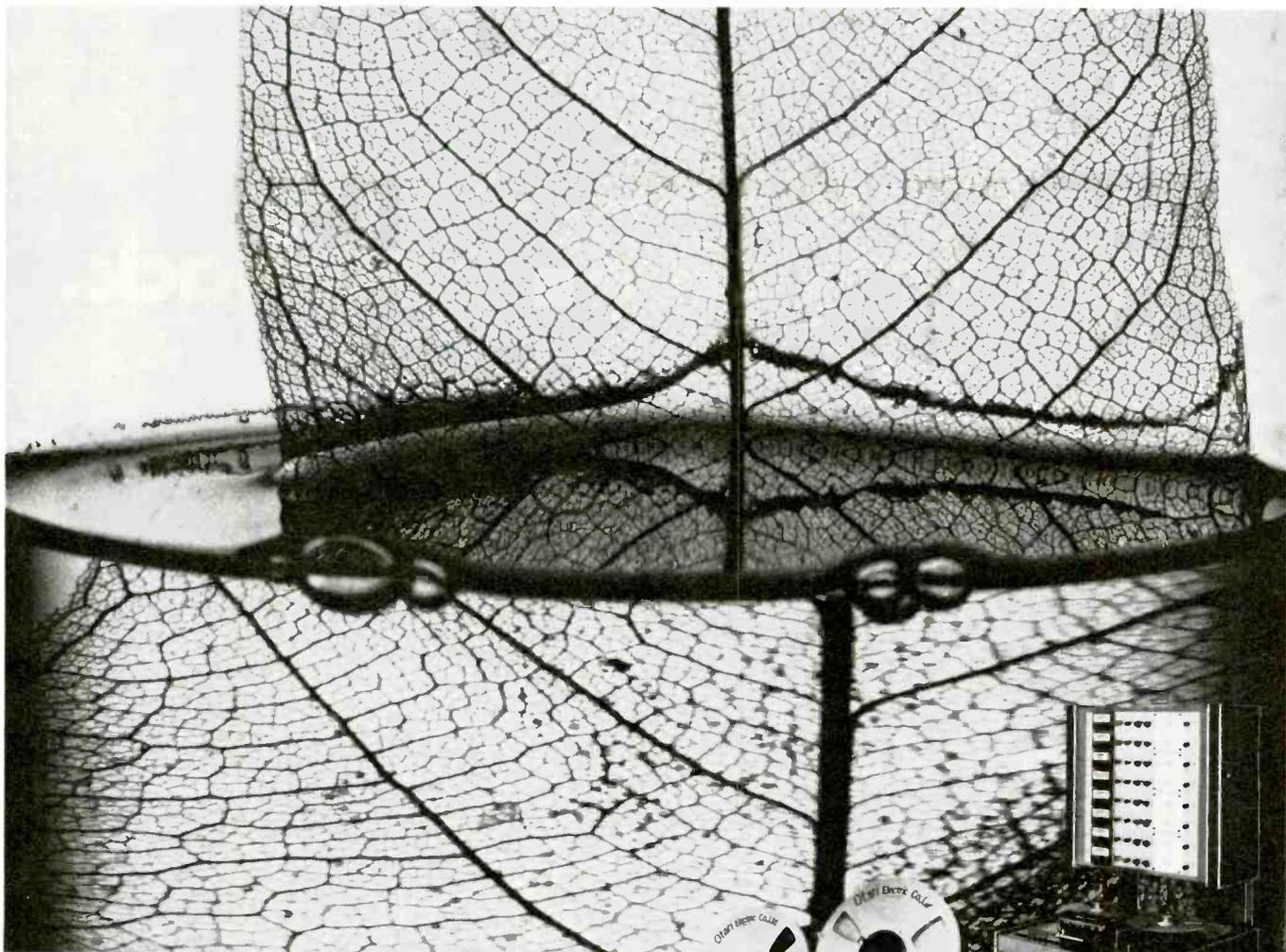
Remember the inner-tube, the slide rule, the vacuum tube, the ice and coal company, and downtown shopping?

Every industry periodically faces change; the period seems to average thirty years. Flexible industries survive; others fade into nostalgia.

It will soon be three decades since television brought us our last major upheaval.

I see an exciting, challenging future for the radio broadcaster willing to test the fertile soil of diversification. **BM/E**

once is enough!



Water is pure and clear. Still, if we look at a leaf which is partially submerged in it, the leaf looks distorted. It is surprising how easy it is to introduce distortion, even by the simplest type of operation on the real thing. The bent leaf doesn't really bother us very much, but when distortion in sound results from the use of equipment, this bothers us a lot!

Some OTARI specialists spend most of their day making sure that the equipment that we produce has the lowest possible wow and flutter, and the highest possible S/N ratio. Naturally, these are not the only features which create the top performance of OTARI products, but they reflect the care that results in a totally balanced OTARI product, and better service.

Trust through experience — one encounter with OTARI equipment and from then on, You will trust the OTARI name.



MX-5050-2S



MX-7308

OTARI

OTARI CORPORATION: 981 Industrial Road, San Carlos, California 94070, U.S.A. Phone: California 415-593-1648 Telex No. 259103764890 OTARICORP SCLS
OTARI ELECTRIC CO., LTD. 4-29-18, Minami Ogikubo, Suginami-ku, Tokyo. 167 Japan Phone: (03) 333-9631 Cable: OTARIDENKI TOKYO Telex: J26604 OTRDENKI

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BY CAPITOL

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A-2
BY CAPITOL
professional broadcast cartridge

The Audiopak® A-2 by Capitol® Broadcast Cartridge.

Broadcast engineers rely on Audiopak® A-2 Cartridges for good reason. All of the major components are assembled to get you from point A to point B. With efficiency and precision. For example, the constant-force, foam pressure pad assures unvarying head to tape contact over the life of the cartridge. The positive, non-slip brake mechanism locks the tape, rather than the hub, assuring accurate cueing and timing. The strong durable housing is yet another factor contributing to its reliability.

And to assure you of premium performance, each cart is individually tested —100%— for wow and flutter, electrical output, tension, and other properties. And because we manufacture the entire package—from tape to packaging—we can assure you of the highest possible quality control.

After all, no other tape manufacturer knows professional recording and duplicating needs better than Capitol.

AUDIOPAK® A PROFESSIONAL PRODUCT MANUFACTURED BY THE SAME PEOPLE WHO MAKE AUDIOTAPE®, AUDIOFILM™, AUDIODISCS® AND THE LEARNING TAPE™ BY CAPITOL®

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CAPITOL MAGNETIC PRODUCTS A DIVISION OF CAPITOL RECORDS, INC., 1750 NORTH VINE STREET, LOS ANGELES, CALIFORNIA 90028

Circle 115 on Reader Service Card

BROADCAST EQUIPMENT

Some top-of-the-list products announced recently are a new ENG color camera; a 5-meter antenna for earth stations; a 78-cart automated handling system; and a multi-channel ENG antenna system.

Color ENG Camera 300

New ENG color camera is smaller and lighter than the maker's earlier models; better performance is claimed. The new Ikegami HL-77 weighs 21 pounds, has three PbO tubes, f/1.4 prism optics, 1½ in. viewfinder, automatic iris, registration stabilized against terrestrial magnetism. It has S/N ratio of 48 dB, bandwidth to 4.5 MHz, pre-heater for quick starts, center resolution 500 lines. IKEGAMI.

5-Meter Antenna 301

New dual-polarized 5-meter earth station antenna designed primarily for the CATV industry uses prime focus feed for wide-angle side lobes. Claimed surface tolerance is .044 in. RMS. System can receive vertical and horizontal signals simultaneously. Manufactured precision eliminates need for special field adjustment. SCIENTIFIC-ATLANTA.

"Go-Cart" Holds 78 Carts 302

Extension of automatic cart-handling system provides model for 78 carts as well as earlier one for 42 carts. New model handles carts on flexible chain like older one. Cart called up is moved to stationary deck for play; maximum worst access time is 8 seconds. Micro-processor control allows system to be used in a variety of ways. IGM.

ENG Multisignal Antennas 303

Quad-polarized microwave receive antennas with four horns covering 360 degrees, electronically selectable, are issued in new versions with electronics for handling two or more signals simultaneously, even on one horn. Circular polarization reduces effects of ghosting and smearing. Complete and separate controls for each operational channel are provided. Bands utilized are 2 GHz and 7 GHz. NURAD.

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

New Time-Base Corrector 304

Time-base corrector is for both high-band and helical VTRs. Model BVT-1000 provides velocity and drop-out compensation, full processing and full NTSC sync. Window is ± 2 H, and "moving window" circuit helps locking with wide error excursions. Unit handles both direct and processed heterodyne modes and has anti-gyro circuits for portable VTRs. \$16,000. SONY.

Fluid ENG Camera Heads 305

Four new fluid pan/tilt heads cover range of weights for cine/ENG cameras: Samson Mini (20 lb.); Samson Junior (30 lb.); Hercules Hydro (50 lb.); and Hercules Fluid Cam (50 lb.). All have independent positive pan and tilt locks, 360° pan range, and choice of Pro Jr., ball level, or geared column bases. QUICK-SET.

R-Mod With Auto Cue 306

The R-Mod, reel-servo modification kit for quad VTRs, is in a new version with an automatic search and cue mode. Pressing the "hold" button at the desired image stores the wanted frame in memory and pushing "hold" again causes automatic cue up to a pre-roll position. Then "play" starts tape and sends edit pulse at selected frame to an electronic editor. R-Mod Kit complete (including new auto cue), \$8500. RECORTEC.

Pulse Distribution Amplifier 307

Distribution amplifier for pulse signals has six outputs. Pulse width adjustment is 0.5 microseconds, delay adjustment to 6 microseconds. With one delay adjustment, all outputs, \$225.00; with three separate adjustments (one for each 2 outputs), \$275.00. DI-TECH.

CCTV Camera For Low Light 308

Useful pictures in light from starlight to full sunlight are produced by TV camera with intensified silicon intensifier target. Model TC1040/H is for CCTV applications, has dynamic range of four billion to one. Lens options include four fixed and three zoom lenses. Runs on internal sync, phase-locked loop or crystal control, reverts to internal sync if exterior control is lost.

continued on page 94



Cameraman's Headset... Keeps the crew in touch

A professional TV Cameraman's Headset series specifically designed to interface with existing Western Electric circuits. Single side unit receives intercom only. Dual side, binaural unit receives intercom and monitors program. Carbon boom mike with optional push-to-talk switch. Designed for comfort and rugged dependability in every day use. Keeps the crew in touch—in or out of the studio. For complete information please write:

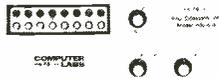
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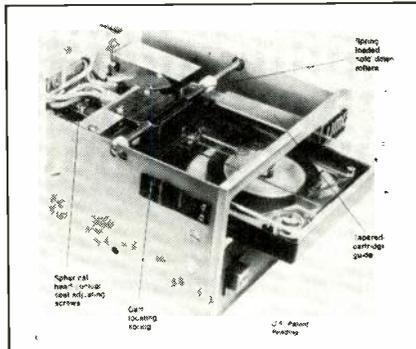
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Broadcast Equipment

\$8000 (plus lens). RCA.

New Locators On Cart Machines 309

Stereo cart machines have locating devices to improve position accuracy. Included are: spring-loaded rollers for left corner post; tapered cartridge guide



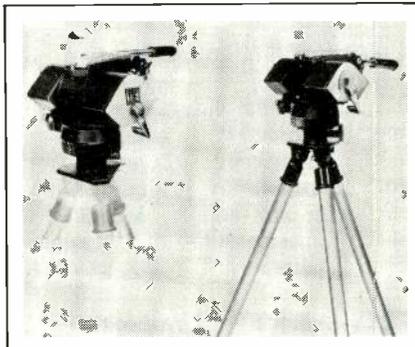
to put cart smoothly in right position and locating spring for squareness in relation to heads. Also: a spherical head/conical seat allows azimuth adjustment with heads immune to external movements. UMC ELECTRONICS.

Semi-Automatic Tape Splicer 310

User's fingers do not touch the tape in making splices with Hervic-Minette Tape Splicer. The splicing tape is held in the unit and is automatically applied. There is a 1mm clearance on recorded side so it will not be damaged. \$10.40. HERVIC.

Portable Camera Head, Tripod 311

Camera head with hydraulic damping and five-pound tripod are for ENG-type cameras up to 30 pounds.



Model ITE-H9 counterbalance gives constant center of gravity, quick disconnect speeds use. \$575. (Heavier models available). INNOVATIVE TELEVISION EQUIPMENT.

Tiling Module For Ditching 312

Burying plastic drain tubing up to 8 inches in diameter to depths up to 6 feet can be carried out with new R-100 tiler,



**SYLVANIA
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Portable Pro Movie Light
for All Film - Tape - ENG
One-hour full recharge · Fingertip
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hand-held · Up to 50 minutes shoot-
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gen · 15,000 c.pwr. spot · 3½ lbs.
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Modern recording capability for new or old recorders. 2-speed EQ, separate EQ for optional SYNC amp. "Linearized" record amp and phase-corrected reproduce circuitry. Fully remotable. Pin-compatible with most Ampexes, adaptable to many others.

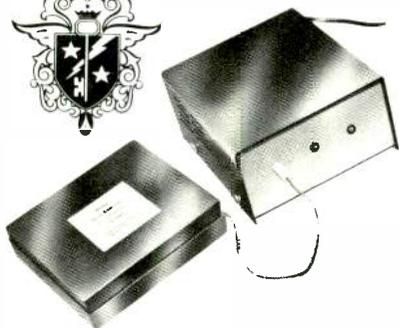
Model 375, \$690.

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The Washington Connection

**BM/E has some Capital Ideas
for Nab '77**

● **Next Month: March Convention Issue:** The most complete preview of the NAB Convention. The new products and inside track on what must be seen in Washington. (Manufacturers be sure you have your products highlighted in this issue.)

● **The Washington D.C. Survival Guide:** The indispensable guide to the exhibits, sessions, and the Washington Scene. The daily planner, maps, inside information on restaurants, points of interest and the Capitol Hill problem solver will make this Survival Guide a bonanza for all who attend this year's convention.

● **May, NAB "Show-In-Print":** The most authoritative recap of what NAB '77 meant to broadcasters. The next best thing to being there and maybe even better. Products and Progress of importance to broadcasters.

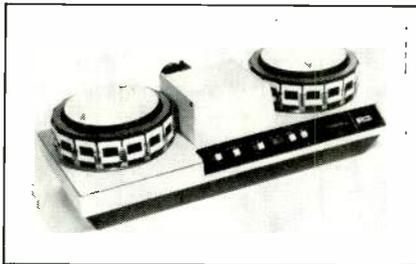
(Manufacturers if you went to the expense of an exhibit, make sure your editorial information is in our hands before leaving the show.)

Broadcast Equipment

module for attachment to R-100 ditching assembly. Tiling boot molds clean groove bottom, then machine puts right amount of dirt on top. Optional laser equipment provides automatic grade control. **DITCH WITCH, DIV. OF CHARLES MACHINE WORKS.**

Microprocessor Slide Control 313

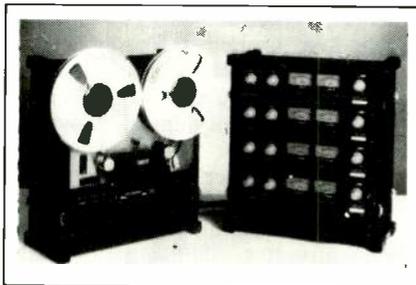
A slide projector with microprocessor control has sixteen different dissolve rates, left and right crawls, high speed random access, a 451-cue memory system. The Producer 32 Selectroslide works into a single multiplexer port in a TV film chain, or can be easily applied



to making motion pictures from slides. All functions are remoted on 46-button master control, with status lights to show condition and 7-digit readout of slide tray positions, up-coming cue. The two trays hold 32 slides, can be refilled during operation. **SPINDLER AND SAUPPE.**

Compact 8-Channel Recorder 314

The 8-channel MZ-5050-8 is a compact half-inch tape machine specifically designed for small studios and musical groups that don't require compatibility with the standard one-inch 8-track machines. The professional features of



the MX-5050-8 include synchronous reproduce on all channels, front panel edit control (which allows both spilling and rocking), IC digital control system

**For more information
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continued on page 102



Communications Headsets... ...for whatever the job

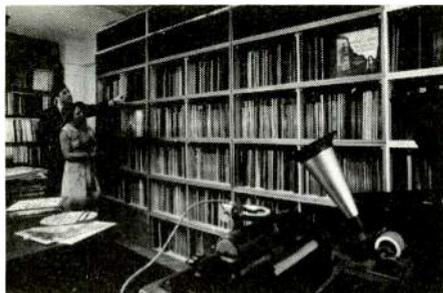
Telex 1320 series headsets offers you six models for all general communications requirements, indoor or out. Single or dual dynamic drivers are impervious to environmental humidity or temperature changes. With optional boom mikes, noise canceling dynamic or carbon. Designed for comfort. Dependably made for heavy duty use. Complemented by the compact Telex IC-10, amplified common talk intercom system for dynamic mike headsets. For "whatever the job," please write for free information:

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Canada: Telak Electronics, Ltd., Scarborough, Ontario

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No matter how young or old the recording, the Institute of the American Musical, Inc. relies on Stanton for playback.

Speaking of problems, how would you like to be faced with the need to accurately reproduce the sound from Edison Diamond Discs, Pathés and Aeolian-Vocalions? That's just what the Institute is faced with — and that's precisely why they turned to Stanton cartridges.

The Institute collection consists of approximately 35,000 recordings, from just about every American theatre or film musical since the Berliners of the 1890's through to the latest stereo and quadraphonic recordings. They have original, historic machines to play the old recordings, but the arms are heavy and the old styli insensitive and somewhat worn. Furthermore, the acoustic playback does not permit them to filter the surface noise or tape these rare records.

Miles Kreuger, President of the Institute, discussed his problem with other famed and experienced archivists. They all agreed that the Stanton calibrated 681 Series was the answer. Naturally, it is the 681 Triple-E for critical listening and taping with more recent discs; the special 681 stylus for LP's; and, for some old 78's, a 681 cartridge, especially wired for vertical response (with a 1 mil stylus).

Today, scholars, authors and researchers, can get perfect to adequate reproduction of any of the material in the collection. The work of the Institute is important work . . . Stanton is proud to be an integral part of it.

Whether your usage involves archives, recording, broadcasting or home entertainment, your choice should be the choice of the professionals . . . the Stanton 681 Triple-E.

Write today for further information to:
Stanton Magnetics, Terminal Drive,
Plainview, N. Y. 11803.



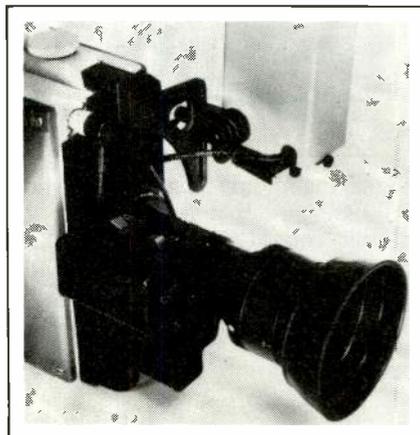
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Broadcast Equipment

with motion sensing to prevent tape damage, adjustable cueing control for audible monitoring in fast forward and rewind, optional DC capstan servo system, front adjustable bias, record lockout, capstan location on non-oxide side of tape, optional portable case, rack mounting kit, or floor console, optional low Z balanced input and output transformers, 600 ohm outputs, XLR connectors, variable or fixed output-level, fixed output switchable between +4 or -10 dBm (standard reference level). OTARI.

10X ENG Lens 315

This rugged lightweight Schneider lens for 2/3 in. cameras features a modular plug-in servo system. It permits the user to add servo zoom to the lens at any



time or remove it when not needed. Optically it is a 10 - 100mm, f/1.8 lens with macro focusing. Prefocused range extenders are available in 1.5x and 2.0x. \$4,000. TELE-CINE, INC.

Zoom Versatility In New Lenses 316

Increased zoom versatility, without any f-stop loss, is claimed for new snap-on supplementary lenses. A 1 1/2 X tele-converter fits the Canon 12-120mm and 12.5-75mm zoom lenses, increasing focal length 1 1/2 times. The 9mm wide-angle adapter gives increased acceptance angles for the same two lenses only, decreasing focal length to 9mm. Tele-converter, \$885. Wide-angle adapter, \$180. CANON.

Black-Burst Generator Kit 317

New kit is aimed at easy addition of black burst to any NTSC color sync generator lacking black burst output. The Model BBG-1 operates with any sync generator that has composite sync, burst flag, subcarrier, blanking and a 5 volt power supply. \$89.00 VIDEO AIDS CORP. OF COLORADO.

Most TV Studios have seen the light.

And Bought it.

Bardwell & McAlister's 2 kw Junior Spotlight with 10" Diameter Fresnel.
Model 14006:
Listed at
\$22250

FEATURES TUNGSTEN HALOGEN "QUARTZ" LAMPS

Specifically designed for high intensity CONTROLLED spot-to-flood lighting in TELEVISION, MOTION PICTURE and large still studios. This 2 kw is one of the most versatile lights on the market and is the industries most outstanding value.



Exclusive features decrease maintenance cost and increase lamp life: 1. New patented arc free socket with toggle-operated, pre-set, spring-loaded contactors. 2. New Ventilation System designed to provide full "flu-action" airflow through either axis. 3. Full parts and service facilities. 4. The best barn door design in the industry.

B & M is the leading TV studio lighting manufacturer in the U.S., offering a complete line of spots, flood, set lights, cyc strips, quartz lights and grip equipment.

Write for FREE catalog or contact your lighting equipment dealer.

Bardwell & McAlister Inc.

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You should, for one, if you buy and use high technology television gear. Those manufacturers which own patents for their products have demonstrated the experience and capability for state-of-the-art design. This experience directly affects the quality and sophistication of their final product.

Spectra-Vision Corporation owns the patents that are the heart of our exclusive Backspacer editor-programmer systems. These patents represent years of research into a technology that we at Spectra-Vision evolved and are constantly striving to improve. The high quality of design that results means consistent operation-to-spec for our programmers plus simple yet reliable modifications to programmed VTR's.



Spectra-Vision JBT-104 Backspacer

PATENTED PREVIEW

Spectra-Vision's patented rolling preview system allows you to see each edit (if you wish) before it happens. The picture and sound on the playback monitor change exactly at the point of edit. The VTR's recue automatically to their pre-roll point for the actual "take."

ELEGANT MODIFICATIONS

Building a programmer is only one part of our story. Our modifications for JVC, Sony, IVC, Panasonic, and Ampex are simple and elegant. We do not adjust the factory pre-set tape path. In addition, Spectra-Vision's modification kits may be installed at our factory, at your dealer's service shop, or at your location by any qualified technician (most VTR's).



Spectra-Vision now modifies JVC-8300U VTR for programmed video editing and Super-Speed Search.

For more information and complete specifications on Spectra-Vision editor-programmers and accessories, call or write:

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Broadcast Equipment

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Video Source Identifier 318

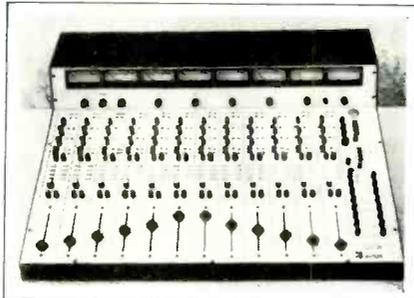
Electronic "tagger" puts any of 64 characters, up to 8 per line, on video signal, for identification. VSID-8 can put characters on any part of screen, in any shade of grey from black to white, with or without background surround. QSI SYSTEMS.

Processing Amplifier 319

The "Genlock Processing Amplifier" allows addition of new backgrounds, titles or action during editing from another camera. Amplifier supplies sync and blanking regeneration, black burst, image enhancement, dark current restoration, color correction, DC restoration, automatic video limiting, other signal processing actions. \$2500. SIEGAL ELECTRONICS.

Eight-Bus Audio Console 320

Audio console has, on each input module, two independent echo sends, two cue sends, six EQ frequencies, in-out EQ switch, line/mic switch.



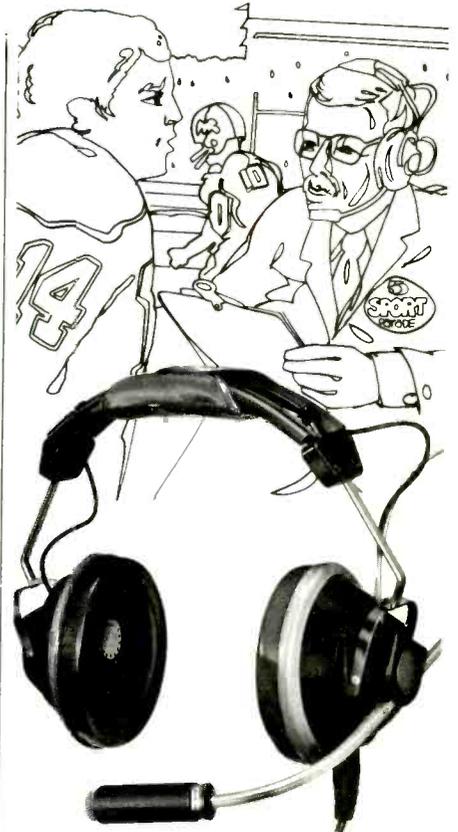
QM-128 also has stereo monitor with push-button selection of bus, line or playback, separate controls on cue, talkback, etc. \$4300. QUANTUM AUDIO LABS.

New Splicing Tape 322

A new splicing tape for magnetic tape, Brand 67, stays intact from -30°F to 150°F and at 80°F with 80 percent relative humidity. It has extended roll shelf life, a year minimum, according to the maker. Resistance to dynamic stress in bin loop transports is higher than that of earlier types. 3M COMPANY.

Low-Cost Character Generator 323

The new Model K50 has 36 scan line characters in a 16 character line, 8 lines continued on page 104



**Color, Action,
Hands-free
Mobility**

Combine the finest omnidirectional dynamic boom mike with an equally high performance binaural headphone and you have the superior Sportscaster headset...the Telex CS-90. For live broadcasts, from the station or on remotes, with cue and program monitoring and hands-free convenience. The audience hears every word, clearly, crisply, with crowd noise for background color and atmosphere. Circumaural ear cushions screen out noise in the immediate area so that special acoustic facilities are unnecessary. Supplied with convenient in-line, mike-muting "push-to-cough" switch. The Sportscaster headset. Color, action and hands-free mobility. For complete information please write:

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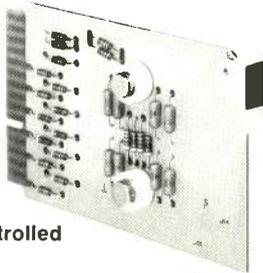
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Remote (D.C.) Controlled

- Four fully independent FET switch circuits on a compact plug-in PC card
- Fast, quiet, reliable Remote-Controlled audio switching
- For switching functions in mixing consoles, and audio switching/routing systems
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Broadcast Equipment

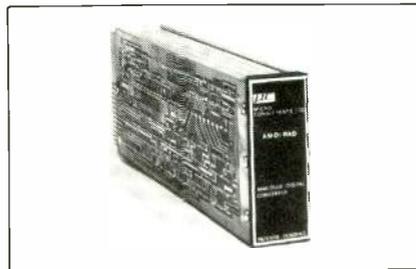
per page; the memory holds four pages, for composition on one page while another is displayed. Full cursor controls allow editing anywhere on the page. Below \$1000. KNOX.

Very Small Video Camera 324

Video camera measures about 8 ins. × 4 ins. × 2½ ins., weighs four pounds. Model C-125 works with light as low as 2 ft. candles, has 10,000 to 1 automatic light compensation, 500 lines resolution, externally adjustable beam and focus. Supplied with f/1.6 lens; standard C-mount accepts others. \$199.50. CREST ELECTRONICS.

A-D Converter For Video 325

An analog-to-digital converter for



video signals is on a plug-in module, one inch thick, 2¾ ins. high, 7½ ins. long. Model 2700/3 includes a differential amplifier, sampler, 8-bit encoder. Aperture uncertainty is 100 picoseconds, jitter less than 15 picoseconds, sine wave response to 20 MHz, rise time, 20 nanoseconds, conversion time, 66 nanoseconds. MICRO CONSULTANTS.

Recording Preamp 326

Preamp takes tape recorder head outputs, feeds mic and line to recorders, has line and monitor outputs. Model RP-85 has mixing facilities, self-synchronizing bias, two isolated DC outputs for external relay or lamp. It has FET switching, 60 dB bias rejection, RF immunity. Below \$260. TELEX.

Tornado Warning Receiver 327

A receiver for schools automatically cues into the Emergency Broadcast System so the school will get quick notice of tornadoes, other dangerous weather or any emergency covered by EBS warning. The "Tornado Warning Receiver" is cued on by the EBS two-tone alert signal, can be pre-tuned to nearest EBS-designated station. FIX-TUNE ELECTRONICS.

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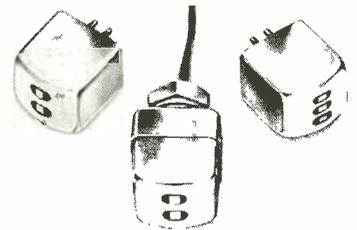
Ask for: HENRY BARRY

CARTOON/TYPE ANIMATION, INC.
85 NUTLEY AVENUE
NUTLEY, N. J. 07110

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Audio Heads? Get on the Beau bandwagon.

There must be some reason why the reaction to Beau mono and stereo audio heads has been so enthusiastic and widespread. There is: Quality and price. From the maker of Beau motors and Beaucart®



audio cartridge tape machines, Beau heads are equal to anything else on the market. But at \$19.00 for mono models and \$69.50 for stereo units, Beau heads are unquestionably the biggest bargain around. Heads either with no mounts or threaded studs with leads, right from stock, are available for all popular cart machines, including Ampro, ATC, Beaucart, Collins, Garron, Harris/Gates, ITC, RCA, Sono-Mag, Sparta, and Spotmaster. And if you can find another quality broadcast cart machine, we'll provide heads for it, too.

For a listing of all Beau audio heads, please request our new head brochure. Call (203) 288-7731 or write today.

UMC BEAUCART DIVISION
UMC ELECTRONICS CO.

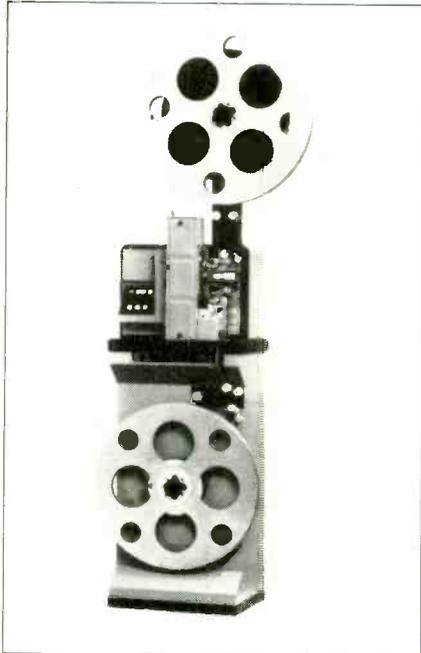
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Heavy-Duty Projector For TV 328

A film protector for TV has instantaneous change of direction, instant stop/start, unlimited hold on single frames. Model Athena 5000 holds from 100 to 5000 feet of 16mm film, has servo control with digital CMOS control circuitry, optical or magnetic play-



back. Digital control allows external digital programming or computer control. L-W INTERNATIONAL.

Lightweight Fluid Head 329

The fluid type camera head, Model 30, is designed for motion picture or video cameras up to 30 lbs, and weighs only 4½ lbs. It has infinitely variable drag adjustment; will pan 360 deg. and tilts ±60 deg. O'CONNOR.

Audio Silence Alarm 330

The ASA-76 provides automatic monitoring of audio loss. High impedance, balanced bridging monitor inputs do not affect the monitored circuits, while assuring that any loss of audio for a predetermined period (1.5 seconds to more than 9 minutes) will be detected, causing an immediate alarm and resultant automatic switching for correction, if desired. The system includes individual selection of either manual or automatic reset of alarm when audio is restored. "Audio memory" circuit provides for alarm lockout of any individual circuit channels when audio is intentionally removed, but will cause automatic reset of alarm upon restoration of normal audio. Each channel is independently adjustable for audio level and alarm timing. RIVERS ASSOCIATES.

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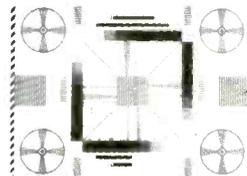
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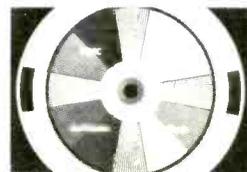
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TM 102



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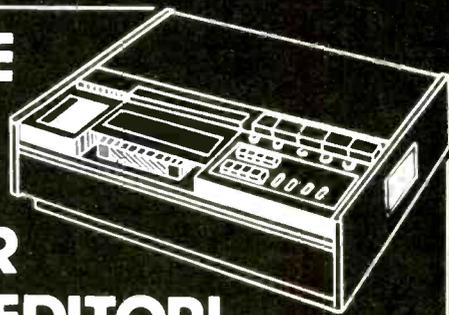


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