JUNE 1977

BM/E

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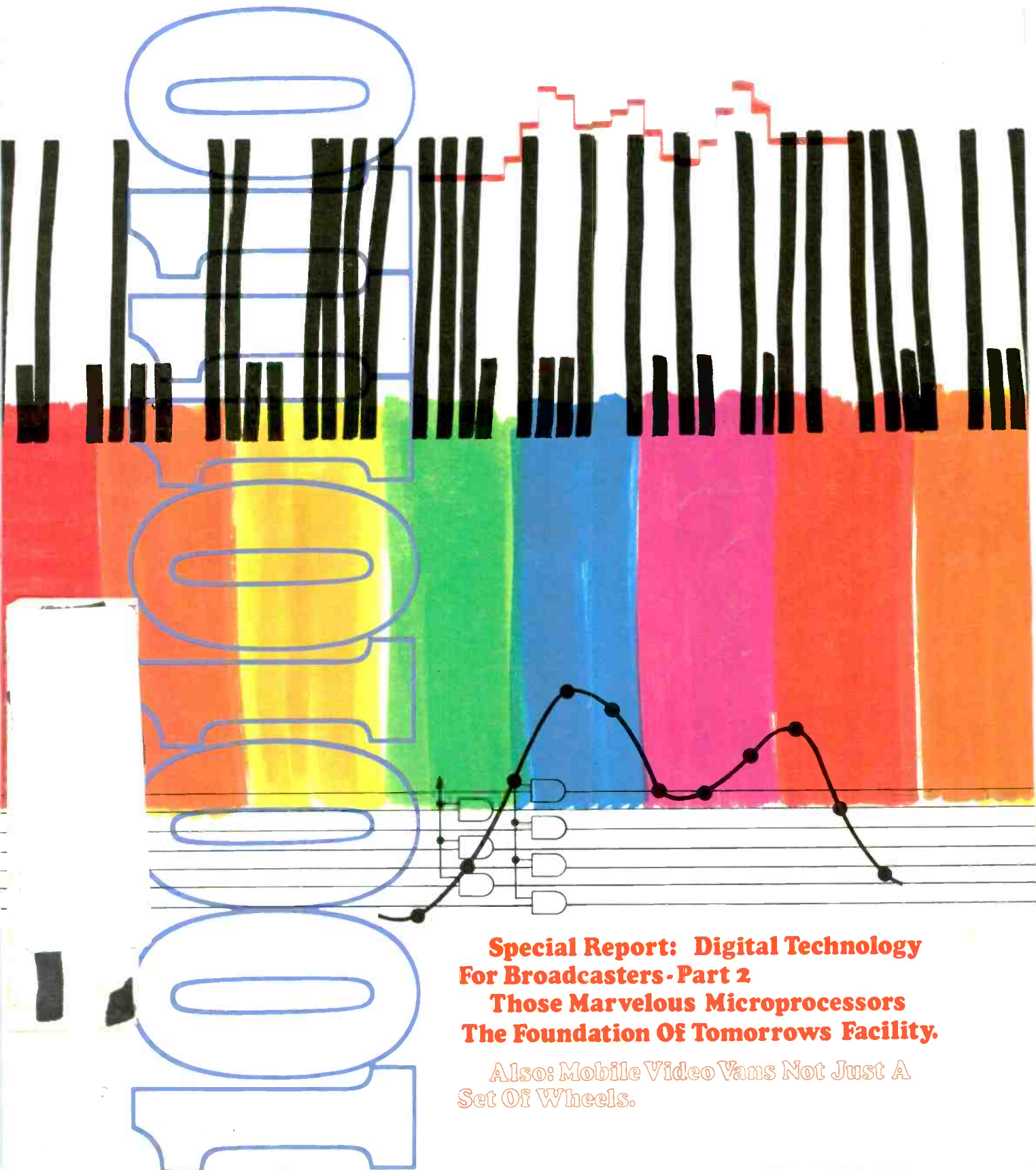

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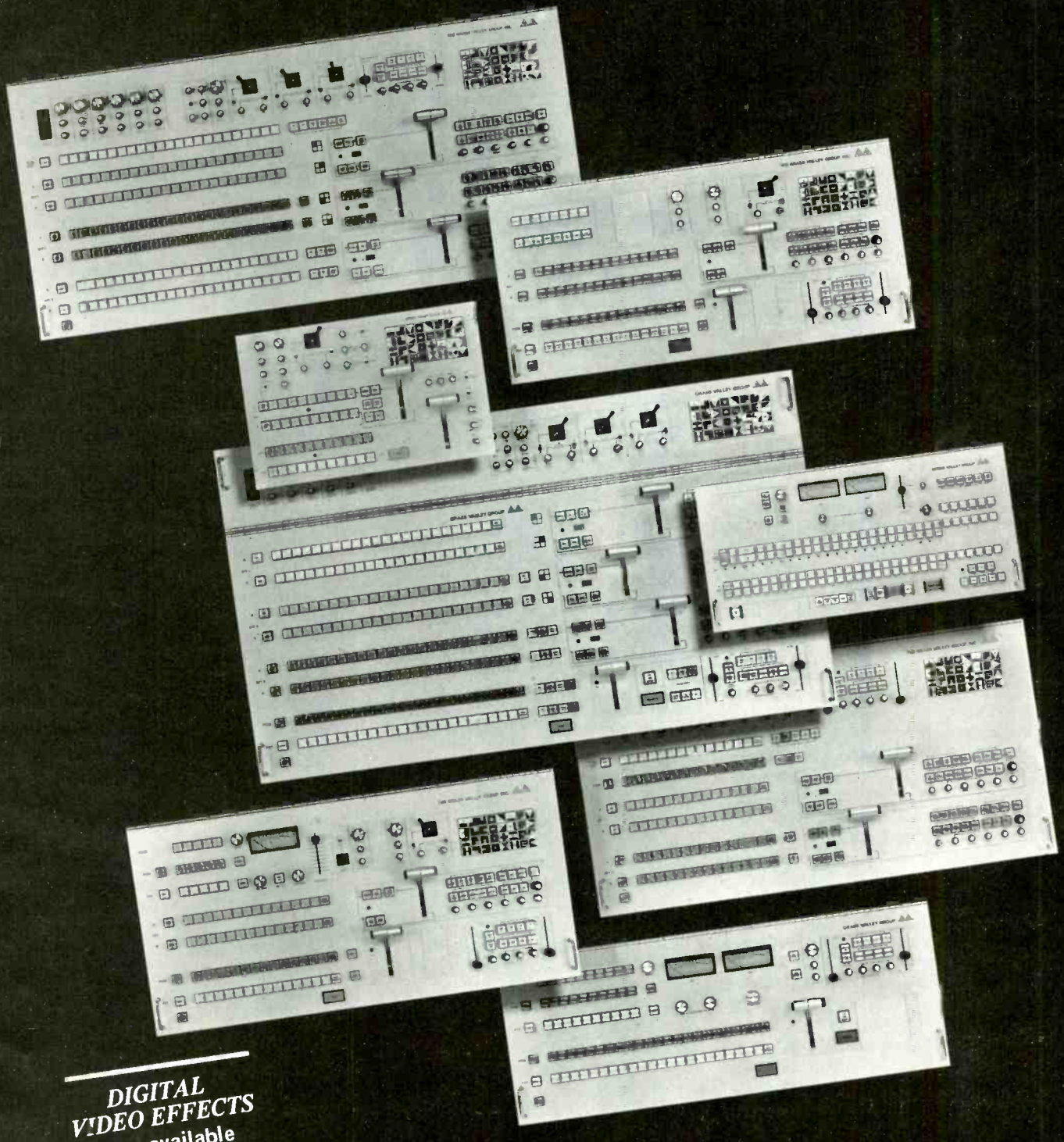

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BROADCAST INDUSTRY NEWS

Bright Future For Radio Report Finds

By 1985 radio, both AM & FM, will be technically better, more profitable, and less regulated according to a study conducted by the broadcast consulting firm of Frazier, Gross and Clay under the auspices of the NAB.

The study used a Delphi Technique in which experts are questioned on a number of topics and results are correlated to establish "probable" future trends.

Among some of the conditions that the panel thought would prevail in 1985 were: The use of quadraphonic FM, a larger FM audience—possibly a 51.7 percent share of the total radio audience; the adoption of stereo broadcasting by AM radio, perhaps as early as 1980; increased use of satellites for radio networking with attendent superior audio quality; improved FM radio reception for automobiles; new FM channel assignments; widening of the AM band, and the development of subsidiary communications authorizations (SCAs) as a new profit center with new services such as facsimile transmission among others.

The outlook for legislative changes projected such things as longer license periods, probably five years; reduced or eliminated requirements for access time for politicians and special interest groups; gradual deregulation for radio with the reduction of ascertainment requirements; less FCC involvement in advertising regulations; no further advertising bans; some opening up of "clear channels" but no "super powers," and there will be some regulation of signal carriage by cable system operators.

Some things that may not be welcomed in 1985 will be annual financial reports made public, the importation of distant radio signals by cable operators, and competition for SCA services from the television broadcasters.

Cable Conventioneers Churn Over Pay Cable And Contemplate Fiber Optics

The 26th National Cable Television Association Convention, April 17-20, was organized around five types of sessions: pay cable, operations, finance, technical and government relations. Pay cable dominated the sessions as it did in 1976, but this year, fiber optics was the glamour technical subject replacing satellites.

William Lynch, chief operating officer, Time Fiber Communications, and Irving B. Kahn in front of Times' operating 12 channel optical system.

Peter J. Alden, exec. v-p, operations, Warner Cable, holds interactive 30-channel home terminal produced by Pioneer Electric for Warner.

The buzz word at most pay cable sessions was "churn" (subscriber disconnects) and speaker after speaker had advice on how to calm it. During an early bird session on "Pay—Which Way to Go?", the various programmers on the panel offered a variety of ideas: try their programming mix (designed for optimum excitement); don't *oversell* but continually *resell* subscribers; increase prices only when you offer something extra.

On the exhibit floor, addressable taps were promoted by manufacturers as the best means of cutting operating costs of "churn." Addressable taps allow you to connect or disconnect a home from the headend via a computer but such an approach is expensive and very few system operators are ready to make the plunge. A logical first move is to install the addressable tap in apartment houses. Magnavox offered such a device, The Smart Tap, for this purpose, priced at about $2000 for a 40-unit module.

There was much bullish talk about pay cable at Chicago despite obvious churn problems. Burt Harris, outgoing NCTA chairman, predicted the entire country would be subscribers to pay TV (cable or over-the-air) within ten years. Marc Foster of Microband urged cable operators to use MDS to deliver pay programs to apartment houses. Gerald Levin, HBO, said the industry was at a turning point now that it was beginning to do original programming. Other speakers agreed—though the actual amount of special programming is miniscule.

Very little was prophesized about the future impact of pay-per-program systems at this year's NCTA Convention (in contrast to other meetings) but the entire industry has its eyes on Warner Cable. By late 1977, Warner Cable will be offering to some 100,000 Columbus, Ohio, residents, a new service that embodies a "vastly increased choice of programming and two-way communications." Through the use of a new home terminal developed by Pioneer, the system will permit subscribers to select from a wide range of programs and events, some offered as part of the basic service, to others available at a per-program charge. During demonstrations at NCTA, Warner showed a new game show which involved viewers at home participation. If Warner succeeds in achieving substantial penetration through its programming experiments, the industry will indeed have a new lease on life including the long-time dream of capturing urban markets. A few years back, Tulsa was the bellweather city in terms of expectations. But Tulsa showed that 30 channels of programming alone was not the whole answer. So all eyes are focused on Columbus.

NCTAers were, of course, buoyed by the recent U.S. Appeals Court Pay Cable Decision which threw out the FCC's anti-competitive restrictions favoring broadcasters. While this decision might conceivably be overturned or modified (see separate item, this

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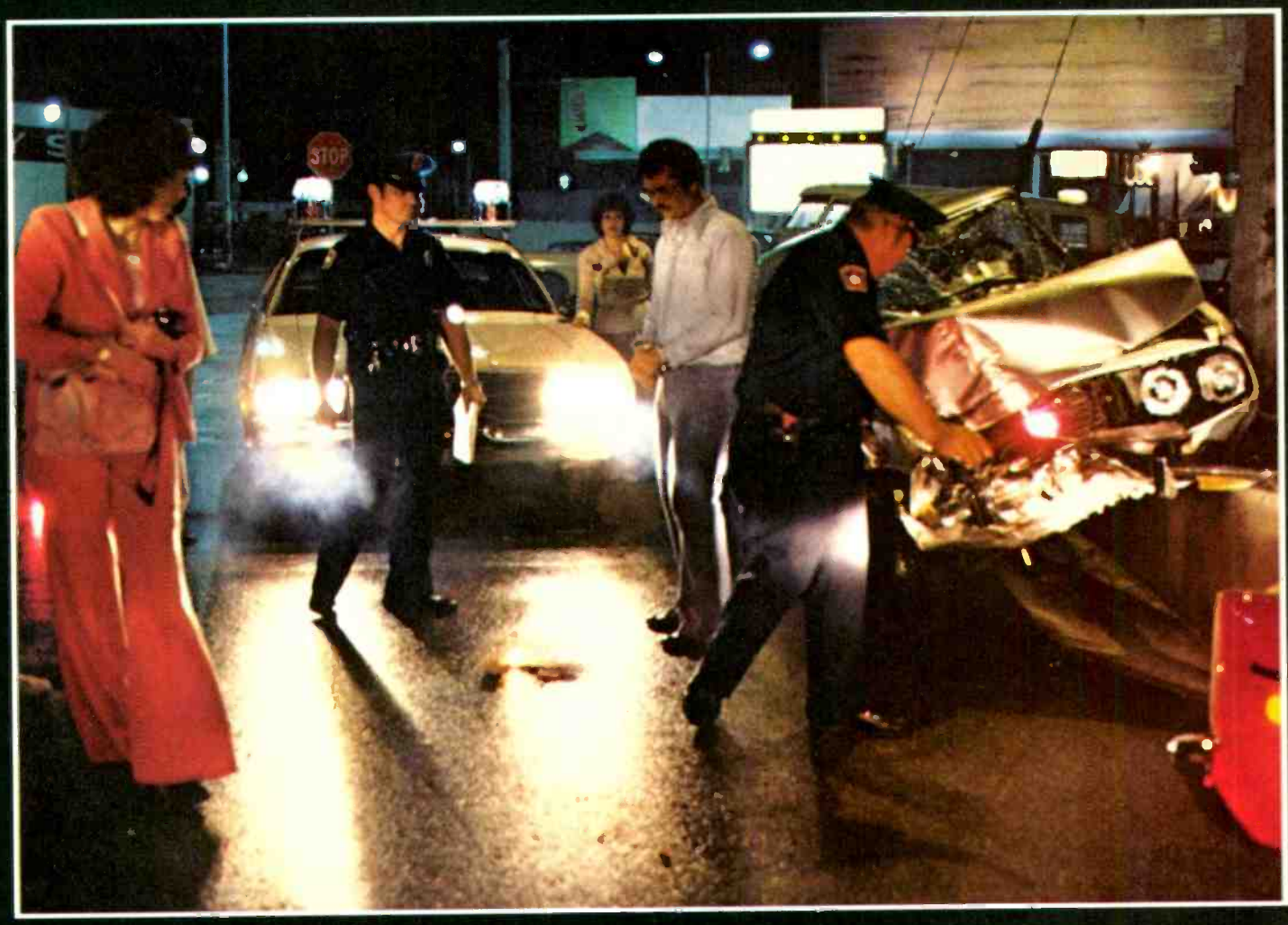

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Magnavox demonstration of how computers can remotely operate addressable taps in cable TV system.

issue), the members of Congress participating at the convention supported the action (House Communications Subcommittee Chairman Lionel Van Deerling, House Subcommittee member Lou Frey, Senate Communications Subcommittee Chairman Ernest Hollings and others). Certainly a rewrite of the 1934 Communications Act would outlaw such protectionist regulation if the Supreme Court does back up the Court of Appeals.

FCC Chairman Wiley tried to give encouragement to attendees by saying he supported a new economic inquiry to determine just how cable TV harms broadcast stations, if at all. If injury, real or reasonably projected, cannot be substantiated, then there should be less restrictions. Industry reaction was somewhat indifferent—it now feels the courts and Congress will aid it. (There is apprehension, though, on rewrite of the Communications Act since Congress may be persuaded CATV is a common carrier. This the industry cannot swallow—it wants programming rights.)

Fiber optics here!

It was clear from a tour of the exhibits area that the era of fiber optics has arrived. The biggest exhibitor was Times Fiber Communications Inc. (of which Times Wire and Cable is now a part). Time was stressing OptiLink, a 12-channel analog fiber optical transportation system to replace coaxial trunk cable. Most celebrated principal of TFCI is Irving B. Kahn (board of directors) and there are those in the industry who feel that Kahn alone could bring on the fiber revolution. But Times/Kahn were not alone. Just the week before NCTA, Comm/Scope revealed it had formed an affiliation with the Valtec Corp. to pursue "the emerging fiber optics communications field." Valtec is an electro-optics manufacturer of optical fibers and cables and semiconductor lasers. Other exhibitors showing fiber optics expertise were Belden and Delta-Benco-Cascade. Both Times and Comm/Scope feature single optical waveguide capability plus multiple fiber optical cable. Times reported it would have six customers with CATV optical trunk cable plants by year end. Each customer, however, was being limited (initially) to a length no longer than ten miles. A paper "System Analysis and Design for an Optical Fiber System for CATV Applications" was presented at the NCTA Convention by Dr. Frank Dabby, founder of Fiber Communications, now an operating company of Times Fiber Communications Inc.

While fiber optics was the most intriguing new product at the show, there were other new developments. Among them: addressable taps (already mentioned), inexpensive pay TV decoders, pay TV traps, new low-cost news displays, a 2-hr. U-Matic cassette.

Jerrold, now taking a back seat behind Times in terms of exhibit space, showed a new low-cost pay TV outdoor descrambler. Unit hangs on a strand or can be mounted under eaves. Called the Starpack, the unit offers a good secure signal in a package not likely to be "filtched" by the subscriber.

There were a number of low cost pay

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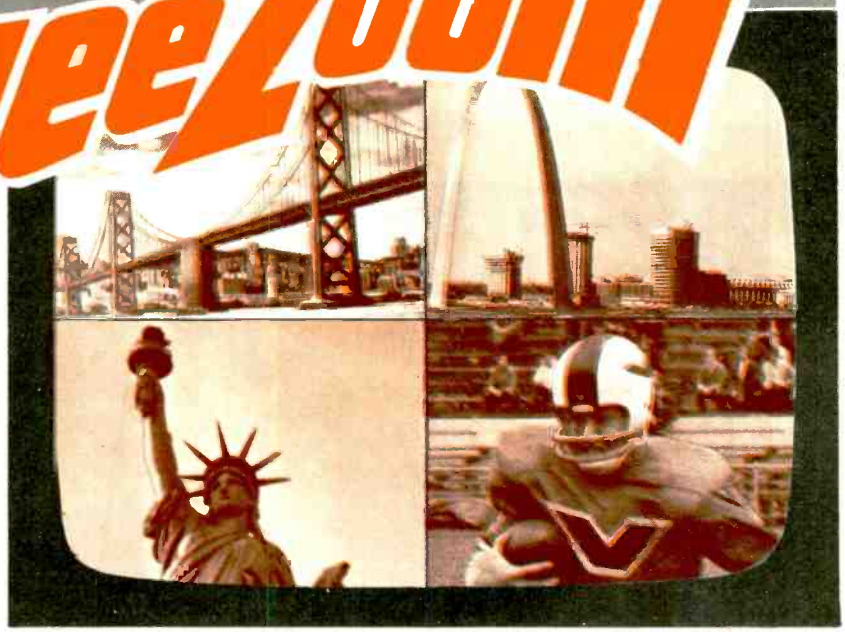

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TV decoders. Oak highlighted a new Mini-coder and Mini-scrambler. Telcin showed a one channel converter/decoder called Pay Com which offered two levels of security. (Telecin also showed a cordless remote digital control converter and a pay-per-program concept.)

TEST, which last year took the convention by storm with its inexpensive tamper-proof electro-deposited filter system that sucks out an inserted scrambled signal, was back with the boast that it had sold over 400 systems so far. TEST this year introduced a signal theft detector—it all fits in an attaché case and can easily sniff out illegal connections. (TEST also had small helical MDS receive antennas and some converters on display.) An alternative scheme to TEST's Scramble Guard was a new security system, Promo, developed by Stern Telecommunications Corp. and distributed exclusively by S.A.L. Communications. This unique low cost (less than $10) filter decoder was named Promo because it delivers an audio promotion message and short preview to those non-subscribers on the regular pay TV channel (the audio message signal acts as part of the scrambler for the pay picture). The tamper-proof device can be mounted indoors or outdoors.

A flexible approach to news displays was shown by Video Data Systems. A customer could start with an inexpensive system and expand to use of microprocessors or full computer control. Systa-Matics showed a new U-Matic deck sequencer, the UDS-23 and a system replacement for its "Juke Box," the 6T6. Sony unveiled a 2-hr. U-Matic cassette.

Satellite receiving equipment manufacturers were on hand in force: Andrews, Compucon, Hughes, Microdyne, Prodelin, Radio Mechanical Structures, RCA Americom, RF Systems, Rockwell, Scientific-Atlanta, TerraCom and Turner Communications.

RTNDA Survey Finds ENG Grows But Film Is Still Mainstay

The Radio and Television News Directors Association (RTNDA) reported results of a survey conducted last year that predicts more than two-thirds of U.S. TV stations will be using ENG equipment by the end of 1977.

The survey found that stations in smaller TV markets (ADI ranks 101-206) were most likely to be all or nearly all ENG. Larger market stations, however, were more likely to be keeping their news film operations, for a time at least, while adding ENG and using it heavily for live feeds from the field.

The survey was conducted for 644 commercial TV stations and 415, or 64%, responded. The results indicated that 55 percent of all stations were using ENG or planning to, and a follow-up survey conducted recently indicated that many stations were adopting ENG earlier than they had projected.

The pioneers in ENG were found to be typically larger market, wealthier stations with budgets that permitted the purchase of equipment which was likely to be outdated quickly. Only 32% of the stations, however, cited budgetary problems as a reason for going slow on ENG. In most instances, "fast changing equipment" was the reason given by news directors for not moving to ENG sooner. The only exception to this was in the smaller markets where 80 percent of the respondents cited cost.

Stations that use ENG were still using at least as much newsfilm as they were ENG, according to the survey. In the top 50 markets, the majority of stations were still using more film than

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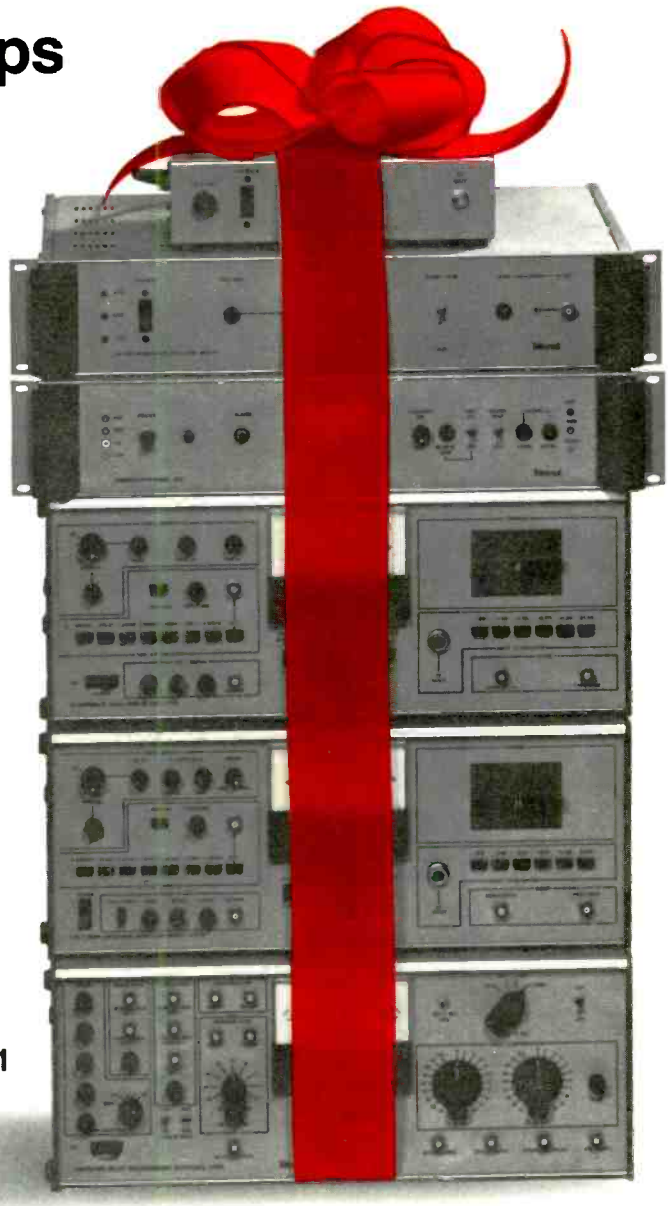

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ENG. In the next 50 markets, it was about half film and half ENG while in smaller markets there was a greater tendency to be all-film or all ENG. Newsfilm had been discontinued by only 7 percent of the stations in the top 50 markets, 18 percent of the stations in markets 51-100, 30 percent of stations in markets, 101-150, and 36 percent of stations in markets 151-206.

Some trends revealed in the survey were: increased "live" ENG, especially in the larger markets; increased use of natural sound and less "talking heads"; more use of the B-roll technique (the use of other appropriate film or video images under the audio of a speech or interview); more on-the-scene reporter's voice-over; the inclusion of more spot events and scheduled events, and more shooting with available light rather than artificial.

Improved Video News Film Now Available

After extensive field testing, Eastman Kodak Company announced that its Eastman Ektachrome video news film, high speed 7250 (tungsten) is now available for general distribution.

The new film is designed to allow filming under extremely low-light levels and is rated at EI 400 under tungsten illumination and has an EI of 250 when exposed under daylight conditions, using an 85B filter. With extended processing, 7250 can be exposed at EI 800 or higher and the film displays excellent forced-processing characteristics. At higher speeds, 7250 maintains its neutral color balance.

Introduced at the same time and also now available for general distribution is a new print film, VN print film 7339.

WSTC Embroiled In Court And At FCC

WSTC, Stamford, CT, has already been socked by the FCC with a $10,000 fine in connection with its editing of a political announcement made under Sec. 315. Furthermore, FCC Administrative Judge Lenore Ehrig has entered an initial decision not to renew the station's license and a suit has been won in U.S. District Court by the candidates whose announcements were edited, awarding them damages against the licensee, Western Connecticut Broadcasting.

Beleaguered WSTC is not without friends however. The NAB has asked the FCC to reconsider the initial decision not to renew the license stating that the decision is inconsistent with the Communications Act and recent guidelines of the commission which call for consideration of a "favorable" or "sound" record of a station's superior past programming in a comparative proceeding.

In the suit for damages, the Court ruled in favor of the complainants and stated that the licensee was subject to payment of damages. The FCC has entered a friend-of-the-court brief urging the court not to let the decision stand for fear that it would frustrate the commission's enforcement policies for Section 315 and have a chilling effect on political programming. Western Broadcasting's appeal is also being supported by the NAB, ABC, CBS, NBC, PBS and the RTNDA.

Courts Free Pay Cable Broadcasters Fight Back

The decision by the U.S. Court of Appeals for the District of Columbia which overturned FCC regulations concerning pay cable is being appealed by the FCC, NAB, ABC and the National Association of Theatre Owners.

The decision overturned nearly every aspect of FCC restrictions on pay-TV operations by CATV systems oper-

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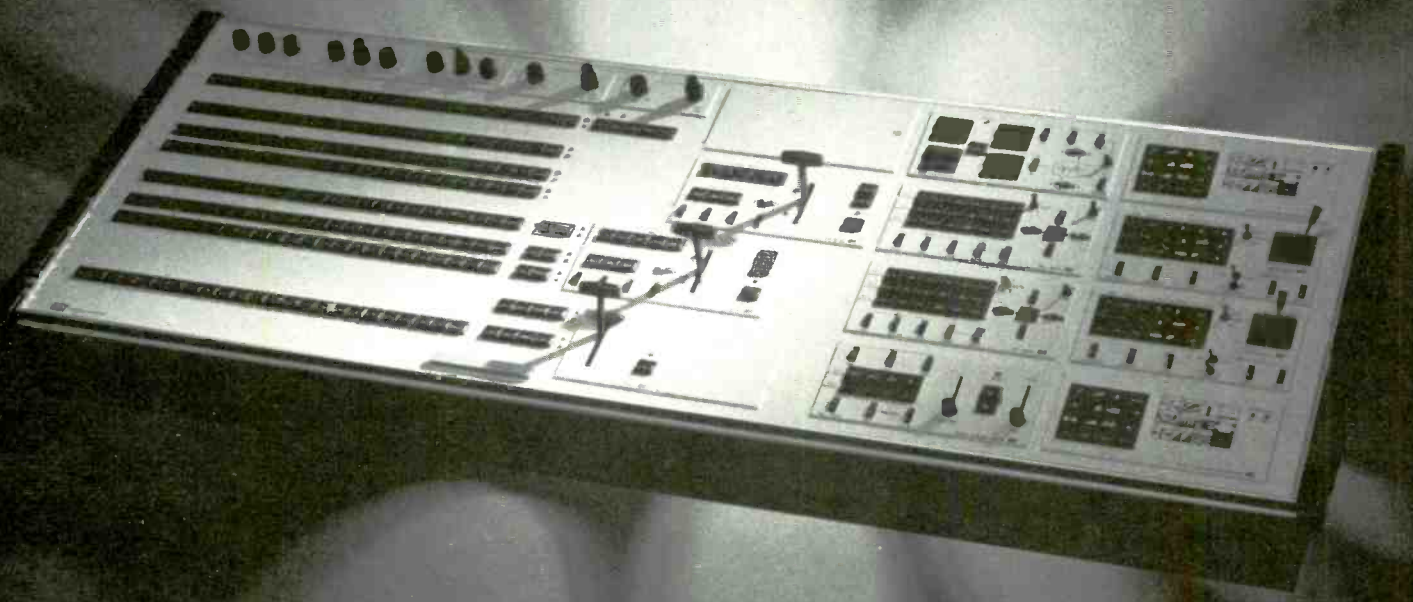
smart switcher



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News

ators. Among the regulations effected were restrictions on CATV operators to the use of films between 3 and 10 years old and so called sports "siphoning" regulations which prohibit CATV operators from carrying on pay channels, sports programming being offered over commercial television.

The FCC, unlike the other appellants, will fight only certain aspects of the decision such as the court's criticism of ex parte contacts, and "sports siphoning." NAB, and the others, will appeal "all aspects" of the decision. Moreover, FCC said it would vacate restrictions on over-the-air pay-TV which were not effected by the court decision, since in the opinion of the FCC it is not fair to discriminate between over-the-air and cable pay-TV schemes.

Interest In CP Antennas For TV Runs High

Although the date for the new FCC rules permitting use of circularly polarized TV transmitting antennas did not go into effect until May 20, keen broadcaster interest is being shown.

A session on CP Antennas for Television was part of the Electro '77 program in New York in April. Broadcasters present and others from the engineering community paid close attention to the presentations by Neil M. Smith, of Smith and Powstenko, who described results of the ABC test at WLS-TV, Chicago; Peter Onnigan, Jampro Antenna Co., who described tests at WLOC-TV, Modesto; and George Townsend, Townsend Associates who commented on transmitter implications.

All agreed ghosting was reduced substantially, particularly on indoor antennas even when the antenna was a loop or rabbit ear type. Slides showed signal improvement was remarkable with a receiving antenna designed expressly for circularly polarized reception (which requires, incidentally, a plastic vertical structural member).

Many questions centered around likely benefits on low band VHF and other UHF channels since test data so far is limited. Speakers were sure benefits would be realized but all agreed there will be many new types of antenna designs developed and offered to simplify feeding, wind load, installation etc. As various local situations are analyzed, new designs are likely to emerge.

When asked whether it would be better for UHF stations to achieve maximum authorized horizontal power before adding a vertical component, advice was that if ghosting is a problem, consider adding vertical right

away. Stations already at maximum horizontal ERP might not need to use the same power vertically even though maximum anti-ghosting benefits occur with maximum vertical ERP. (The highest possible tower might not be desirable because of increased shadow area at the base of the tower.) Advice came from the speakers plus comments by Dr. Siukola of RCA, Fred Ables of Alford Associates and Tom Vaughn of Micro Consultants who were in the audience. Townsend said many UHF transmitters could be upgraded for better performance and better efficiency to reduce costs.

Business Briefs

Newhouse Broadcasting Corp. has announced an agreement to sell 50 percent of its stock interest in Mt. Hood Radio and Television Broadcasting Corp. to **Lee Enterprises Inc.** The sale will give Lee Enterprises a major share in KOIN-TV, Portland, OR, a CBS affiliate . . . . The FCC has approved the transfer of WCYB-TV, Bristol, VA, from **The Starr Broadcasting Group, Inc.** to **Grit Publishing.** Starr recently transferred control of WLOK, Memphis, to Gilliam Communications . . . . Swanco Broadcasting, Inc., Tulsa, OK, has changed its name to **Swanson Broadcasting.**

Data Communications Corp.'s BIAS Division has added 18 new clients to their Broadcast Industry Automation System. Fourteen of the new clients are television stations and four are radio. BIAS now has 160 client stations . . . . **Automation Electronics, Inc.,** a newcomer to the business automation systems sweepstakes, announced contracts for the installation of their Autotron in-house business system at WIAR/WOVV, in Fort Pierce, FL.

CCA Electronics Corp. announced that it received new orders in excess of $500,000 during the NAB Convention held in Washington, D.C. this past March. Among the orders received for TV transmitters, radio transmitters and antennas were six orders for the new CCA Optimod units introduced at the show . . . . **ABC** has purchased more than a million dollars worth of **Ikegami** ENG cameras for use by the network. The order involves some 30 Ikegami HL-77s.

Hitachi Denshi has announced that its FP-3030 portable color camera, introduced more than a year ago, is being delivered to dealers and customers. Hitachi has also announced the extension of their warranty on the new FP-1212B, HV-1100A and FPC-1007P color cameras from one to two years . . . . **Lexicon, Inc.** has announced a

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Business Briefs

new price reduction on its line of digital audio delay systems of as much as 23 percent

Cinema Products Corp., Los Angeles, has filed suit in the Federal District Court in Los Angeles against **Panavision Inc.** and Robert E. Gottschalk, president of Panavision, charging that company with infringement of CP's patent for the Steadicam system. The suit also alleges that Panavision has engaged in unfair trade practices . . . . **Fuji Photo Film, U.S.A.** announced the formation of a new **Magnetic Tape Division** to market all of their audio and video tape products . . . . **International Microwave Corp.** has consolidated its subsidiary, Communication Carriers, Inc., into the parent firm where it will be known as **The Communication System Division.**

The **Corporation for Public Broadcasting** (CPB) and **Comtech Laboratories, Inc.** signed a $1.4 million contract which calls for Comtech to build the main origination terminal for the projected public broadcasting satellite interconnection system.

News Briefs

Rep. John Breckinridge (D-KY) has made known his intention to hold hearings before the Small Business Subcommittee on Antitrust and Restraint of Trade Activities to **investigate complaints over the pricing of automobile radios.** Breckinridge is chairman of the Subcommittee and intends to determine in the hearing what, if any, relationship exists between cost of manufacture and retail price . . . . **Systems Resources Corporation,** the manufacturing subsidiary of Chyron Corp., announced that Joseph L. Scheuer has been appointed president of the firm replacing Eugene Leonard who resigned to pursue a private consulting practice . . . . Philip J. Lombardo, president of **Corinthian Broadcasting Corp.,** has assumed full operating responsibility for the company. The office of chairman has been eliminated upon the retirement of C. Wrede Petersmeyer who held that post.

Manhattan Cable Television, Inc., New York City, has moved for the first time to prosecute an offender of the state's "Theft of Service Law." A man was recently arrested and arraigned on charges of commercial bribery and attempted theft of service. It is alleged that the man placed a note, with his name and phone number, on a Manhattan Cable truck offering a "few bucks" in exchange for an illegal cable hookup.

Caniel Aaron, chairman of NCTA, has urged the Copyright Office to strive for simplicity and flexibility in its new rules governing CATV operators responsibilities under the new copyright law. He further urged that an industry advisory group be established to assist the Copyright Office in designing a simple reporting form . . . . **Ken Gunter,** executive vice president of UA-Columbia, San Angelo, TX, has been **named chairman** of the Technical Subcommittee of the NCTA Communications Act Rewrite Committee.

Action for Children's Television (ACT) filed a **petition with the Federal Trade Commission** charging that certain televised ads unfairly induce children to eat sugared snacks that cause tooth decay. ACT also filed 4 individual complaints against the Nestle Co., the Fox-Cross Candy Co., the Squibb Corp. and Mars, Inc. . . . . The **NRBA** announced its **schedule of regional seminars** that will take place at airport facilities in several cities. The seminars are aimed at salesmanagers and advertising reps. The schedule is: June 15th, Airport Marina Hotel, Dallas-Ft. Worth; July 13, Ramada Airport, Boston; July 15, Sheraton Airport, Memphis; July 20, O'Hare Hilton, Chicago; and July 21, Marriott, Kansas City.

Introducing two new ways to get the lighter side of the news.

Microwave Associates' MA-2CP and MA-2EP.

They're by far the lightest, easiest to carry, simplest to use and maintain portable microwave radios to move onto the market.

Because they're so light, the 2 watt MA-2CP and 8 watt MA-2EP open up a new era of flexibility in news gathering at 2GHz. You can go almost anywhere the news is.

Both models have a unique frequency offset capability that gives you a total of 21 microwave channels. Three times the frequency agility of older models.

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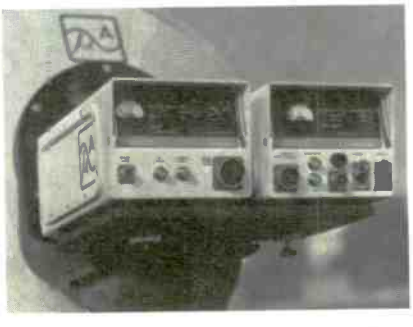
In addition, the MA-2EP provides sophisticated diagnostics, switch-selectable tuning and the opportunity of mounting the RF head up to 30 feet away.



Both the MA-2CP and MA-2EP are engineered with people in mind. And each system is compatible with all our Portable Line accessories.

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Circle 117 on Reader Service Card

If we could fill this page with the list of users of CCA transmitters, you wouldn't be able to read the 1,300 names.

The type would be too small to read if we tried to fit all 1,300-plus users of CCA transmitters on this page. That's how many there are worldwide—including those who purchased over $600,000 worth of CCA equipment during the '77 NAB.

So we've listed them in a new booklet. You'll see all of our customers, and what they use—and the list includes many repeat customers. Because CCA transmitters and associated equipment are simple, reliable, low-cost performers. And we make them for every power level—for AM, FM and TV.

CCA has it! You can, too. For a copy of our List of Users, call our toll-free number or write. And watch for more surprises from CCA. We're on the move—and we mean business.

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Circle 118 on Reader Service Card

Radio Listeners Love Drama

More Suppliers Needed: Educational Stations Make Their Own

ONE PHENOMENON OF RADIO'S "COMEBACK" of the last decade is the reascendant popularity of radio drama. It has become unmistakeable that radio listeners, young and old, love to hear well-done drama.

The great success story is, of course, the CBS Mystery Theater, now in its fourth year, running five to seven days a week on more than 200 stations around the country. (See *BM/E*, June 1976, for an account of how a Mystery Theater program is put together.) Almost without exception those using the program are delighted. KSL, in Salt Lake City, for example, gets a higher listenership than any other station in town during the 8 to 9 pm Mystery Theater, seven days a week.

CBS started a second drama series this year, the General Mills Radio Adventure Theater, running twice a week, on Saturday and Sunday. Sponsored by General Mills, the series is aimed primarily at younger listeners, with dramatizations of real and fictional stories of adventure: Moby Dick, Treasure Island, the Life of Lindberg, the Red Badge of Courage, etc. It is directed by the incomparable Hi Brown, who originated and directs the Mystery Theater. As this was written, there had been no rating sweeps on the Adventure Theater, but program directors interviewed by *BM/E*, were sure they had another winner.

The sad side of this story is that program directors of radio stations who would like to try good drama are unlikely to find any. The two CBS series are primarily for CBS stations and affiliates. If an affiliate turns down one or both programs in any market, other stations there will get a crack at the one rejected. Aside from the CBS series, there are mostly recordings (sometimes pirated) of some of the drama series of a couple or more decades ago.

We can take it for granted that the average commercial radio station in a small to medium market lacks the resources to produce its own high-quality radio drama. In this impasse, *BM/E* interviewed Hi Brown to learn some of his general ideas, and perhaps stimulate other organizations to consider the production of radio drama.

However, the story is quite different when we turn to educational radio stations. On the campus, the resources *are* often available for producing radio drama. A very successful program of drama is temptingly described in the article by Dr. Eli Segal, of Western Michigan University, which follows the interview with Hi Brown below. The potentials put to use by Dr. Segal are available in many communities.

Radio Drama Is Entertainment For Today

An interview with Hi Brown

"WE HAVE NO THOUGHT of 'going back' in any sense to the radio drama of thirty years ago—our shows are designed as entertainment for *today*, not as nostalgia trips," said Hi Brown as *BM/E* listened. His statement was all the sharper since a number of the most famous of those older radio dramas were created and directed by him.

His concept of the CBS Mystery Theater and, later, the Radio Adventure Theater, was as fresh, living entertainment which puts the imagination of the listener to work in enlarging the impact, the suspense, of every scene and action. The responses of audiences have overwhelmingly proven his success: his two program series have several million devotees, and the "regulars" include a high proportion of young people who have grown up on television.

"We wanted the Mystery Theater to run five to seven days a week to establish a regular listening pattern. Not that everyone would listen every night, but they would know the show was always *there* and would come to accept radio drama as a regular force, get educated to its patterns. We seem to have been most successful in this. I get more telephone calls than I can count in which the caller says, 'Thank you, thank you, for a fresh listening experience,' for giving us an alternative to television! We know now that the upcoming generation is just as turned on by good radio drama as the older people were."

Brown pointed out that the door had been opened wide for good radio drama but that very little seemed to be on the way to fill the need. He said that his frequent lectures on college campuses and in schools had brought him into contact with many young people, and a great many in every part of the country were especially keen on drama—literally scores were writing, producing, directing, acting in plays. This made it possible to produce radio drama on college campuses. (Editor's note: see following article by Dr. Eli Segal.)

As an example of the high interest his programs were stirring up in the schools, he described a plan just getting underway in Vermont, where a local station had asked for the script of an Adventure Theater program, and was organizing groups in the local schools to compete in producing their own versions on tape. The winning production would go on the air. (Principals in this scheme did not want to be identified until the plan was further advanced.)

As one more evidence of the high interest radio drama was engendering, Brown noted that he had been invited to speak about his work at the six regional meetings of the NAB this year, in Cambridge, Atlanta, Chicago, Denver, San Diego and Dallas.

"We need more straight drama and we need comedy—the young people on the campuses keep asking me for comedy. Again, I want to emphasize that for radio drama to have its full effect, it must be regular, repeated. I don't mean that the stories should be serials, like the old soap operas: each one of our programs is complete in itself. But the listener comes to know that good radio drama will be there again, same time, next night; he gets the habit of following aural drama. That is most important. But where is the material going to come from? If only some of our great theatrical organizations could get interested in radio drama! I have been directing six shows a week for months on end, and I love it, but it's crazy. Believe it or not, I would welcome some competitors!"

continued on next page

Radio Programming

You Can Do Drama—An Urgent Message For Educational Radio

By Dr. Eli Segal, Associate Professor of Instructional Communications and Manager of Audio Services, Western Michigan University.

ECONOMICS GENERALLY PROHIBIT a renaissance of commercial radio drama, but there is little cause for educational stations to neglect this effective and entertaining art form.

In May, 1974 Western Michigan University's 50,000 watt WMUK(FM) in Kalamazoo began a series of locally produced science-fiction radio dramas to offer listeners an alternative to television reruns. The half-hour programs ran every Monday through Thursday at 7:00 p.m. for eight weeks. We attracted a large family audience, drew over 200 mail and phone responses, and won an Ohio State Award for "network quality radio drama." Requests for the series to return were so insistent that this past summer *FUTURE TENSE*! ran for twelve weeks. From this experience we learned that competent dramatic productions can be achieved well within our physical, financial, and talent resources. As a result, we now use dramatic radio for specials (such as Halloween), for instructional purposes (combined with course credit lectures), and we produced an eight-part bicentennial series on Michigan history.

The script

The would-be director's first need is a script that can be produced in the available facilities. Not all scripts can, so be realistic about your choice of material and your production capabilities. With proper permission, scripts can be *adapted* from short stories, novels, or films. I emphasize *adapted* because it is critical that the script make full use of the radio medium.

Corner an English teacher from a high school or nearby college. Familiarize him with the *structure* of a good *radio* script. There are many examples commercially available on records. Avoid long narrative passages if, indeed, any narrator is used. Dramatize short scenes that compress time and end with a sub-climax, and thus build the overall show climax. Make sure of sonic perspectives on-and-off-mic, crowds, and backgrounds. Edit stage-like entrances and exits the way a film adaptor would edit a stage production. Music can bridge one scene's high point to the next scene's high point. There's no need for an entrance line or an exit line as in a stage production.

Limit each scene to a two-minute maximum; in general, the shorter the better. Use the radio medium's greatest strength—the imagination of the listener. Let sound effects *suggest* the action along with the dialog, much like a good caricature can suggest in a few lines the essence of what a detailed photo can often ignore. Don't overdo effects; use restraint.

Both music and effects are self-defeating if the listener becomes "aware" of them. They should merely further the mood or action in the listener's imagination. Generally, 18 to 22 typed, double-spaced pages of dialog, music, and effects will fill half an hour.

Casting

These days there's hardly a hamlet that doesn't have its little theatre group; more likely, two or three amateur or semi-professional stage companies. Remember, though, when you hold auditions, ultimately you're judging *the sound that comes out of a loudspeaker*. Appearance, age, or the ability to project to the second balcony make no difference here. The actors are playing to the microphone, hopefully, in an almost intimate relationship to it. Keep an ear open for vocal contrast and good character voices. A radio drama is not a bunch of leading man—leading lady voices. Rather, it is human beings who don't all speak in radio announcers' pear-shaped tones. The effective community drama producer maintains a mental casting file on who can do what.

Production

In radio's golden age all elements of a drama—actors, music, effects—were performed "live" as they happened and in their proper sequence. In today's non-professional community drama it is more expedient to work with the cast intensively, scene by scene, record the results, and deal with music and effects later. A typical rehearsal begins with a read-through, with the director assigning pre-cast roles. Once each actor knows who he is in the context of the whole script, begin working scene by scene, defining characterizations, perhaps changing dialog that sounds forced, working out in advance microphone perspectives and coordination of voices with sound effects that will be added later.

Take a ten-minute break to release tensions. Then bring the actors into the studio. The studio can be any "dead" room that affords a window view of the director. Our dramatic studio is a former faculty dorm kitchenette and measures only five by six feet, but it works.

Use only one bi-directional microphone such as an RCA BK-11A or a used but rebuilt RCA 44B(X). These ribbon microphones lend a warm quality to the human voice and their figure-eight pick-up pattern allows the actors to move at an 18-inch radius around the mic and achieve a variety of sonic presence perspectives, as well as to face each other in one-to-one dialog without the hollow sound of two cardioid mics used simultaneously on loud, dynamic dialog.

Rehearse each scene on mic until the desired reading is accomplished, then tape that scene. With semi-pro actors you can often achieve short scene of surprising quality. But I have found the pressure of recording an entire script all at one in sequence shakes much of their confidence, and too many retakes after the show is recorded really lower cast morale.

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BM/E's Program Marketplace

Syndicators For Radio

Broadcast Programming International

P.O. Box 547, Bellingham, WA 98225. Tel: 206-676-1400

Take the oldest continuous syndication operation in the U.S. and give it a new management full of fresh talent and fresh perspective, and you will have the basic course of events at Broadcast Programming International.

The late Rogen Jones founded it in 1960 as International Good Music (IGM). Jones found that stations buying the automation hardware he manufactured were often at a loss without special software to go with it. IGM supplied the programming, originally with a classical bent, Jones having spent a reported $1 million in getting rights to music and building up a library of classical records and tapes

(now a part of BPI's larger library covering every style of music).

In large part because of his long illness, Jones spun off the syndication business and renamed it Broadcast Programming International. It had been successful from the start. Kemper Freeman, Jr., bought BPI in 1974. He had been in the radio business nearly all his adult life, owning and operating several stations. He had also been a Washington state legislator, and still is director of a number of local businesses, active on many community boards, known as a man who gets things done on the community scene.

As senior vice president, he brought in Michael D. Kirkland, also in radio for more than a decade, starting as a creator, a musician. For about ten years after college, Mike Kirkland was the leader of the very successful singing group, the Brothers Four. The group became active in producing their own records, made many commercials for radio and television, did some syndication of radio programs, bought a radio station (KSWB in Seaside, Oregon). Kirkland left the group, did graduate work in multimedia communications, worked in film and television.

But he decided he really wanted to be in programming for radio on a national scale, if possible with a base in his home area, the Pacific Northwest. The call to BPI offered this combination to perfection.

Within the past year Kemper has added another key management person, David Ceccarelli, to head the sales effort. Ceccarelli has had a high-velocity career as a salesman in various businesses, becoming the youngest man ever to be sales manager of a national firm, Libby McNeil Libby. Providing continuity are several employees who have been with the firm since it was founded as IGM, undoubtedly the only group of people anywhere who have spent 17 years in one radio syndication business.

The new management has expanded all phases of the operation. BPI now has well over 200 subscribers. The programming covers a wide range of popular styles, with several different format frameworks (see below) and considerable flexibility within each.

For station managements: control and time to manage

Mike Kirkland says that the two most important things a syndicator can offer station managements are full control of programming and time to manage the station. Kemper Freeman, as operator of several radio stations, had first hand knowledge of the enormous amount of time the management could spend simply on getting viable programming together, with no assurance that getting successfully through one day would take care of the next one. If the station found a program director who developed a successful operation, he was likely to think of that success as his ticket to greener pastures.

BPI, says Kirkland, has the resources and experience to choose winning music and put it into a total programming framework that has battle-tested features. Like other large syndicators successful on the national scale, BPI makes an analysis of each station's market situation and resources, and develops a complete plan of action. BPI's analysis is extremely systematic, based on a comprehensive questionnaire and exploration with the station management of all factors in the station's situation.

With the main body of programming laid out in detail, and on the shelves in the form of rolls of tape, the management knows that the music will always be what the management has chosen and of totally consistent quality, rather than pulled in a different direction by each dj or programmer who puts material on the air—possibly material of much lower quality than the management would like. The management can put its effort into the operations the station must do itself, and do well, for market success. These include production of high-quality commercials, expert handling of news, professional-grade IDs, PSAs (BPI can help on the IDs and community announcements as noted in a moment). Particularly in the medium-sized and smaller communities, the management must involve itself deeply with the community on many fronts.

Above all, the management can sell the station's services. A management that has no time to sell effectively, because the available personnel are tied up with programming, is seriously crippled.

The formats: resourceful variety, musical taste

BPI's formats include all types of popular music, with the exception of the hard, "screaming" rock, widely regarded as no longer a broadly marketable commodity for adult demographics. Within each format, there is a detailed programming plan for each station, showing the exact sequence of play for each hour of the day: this takes into account day-part requirements in the station's market.

But Mike Kirkland points out that, essential as such program planning is, it won't get the results wanted without some other elements that can't be specified on paper—the musical taste of the programmer, his feeling for the real value of music on the market, his sense

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Radio Programming

of the tastes of different audience groups, his ability to distinguish between short-term fads and longer-term trends in musical appeal.

Musical taste is crucial in the *sequencing* of numbers which is the essence of all radio programming. Whether it is called "matched flow" or something else, the sequence has a primary effect on listener response. The sequence to a large extent determines the character of individual numbers within it.

BPI aims to supply viable musical taste with highly experienced programmers in each format area. For the country format, for example, the director is Chris Lane, nationally famous for his work in this area. At the top, Mike Kirkland provides an overview as a professional musician with more than a decade of national success in popular music.

The formats are:

Bright N' Beautiful—Includes a main body of uptempo instrumentals and medium/slow vocals and instrumentals plus "bright" sparklers and "beautiful" sparklers. The elements are mixed by BPI to meet the station's needs.

Country Living—Announced by two outstanding country "personalities," Don Harris of WBAP and Bob Jackson of KRAM. Includes a monthly, "copy service," customized IDs, PSAs, etc., for each station, by the two announcers. (Available with the announced versions of other formats, or for a nominal fee with unannounced formats.)

Announced MOR—Presented by three proven air "personalities," KOMO's Larry Nelson, KJR's Lee Smith, and KVI's Jim French. Localized copy service.

Adult Contemporary—Aimed for the 18-49 group; in use by more than 70 successful BPI subscribers. Localized copy service available.

Album Oriented Rock—This is the varied, high-fidelity, well-produced rock, the quieter rock that young adults recognize as their own. Again, local copy service available.

Easy Listening—The all-time great standards, plus "big" arrangements of current hits. In announced version, presented by personalities Bob Concie and Del King. Also available in unannounced version. Used by over 60 successful BPI stations. Local copy service.

Mike Kirkland sums up: a polished expert syndication service is simply an *opportunity* for a station's performance to be raised to a high professional level. Just how high depends squarely on the station management. **BM/E**

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The CP-240A-AN controls up to 80 inputs on a standard 1¾" rack increment!

Here's how it works with DYNAIR's 1400 and/or 8100 Series switching equipment: select your source group from the left bank; FILM, VTR, NET . . . whatever. The group button flashes until you select one of ten specific sources in the group on the right bank. Both buttons take on a steady glow. You have just switched the system (audio, video, audio and video, or data) to the selected source.

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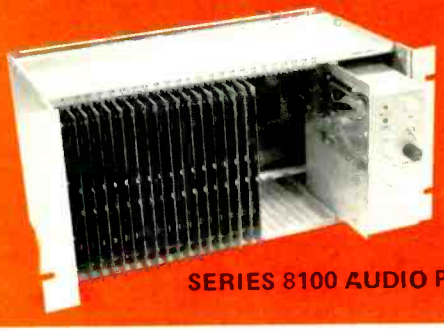
DYNAIR solid-state switching equipment meets or exceeds broadcast requirements and offers optional control systems not available elsewhere.

SPECIFY DYNAIR!



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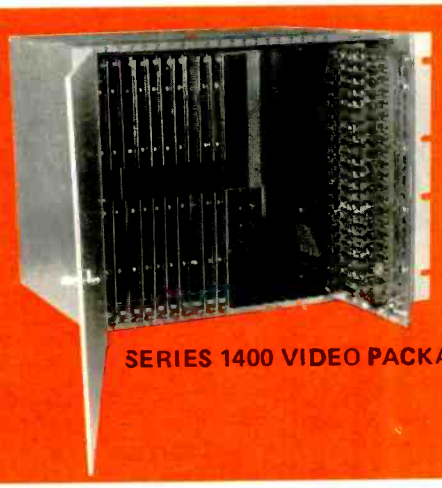

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trast compression and you have a camera system unsurpassed in stability, picture quality and performance.

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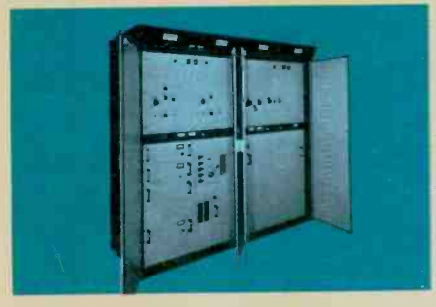

VHF/UHF Transmitters—an advanced, new television transmitter line. Pictured is the 17.5 kW VHF transmitter which can be paralleled for 35 kW. UHF transmitters range from 1 to 55 kW and may be paralleled to 110 kW. All use a unique, common 1-watt I.F. exciter which can also be retrofitted into earlier competitive systems. Over 1,000 Philips transmitters have been sold world-wide.

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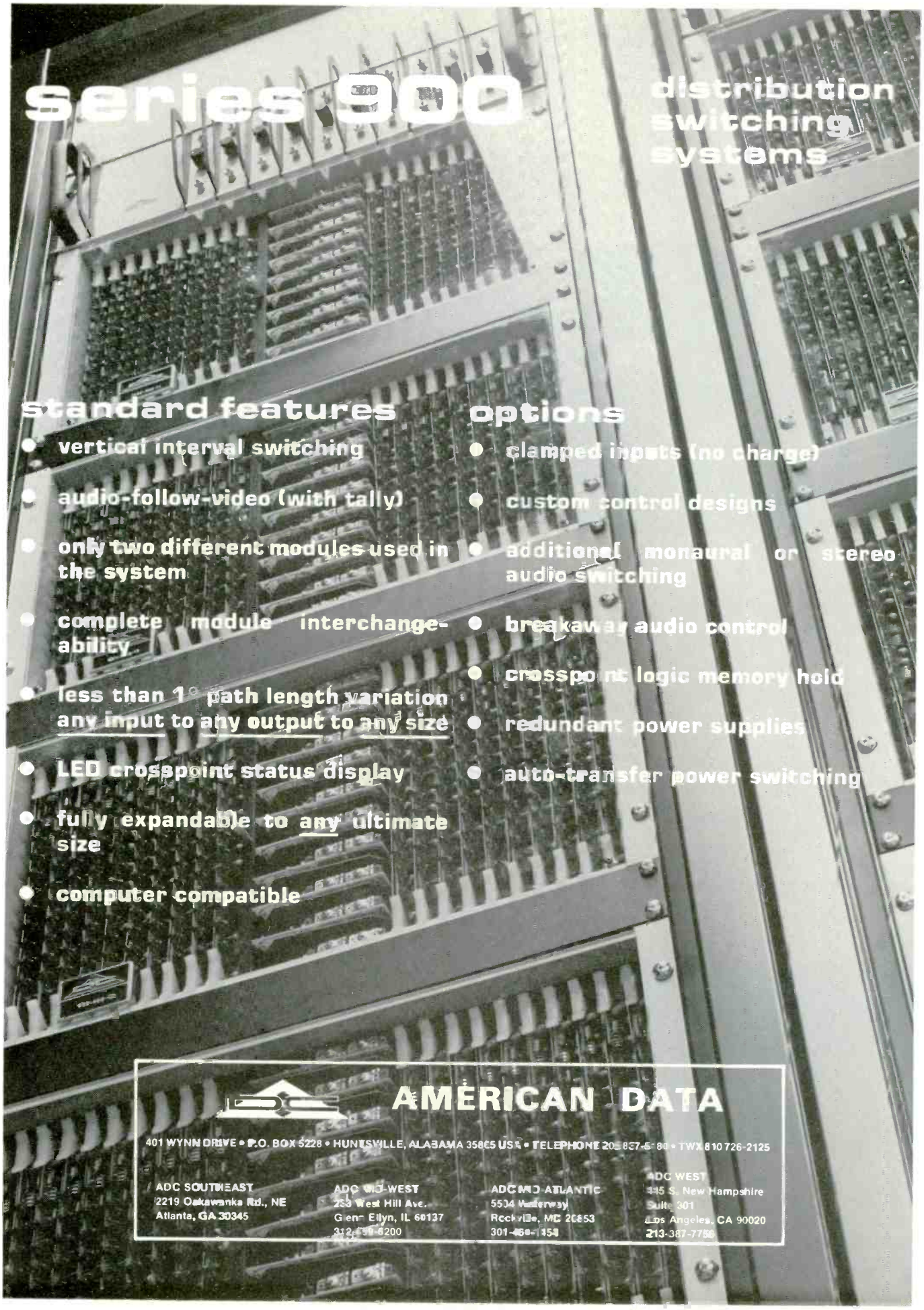
Circle 124 on Reader Service Card



Circle 125 on Reader Service Card

This scene is created by superimposing the lights recorded on the EFS-1 over the singer. The frame store device, in effect, becomes an extra camera.

Frame Store Device Used As Camera By T.A.V.

Floppy disc analog frame store recorder is used on The Merv Griffin Show to enhance production, save money.

IT DIDN'T TAKE LONG after ABC Sports took delivery of the first Frame-Stor™ (Arvin/Echo) device last spring and applied it to baseball and then the Kentucky Derby for the word to spread. Soon other networks, station affiliates and independents began to experiment with this low cost (less than $15,000) electronic frame storage device.

Producers found the unit helpful in doing daily news and weather shows, and in reporting election results. Over 200 frames of graphs, charts, etc. could be entered and instantly accessed (from 8 millisec to 2 seconds depending on how adjacent frame addresses were). The system got a tryout at last year's Emmy awards.

There is no doubt that the broadcasting world is now very much aware of cassette-loaded floppy-disc frame storage. Devices from manufacturers other than Arvin/Echo are now available. Eigen Video has similar analog units in the field and at NAB '77, a new company, the Adda Corp., announced a somewhat more expensive digital electronics still storage system. Frame storage is now being used as a creative tool in the world of teleproduction.

Trans-American Video Inc., Los Angeles, is one of the first major teleproduction houses to take advantage of the capability of frame store devices. T.A.V. has found it can use the Frame Stor™ to make The Merv Griffin Show an exciting graphics event as well as an entertaining talk show.

T.A.V. takes pride in its production expertise—it has produced such spectaculars as the MDA Jerry Lewis Labor Day Telethon, The Bob Hope Special, The Dean Martin Celebrity Roasts and the Emmy Awards.

Capturing action shots and freeze framing guests reactions is only one of the many functions performed by the EFS-1. A big plus is its ability to relieve telecine overload thus freeing traditional (and more expensive) display devices for more complex projects. Producers are now finding that the pay-off period for the EFS-1 is approximately six months—that's how much they are saving by not having to use other equipment.

Pete Wood, vice president, production services, at T.A.V., and Bud Keys, technical director of the Celebrity Theater, who manages the remote control unit, are quite impressed with its performance. They use it, among other ways, to record the "bumpers" on The Merv Griffin Show going in and out of each commercial—there are about 20 or 30 of them. During the show, when there is a lot of singing action, Keys will freeze frames in order of the artist's appearance, about two frames per artist, and at the end of the show, he puts them up and re-rolls the credits over them.

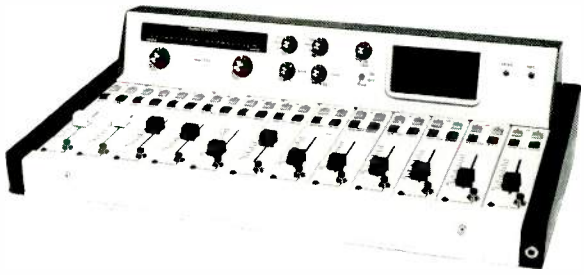
Wood claims that the unit works well as a sort of "quick camera."

continued on page 31

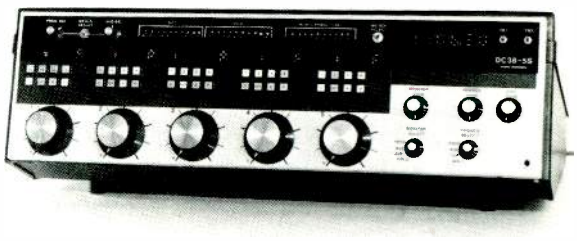
"More with Merv" and "Merv will be right back" are disc recorded bumpers used in coming in and out of commercials.

Ramko stole the show

with the most advanced trouble-free broadcast consoles in history!



DC-12



DC-38

FEATURES OF NEW DC-12 SERIES CONSOLES

- Remote controlled rack mount audio electronics. All solid state audio routing and attenuation. Completely DC controlled
- Dual channel
- Plug in mixer/switching modules allow up to 12 channels on standard models
- Up to 20 channels with extender electronics
- 2 inputs per mixer
- Quiet, lighted push buttons
- Tone generator built in
- Duo-Q — Two points of cue initiation. The standard full off mixer position and the lighted push on/push off switch located just below each mixer. Thus the mixing pot may be left in the mixing position and still cue via the switch below
- Minimum 5 million operations on mixer controls
- Minimum 5 million operations on input and output select switches
- Talk back thru cue system
- Solid state balanced in and balanced out
- Zero tracking error on stereo consoles via Ramko's exclusive time shared attenuators
- All plug in electronics.
- Patch panel programmable cue and monitor mute
- AC line filtering built in
- Lightning fast interior access
- Patch panel gain select on all inputs. All inputs may be made to accept anything from mic thru high level
- Interchangeable, colored push button caps
- 4 year warranty on all consoles
- 2 week free trail on all standard models
- Simulcast output and metering on all stereo models

Pricing from

3600^{00} TO 4400^{00}

(12 channel mono) (12 channel stereo)

Will be lower if fewer channels are desired.

FEATURES OF NEW DC-38 SERIES CONSOLES

- Dual Channel
- 5, 8, & 10 mixer versions
- 4 inputs per mixer
- Alpha numeric readouts above each mixer
- Solid state meters
  - (a) 3 meters for stereo. Left, right and mono mix (simulcast). The left & right meters are switchable to Audition or Program. The mono mix meter is switchable to a special circuit for phase checks.
- Duo-Q
  - (a) 2 points of cue initiation are provided. The standard full counter clockwise position on the channel mixer & right above on the output switching group. Thus the mixing pot may be left in the mixing position and still cue via the switch above
- Up to 20 million operation mixer controls
- Up to 20 million operation push button switches
- Talk back thru cue system
- Completely DC controlled. All solid state audio routing and attenuation
- Exclusive time shared attenuators provide *ZERO* tracking error on stereo consoles
- Solid state balanced in and balanced out
- Plug in electronics
- Patch panel programmable cue and mute
- Patch panel programmable cue and live mic flashing indicators on each channel
- AC line filtering built in. Suppresses both line transients and RF
- Lightning fast interior access. Total access in less than 15 seconds
- Patch panel gain select on all inputs. Each input may be made to accept any input from mic thru high level
- Interchangeable snap in legends on input and output select switches
- Interchangeable back lighted alpha/numeric status indicators
- Optional digital clock and production timer
- Front panel, Prog. & Aud. balance controls (stereo only)
- 4 year warranty on parts and labor
- 2 week free trial

Pricing from

2400^{00} TO 4700^{00}

(5 mixer mono) (10 mixer stereo)

An Unconditional 4 Year Warranty

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Frame Store

Bud Keys at work recording bumpers for the show.

Engineer operating the EFS-1 recorder.

"First we'll shoot a super of a light over a singer, and get a pretty light with lots of stars over it. Then I'll super that over the next shot. In other words, we still have four cameras, and the EFS-1 becomes the fifth!"

A major convenience to T.A.V. is the recording of all graphics ahead of time. This frees the camera during the show, and no one has to go out and retrieve the graphics. In fact, it's been so invaluable in this function that T.A.V. wishes it had two; "I could put graphics on one, and still store other material on the second unit, then alternate their use in separate keys," says Keys.

The frame store equipment has proved dependable. Keys says, "You know I'm super cautious of a new piece of gear . . . it's got to work before I really start to lean on it, and work well. I hate to punch blind, but a lot of times you don't have the time to check . . . you punch blind. The unit hasn't missed yet." Keys is known at T.A.V. as the T.D. that feeds creatively—he's always pushing buttons to create his own special effects.

As mentioned, until low-cost frame store came on the scene at T.A.V., expensive telecine chains were required. T.A.V.'s principal film chain was designed for film-to-tape transfers (both reel-tapes and cassettes) and incorporated a Fernseh Color Corrector and other devices for real time scene-by-scene correction. It cost over $100,000 and it didn't make sense tying it up every afternoon for The Merv Griffin Show when it could have been used transferring films. Acquisition of a floppy disc frame storage device for simple graphics insertions alone rather than another telecine (even a low-cost one) was logical.

Because of the interest that the frame grabber has generated on Griffin's stage, the rest of the T.A.V. plant wants it as well. Engineers report it has been a lifesaver in a number of incidences. One in particular involved the Don Kirschner "Rock Awards Show," in another part of the studio. They were prepared to use a video character generator which went on the fritz and could only provide a portion of the capability needed for the show. The crew needed to record some art cards in actual teletype form, so they hurried over to the Griffin stage to borrow the Frame-Stor™ and a time base corrector. They inserted the title material and then called it up live during the show. The show went on the air without anyone knowing the difference. **BM/E**

Miami Newsfilm Update:

The two largest TV network affiliates in this competitive "Top 20" market choose to upgrade their newsfilm equipment rather than switch to All-ENG, recognizing the indispensable role of 16mm newsfilm in a balanced newsgathering operation.

Despite the continuing "All-ENG" hysteria, the majority of affiliate and independent TV stations across the country have opted for a balanced newsgathering operation — a healthy mix of modern, one-man-band newsfilm cameras and a limited number of ENG units with live transmission capabilities.

What's happening in a "Top 20" market like Miami is typical of current trends in gathering news for television.

Basically a flat narrow strip along the coast, with the Atlantic Ocean on one side and the Everglades on the other, Miami is considered among the fastest growing markets in the country. Long favored as a major convention town, Miami is also a gateway for South America, Central America, and one-stop service to Europe. Since 1960 Miami has been the third-ranked city in the country in terms of datelines, with more hard news stories in one day than any other market this size.

"Our cost analysis left it very much up in the air as to whether ENG saves you money in the long run."

WCKT-TV, the NBC affiliate in Miami, has won numerous awards in recent years for its outstanding news coverage and investigative reports.

"We have two ENG units with live and tape capabilities," says Gene Strul, News Director, WCKT-TV. "The time had come to decide whether to go All-ENG or to retain film cameras.

"Our cost analysis left it very much up in the air as to whether ENG saves you money in the long run.

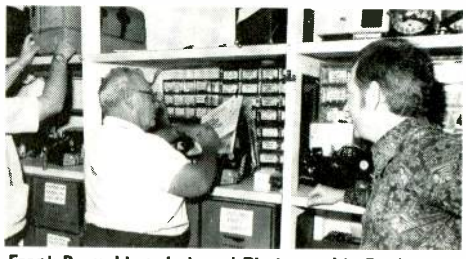
"We have also found that, contrary to reports, ENG units still do not serve as replacements for film cameras. We still cannot edit tape with any great speed. And the support equipment for ENG is bulky and difficult to maneuver. We use helicopters frequently to cover stories. (We also use them to rush material to us.) On occasion, we also shoot film from boats. ENG could be a problem when a helicopter or boat is needed. We also do a lot of investigative reporting where ENG would be difficult to use because the amount of equipment required would let everyone know what we're doing.

"As far as the public is concerned, it doesn't make much difference whether we use tape or film. The audience isn't interested in the difference — unless it's live. Of course, the public isn't gaining anything if a story is put on live just to use the live capability. That's just a promotional gimmick, and the public gets blasé after a while. After all, they have already seen a *moon walk* live, and they see golf games and other events live. After a while they say 'so what.' Why bring in a feature story live when it could have been done better on film?

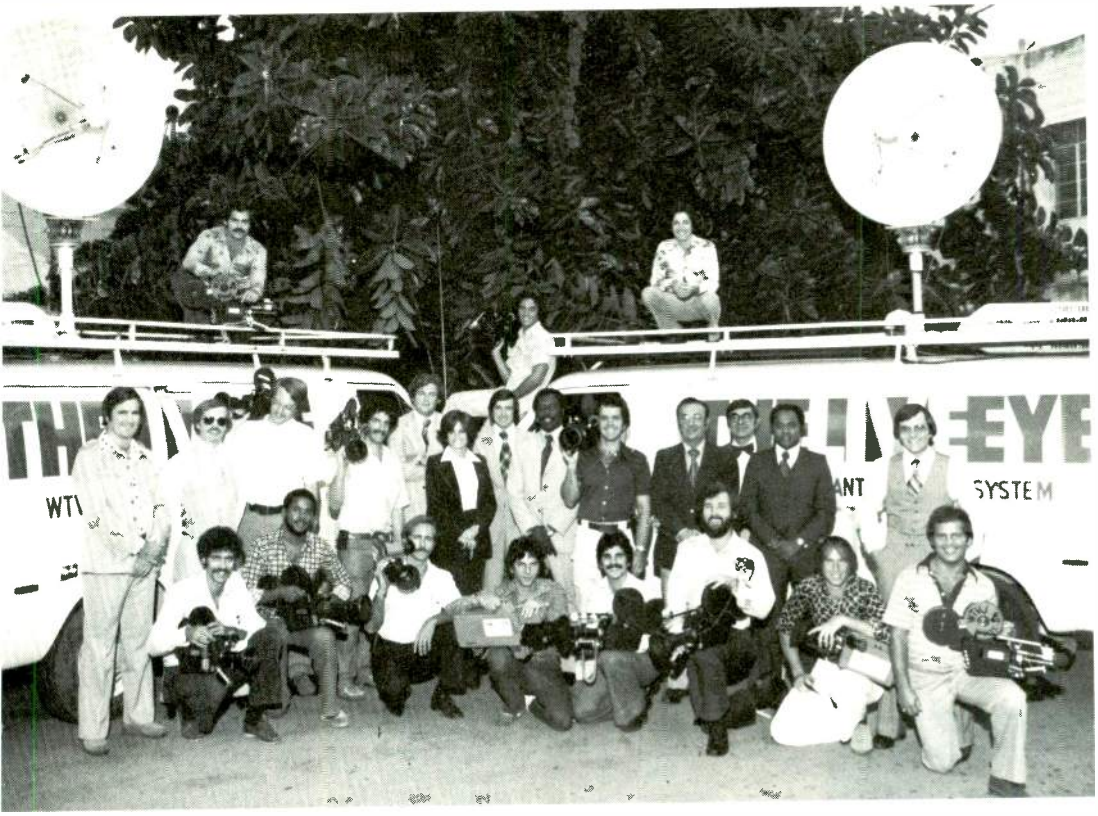
"The question was: should we invest in modern newsfilm cameras or more ENG? We felt that our two ENG units were enough to supplement film and serve our purposes at this point. And so, as our old newsfilm cameras have gone out, we're replacing them with new CP-16 units."

Dave Seeger, Newsfilm Reporter, WCKT-TV, loading his CP-16 into the news car. "VNF 7240 gives us a lot more latitude," says Seeger. "Working on various investigative series and shooting frequently at low light levels, I've probably 'forced' more film than any photographer around here." (Eastman Kodak has recently developed a new, remarkably fast stock, VNF 7250, with an ASA rating of 400, which permits shooting at light levels as low as two footcandles without requiring any forced developing! If needed, the new VNF 7250 can be pushed three stops to an ASA of 3200!)

Gene Strul (right), News Director, WCKT-TV, and Dave Choate, Assistant News Director, in conference about an upcoming investigative series. "We have found that, contrary to reports, ENG units still do not serve as replacements for film cameras," says Gene Strul.



Frank Broughton, Lab and Photographic Equipment Manager, WCKT-TV, accepts delivery of eight CP-16's from Charles Sutyak of Photomart (the regional CP-16 dealer headquartered in Orlando, Florida). WCKT-TV purchased two CP-16's in 1973, two in 1975, and in the winter of 1976-77 — twelve additional CP-16's!



"I don't think our equipment inventory should lie exclusively with ENG or film," says Ralph Renick, Vice President for News, Wometco stations. The WTVJ-TV news department equipment inventory includes two ENG vans, five ENG cameras, and nine of the station's CP-16's.

"I don't think a station should go All-ENG primarily because, with present ENG technology, your coverage would be limited."

WTVJ-TV, the CBS affiliate, is the oldest station in Miami. And the "Ralph Renick Report" is probably the longest continuing newscast in America. WTVJ-TV also has the greatest number of ENG units in Miami: five.

"I don't think our equipment inventory should lie exclusively with ENG or film," says Ralph Renick, Vice President for News, Wometco stations. "I don't think a station should go All-ENG primarily because, with present ENG technology, your coverage would be limited.

"Plus, some stories, especially features with a great deal of motion involved, lend themselves better to a newsfilm camera. Stories that are better covered with film include some breaking stories where you have to be able to move rapidly, and out-of-town stringer stories. While film in our shop is becoming a back-up or secondary system of coverage, with ENG being our primary and preferred mode of coverage, it is important that the news manager invest sufficiently in film equipment that is reliable.

"As for film versus ENG cost factors, the extra personnel involved in ENG and other extra expenditures have made the two a financial draw, they break down about evenly."

Ralph Renick (left), Vice President for News, Wometco stations, with Jim Rutledge, News Assignment Editor, WTVJ-TV. "We see film as part of the news operation for the foreseeable future," says Renick.

Cameraman Jeff Fort, of WTVJ-TV, takes a light meter reading, getting ready for a federal prisoner to come out of the courthouse building. WTVJ-TV acquired twelve new CP-16's in the fall of 1976, of which nine were assigned to the news department.

The leading TV stations in Miami may differ in their general approach to news and newsgathering, in the specific tape/film ratios they use in covering the news, and the extent to which they use ENG live capabilities. Though the competition among the stations is keen and lively, on one subject there's a definite consensus: *16mm newsfilm still remains the backbone of a balanced TV newsgathering operation.*

The VTR Format of Tomorrow. While others are still talking about it... Bosch already has it: the BCN System.

Since the BCN was first introduced, more than 370 of these systems have been ordered from all parts of the world. More than 150 of them have been delivered and are in operation.

The four basic requirements placed on a new VTR format:

Top broadcast quality for all TV standards.
Universal applicability.
Reel-to-reel and cassette handling.
Adaptable to future developments.

The secret of success the BCN scanner

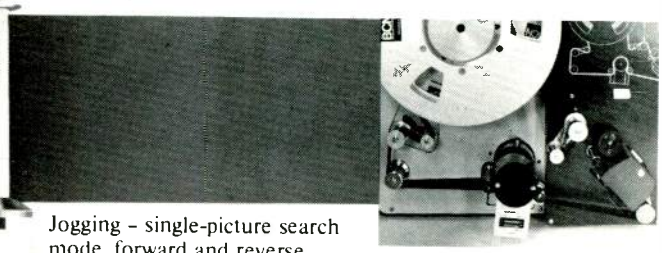
The BCN System meets these four basic requirements for a new VTR format today: The compatible and economical BCN 1" format produced by Bosch guarantees broadcast quality in all TV standards and color systems (PAL, PAL-M, SECAM, NTSC). For all fields of telecasting and VTR applications. It is adaptable to future developments in video tape and video head technology. The segmented-field process makes purely electronic switching of writing speeds possible. As a result, the BCN is already an economical and universal VTR with a guaranteed future today.

The portable BCN 20

The BCN System offers two different portable versions: the portable BCN 20 with a tape capacity of more than 60 minutes on one reel - and the BCN 5, the 20-min. cassette recording and play-back version. Both versions operate under all conditions with full broadcast quality. In the future, the BCN cassette version will also be used in an automatic multi-cassette VTR.

The BCN 5 cassette VTR

The BCN System features electronic editing with: Single-picture display - for an unlimited time with no danger to the tape.



Tape guidance system in the BCN 20

Jogging - single-picture search mode, forward and reverse. Slow-motion, fast-motion - variable take-search mode. And all this with a state-of-the-art digital store. The BCN format also offers the possibility of filing over 100.000 single pictures (for example, slides) on a 90-min. video tape with an extremely short access time to each single picture.

The BCN System is not only a broadcast VTR: It is also an electronic alternative to film. For the quality- and economy-minded industrial user, and for all professional non-broadcast applications.

The BCN System is offered by four leading manufacturers of "broadcast" equipment, and it is produced in both Europe and the USA.

The BCN System is designed for both basic tape-handling methods: reel-to-reel and cassette handling in full broadcast quality, in both portable and stationary VTR's.

BCN - a format with a guaranteed future.

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The Impact Of Digital Technology On Broadcasting: Radio And TV

Digital Technology For Broadcasters—Part II

Digital technology is likely to produce a "common language" in the broadcast industry as a spin-off of more sweeping changes for both radio and TV

LAST SEPTEMBER IN SAN FRANCISCO, a speaker at one of the NRBA panel sessions received good humored applause when he said, "It's been really great to be at a meeting of broadcasters for three whole days without hearing the words 'black burst' or 'moire.' " Though these words will not drop from the vocabulary of TV broadcasters, the future will find radio and television engineers speaking a sort of "Esperanto" based on the fundamentals of digital technology.

Words such as "bit," "sampling," "pulse-code modulation," and "codec" will likely find their way into a great many discussions in the near future. At NAB '77 exhibits, one of the most outstanding elements was the ubiquitous presence of microprocessors. There were microprocessors in video production switchers, audio consoles, frame syncs, and audio cart machines. True, most of these microprocessors were being used for machine control but increasingly they were finding direct application to the digitized signal itself—both video and audio.

This month in Part II of *BM/E*'s special report, we take a look at the microprocessor itself. John Davis of Vital Industries, in his article (p. 38) will de-mystify the role of the microprocessor. The purpose here is to make a simple statement as to what the microprocessor is. Articles to come in subsequent issues will be progressively more technical until the reader has a sense of the role and value microprocessors have today and are likely to have in the future. Bob Dolson of Retina, Inc., will present you with some notions of how all these various microprocessors might be brought together to provide a degree of power and flexibility in the modern broadcast facility never before possible (p. 40). In Part I, we suggested that the industry is in the "Black Box" stage of adopting digital technology. The question now before us is when, where and how will we emerge from it?

To try to answer that question we will take a look at this new technology from five characteristics: 1) its relative advantage, 2) its compatability, 3) its complexity, 4) its trialability and 5) its observability. These five characteristics are derived from the work of Mssrs. Rogers and Shoemaker as outlined in their book, "Communication of Innovations" (2nd Edition, 1971, The Free Press, a division of Macmillian Publishing, Inc., New York). In this work, it is suggested that the rate of adoption for any innovation will be greatly affected by these attributes.

The relative advantage of digital technology for broadcasters remains to be seen from the economic standpoint. All indications are that digital technology will be less expensive than its analog counterpart in the long run, but at its current stage, early adopters of digital technology are likely to have to absorb a large portion of the cost of the research and development that went into this technology.

Currently, broadcasters are absorbing these R&D cost in devices for which there is no analog counterpart or at least no efficient analog counterpart. Devices like the Grass Valley Group's DVE (Digital Video Effects system) introduced at NAB and the Vital Industries' "Squeezoom" are likely to be accepted into the broadcast facility because of the demand by producers for more flexible and creative hardware.

But then the question arises, what about digital devices for which there are comparable analog devices? Here digital technology will have to demonstrate a clear technical superiority. Several benefits that can be expected from digital equipment that fall into this category of technical superiority are the elimination or great reduction in noise, greater stability since "drifting" is eliminated; greater reliability; no requirement for adjustment since operation is determined by pre-set instructions, simpler signal processing and relatively inexpensive storage of program content.

The presence of such attributes in digital equipment may bring us a generation of equipment that fully replaces its analog counterpart. Though the considerably greater bandwidth required by digital technology for recording promises to retard the development of digital VTRs, digital audio recorders are already making their debuts.

Part I of this report (*BM/E*, Feb.) we reported on the digital audio recorder from Soundstream. By the time you read this article, Mitsubishi will have demonstrated, at the AES show in Los Angeles, its pulse code modulation recorder of which it says, "There is no tape speed variation, no crosstalk and no wow and flutter." These developments are exciting but there are drawbacks. Monitoring will be more difficult since analog equipment such as picture monitors or VU meters, may not tell us little about errors occurring in the digital domain.

One of the greatest concerns that will affect the rate of adoption of digital technology in broadcasting will be compatability. Technically, compatability is handled by A/D and D/A converters which allow us to continue to see the signal in its analog form. There is, however, some conjecture about how often we are free to convert the signal back and forth before introducing unwanted noise. A SMPTE study group has looked at this question and it appears that such conversion can take place through seven codecs (pairs of A/D-D/A converters) before serious impairment takes place. Each time the signal is so converted, quantizing errors and inter-character crosstalk occurs. Another side of compatability

Digital Technology—Part II

is concerned with the human factor—how foreign will this digital equipment seem to those who have to use it?

"Complexity," as defined by Msrrs. Rogers and Shoemaker, "is the degree to which an innovation is perceived as relatively difficult to understand and use." The relative ease of using this equipment, however, is inextricably tied to the question of understanding. Much of the current digital equipment, and that yet to come, contains a high degree of automatic operation. This, coupled with the general trend towards automation of the broadcast facility would seem to indicate that an all digital plant will be fairly easy to operate. Maintaining such a plant, however, is another story all together. Complaints of "bugs" in such systems rain in all the time, but this is to be expected. As diagnostics improve and the level of understanding increases, chances are that locating these bugs will be easier. The complexity of the digital technology is such that economics may demand that the offending circuit board be returned to the factory rather than any attempt to fix it in-house. This, of course, presents the problem of spare parts—which circuits are most likely to fail and which components should be kept on hand?

At this stage of the game, the last two characteristics we will look at, trialability and observability, seem positively related to the adoption of digital techniques. Most broadcast facilities already contain digital equipment and broadcasters are obtaining valuable experience with the equipment. The trial period may go on for some time as digital equipment is developed for successive functions within each plant. As with other changes in technology for broadcasters, there is one all-consuming need and that is to stay on the air. This industry, however, is not unaccustomed to building and using parallel facilities and running extensive test before "throwing the switch."

The last factor to be considered is, "How observable are the results of this innovation." The answer is, quite observable. This is one industry where observation of what the other guy is doing is nearly a fulltime occupation. There won't be much change here—you'll still be able to tell the pioneers by counting the arrows in them. Nevertheless, the arrows should not rain down any heavier than they have in the past.

The rapid changes that have already taken place promise to continue and perhaps accellerate (see Miller article, p. 50). Given the developments in digital audio recording and digital audio production (see Cooper article, p. 47 and February article on digital recorders) it is conceivable that an all-digital radio station may precede an all-digital television plant. For both radio and TV, transmission to the home receiver will remain analog for the foreseeable future since it would take many years for any changeover to take place in the home.

BM/E will continue to report on the major developments in this field. In August, Digital Technology for Broadcasters—Part III, will report on digital video effects and the various approaches to digital transmission involving data reduction techniques. **BM/E**

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Reduce Luminance Noise in Any Video Signal by up to 6 dB.
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MICROTIME

Introduction To Microprocessors—Part I

By John Davis

The microprocessor is becoming a common component in modern broadcast equipment. In this article, the first in a series, the author presents a simple, straightforward definition of what a microprocessor is and what it does.

THE ADVENT OF THE MICROPROCESSOR heralded an electronic revolution in which the computer was transformed from a large, expensive, rather esoteric machine, into a compact, inexpensive, common device that will be used by millions of individuals. These microcomputers are finding the way into video games, microwave ovens, electric typewriters, stereo sets, dishwashers, electric ranges, clothes washers, automobiles, recreational equipment, office equipment, and other specialized control applications. The market for microcomputers has been estimated between 600 million and two billion in the United States alone. Just as important for the broadcaster, microprocessors are appearing in audio and video switching equipment, camera control units, small automated traffic systems, and are being used in the control of digitized video.

What, then, is a microprocessor? A microprocessor may be defined as a single integrated circuit chip that contains some of the processing power of a small computer. This compares to a microcomputer which is a full operational computer system, utilizing a microprocessor chip. In this article we will review the composition of the microprocessor and microcomputer in general and how they function.

The reason for the vast impact of the microprocessor is that this inexpensive device (some as low as ten dollars) is capable of accomplishing very complicted digital logic and/or calculations, thereby replacing a large number of digital integrated circuits. It is also very flexible, since the same microprocessor can perform many different tasks depending on the programming that is used. The programming or software is a series of instructions that tell the microprocessor how to solve a particular problem.

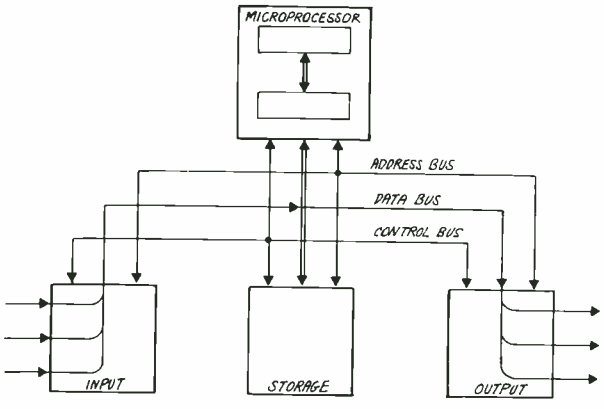
A bus is simply a set of parallel lines which interconnect electrical elements. Three buses used by the microcomputer are the address, data, and control buses. A microprocessor develops the address and control bus signals used by the other system elements. The data bus is bidirectional and permits the microprocessor to exchange data with the other elements. These lines allow data to be transferred between elements of a microcomputer system in the form of ones and zeros (electrically high or low). The binary system, using two as a base in contrast to the decimal system which uses ten as a base, permits calculations and numerical data to flow through the microprocessor system. To convert from binary to decimal each digit after the initial one is multiplied by the base two.

A microcomputer may be viewed as consisting of four elements, connected by three buses (see Fig. 1).

The microprocessor transforms data present at its inputs and controls which element the data is transferred to in accordance with the software the microprocessor is executing. The input section accepts data for processing. The output section presents processed data for use. In many instances, the input and output are, in fact, the same device. Data may be transferred to and from the input/output devices in either parallel or serial form. Serial data transmission is typically slower but requires less cable than parallel data transmission. The storage element saves values for future use. This memory can consist of Random Access Memories (RAM), Read Only Memories (ROM), magnetic tape, floppy disc or other digital storage devices. The RAM permits the microprocessor to read or write for it by placing the address on the address bus, then manipulating the data on the data bus. The ROM allows the microprocessor to read from the storage area, it cannot write (or change the data), hence the name Read Only Memory. This permits programming material to be entered once and thereafter it may be referred to by the microprocessor. It is non-volatile, it will not be lost when the system is powered down. This programming when entered into a ROM or a PROM (Programmable Read Only Memory) is called firmware.

The word size of the microprocessor is usually defined as the width of the data bus. In future articles, we will discuss the two most popular 8 bit microprocessors, the 6800 and 8080. **BM/E**

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



The basic microprocessor structure. "Firmware" are the instructions programmed into the ROM or PROM.

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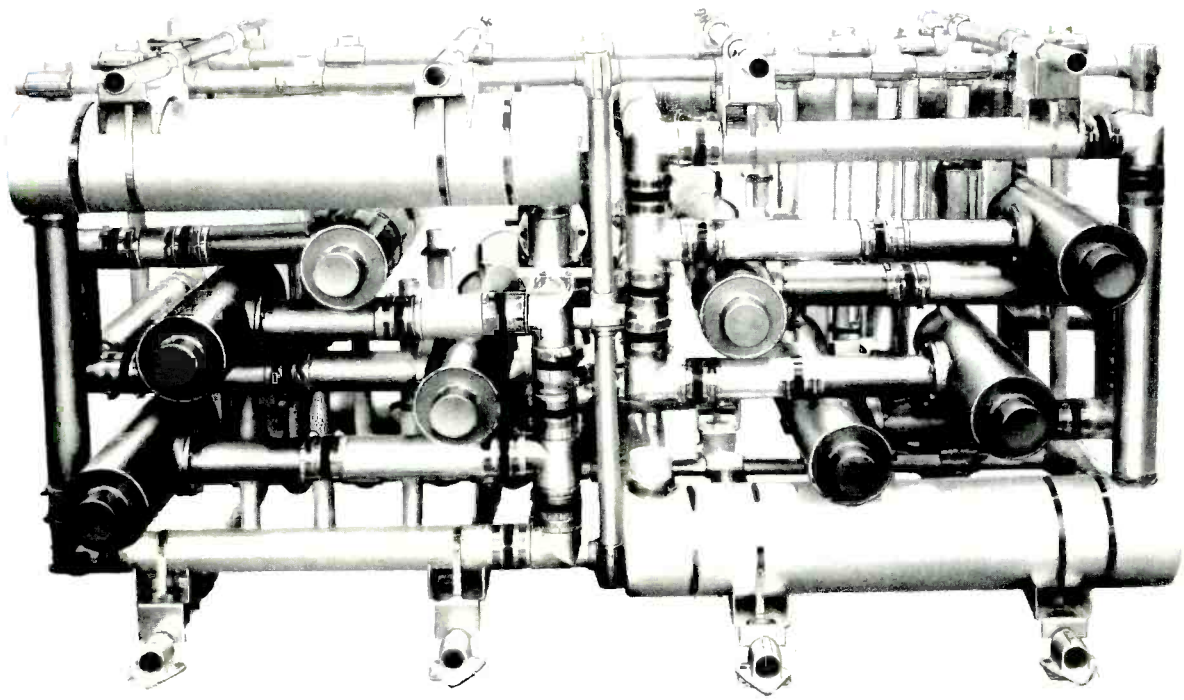

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"Systems Of Black Boxes": Integrating Digital Devices In A Production Environment

By William R. Dolson

The author explains some fundamentals to help broadcasters plan a "future oriented" system. Many of the components are on hand now. The heart of the system is the microprocessor.

AS THIS YEAR'S NAB DEMONSTRATED, digital "black boxes" will become increasingly dominant in broadcast facilities. It is already common to encounter several such digital subsystems within a medium scale operation. While it is still debatable as to whether we shall ever see an all-digital facility, it seems reasonable to conjecture on the next evolutionary development of digital techniques in broadcasting. If we are now at the "black box" stage, the next step in the industry-wide odyssey might well be described as "Systems of Black Boxes."

The point at which isolated digital devices become a "system" is the point at which those components can intercommunicate, exchanging control information with other and external digital systems such as computer editing, station automation, titling/graphics, or data processing systems. This system stage differs from the black box stage in that the primary concern is not manipulating video or audio information in digital form. The major concern in the system stage is manipulating the digital control information which is required to effectively utilize digital devices.

The impetus for creating systems already exists. A systems approach to integrating digital black boxes within a production environment can offer a number of cost-effective advantages:

Improved Control. Automation systems may not only control programming sequences and signal routing but may also monitor and correct signal quality.

Reduced Errors. Signal processing or effects sequences may be established and previewed at non-critical times and then repeated reliably on-air.

Increased Flexibility and Creative Potential. Editing or titling/graphics systems may dynamically "slave" other digital subsystems such as frame stores or signal processors, allowing the "master" system to expand its repertoire of effects dramatically.

Improved Flow of Information. Data on equipment availability and utilization may be collected and forwarded to billing, traffic, or management information systems. Edit decision lists or production sequence information may be maintained on central data processing facilities along with traditional accounting information.

A set of digital video devices becomes a system when the information employed to use them may be transmitted between them. This information may be new or it may be information which has always existed, perhaps in some haphazard form; handwritten notes, typewritten procedures, or a few neurons in someone's head. A systems approach unifies and organizes this information in a coherent manner, allowing more effective and responsive operations.

Until the advent of digital devices in broadcasting, implementing a systems approach to production facilities remained impractical. Broadcast facilities were exclusively analog, and the extensive analog-to-digital and D/A conversion required would have been prohibitively expensive. With digital black boxes appearing the situation has altered. These devices inherently speak the digital language of information processing, and the advantages of an information systems approach may begin to be manifested. The development of these systems will be gradual, paralleling the penetration of digital devices.

In the remainder of this article we'll explore different strategies which might be employed to create such systems of black boxes and we will illustrate the long-term benefits resulting from the application of this type of approach.

A simple "System of Black Boxes"

"Systems of Black Boxes" are certainly not commonplace, but digital black boxes are becoming more so. A typical station or production facility may already be developing the groundwork of an eventual systems approach, perhaps without realizing it. Suppose a single "black box," such as a digital frame store is to be connected to an external control system, such as a computer editing system. Such a configuration would allow the editing system to make use of the frame store's capability for freeze frames, zooms, or "hall or mirrors"

Mr. Dolson is president of Retina Inc., a New York based television production and digital systems consulting firm.

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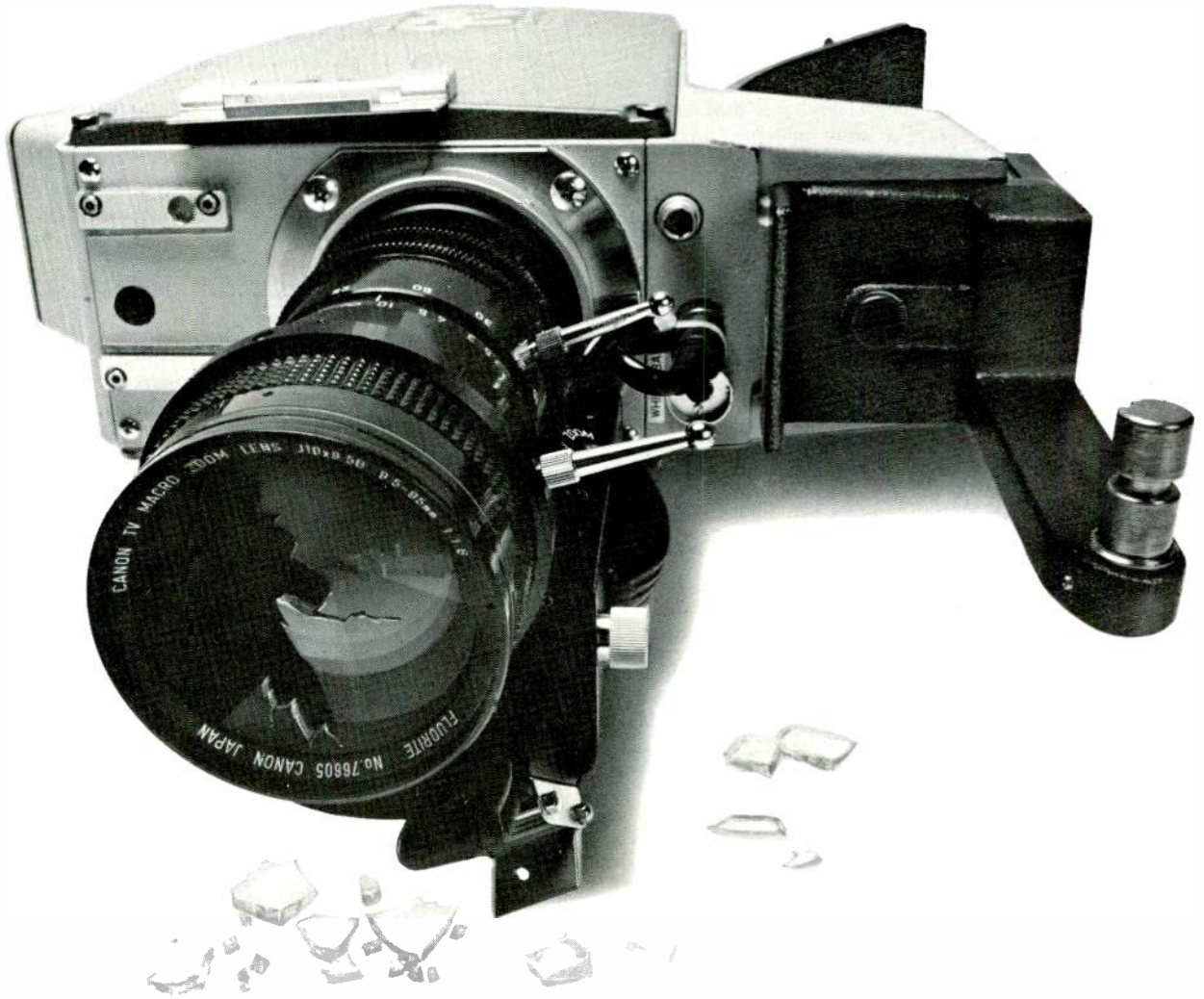

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effects, presumably in both on-line and off-line editing modes. With the right VTR's and some modification of the editing system software, this configuration could even do variable speed forward and reverse action, using the technique shown by the Bosch Fernseh digital frame store for BCN machines. We assume the editing system's software has been modified to allow these new functions. What remains is to devise some method for allowing the editing system to transmit digital control signals to the frame store. Fig. 1 presents one such interfacing solution.

Random logic interfacing

The interface presented by the digital frame store is typically a number of logic level lines conveying control signals to the store and perhaps returning status and/or digital video data. No standard has been established for these combined control and data lines, and it is dubious if such a standard is practical. The digital interface presented by manufacturers differs markedly for devices in the same class, and as new capabilities and features are offered, interfaces are bound to continue to differ.

The interface presented by the computer editing system is typically a general purpose parallel digital interface, consisting of logic level signals which may be modified or read by the computer. What is required is a means to map the interface presented by the computer to the interface required by the frame store. The simplest solution is known as a random logic interface. This is a special purpose digital interface, which is built to perform exactly this one function of converting the set of control signals provided by one device to that required by another device. A random logic interface may consist simply of level inverters, pulse shapers, or some local buffering of signals.

A random logic interface is often the simplest solution for a particular configuration, however, since it is designed for a single purpose, it suffers from inflexibility, lack of expandability and lack of generality. Should the frame store vendor offer an "add-on" next year which allows colorizing, or digital keying, the random logic interface may well require a re-design.

Microprocessor interfacing

The inflexibility of many random logic interfaces has often prompted systems designers to employ a microprocessor as the interface between devices such as our frame store and editing system. Single board, even single chip microprocessors are available which are more than adequate to perform the interfacing required in our configuration. Microprocessor interfaces have the advantage that most of the interface is implemented in software or microprocessor programming, which is considered simpler and less expensive to design and modify than random logic.

Microprocessors are usually designed with modular collections of very general-purpose interface lines. In the case of our editing systems and frame store, both would be directly interfaced to the microprocessor.* The microprocessor would then perform any re-formating of control data which would be required by the frame store.

The microprocessor interface may or may not be superior to random logic in terms of simplicity or implementation cost. It is clearly superior in terms of flexibility and generality. Unfortunately, even this interface solution can suffer drawbacks if the number of devices

*By directly we imply without additional digital devices, not necessarily direct connection. We would hope, in fact, that some form of isolation be used on signal lines between separate devices.

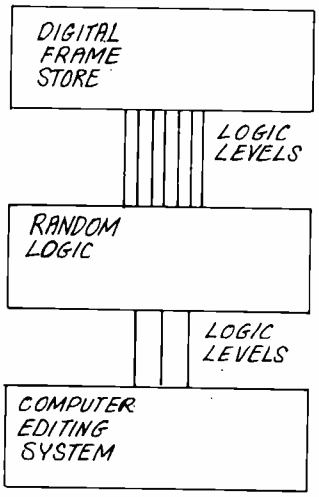


Fig. 1. Random logic interface between digital frame store and editing system.

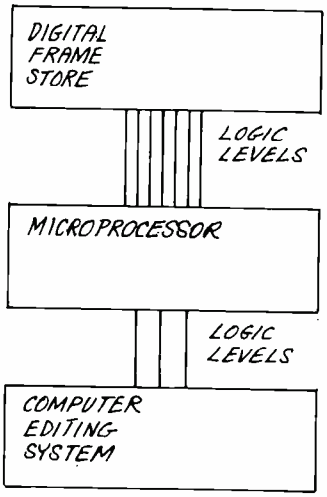


Fig. 2. Substitution of a microprocessor for random logic overcomes inflexibility.

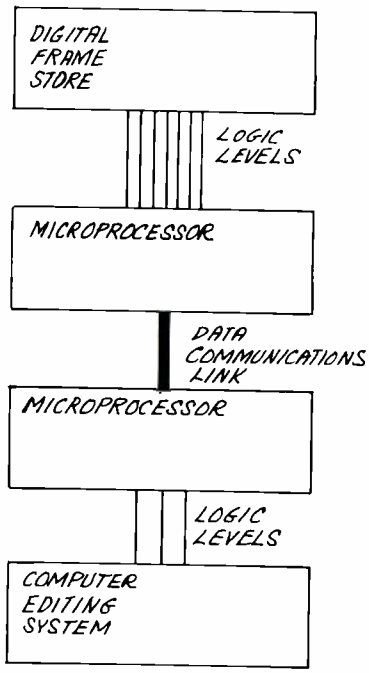


Fig. 3. The distributed microprocessor system. Data is exchanged by protocal.

involved in the system configuration grows.

Distributed microprocessor interfacing

Fig. 3 represents a third variation on our simple system interface. This variation is termed a distributed microprocessor interface. In this case two microprocessors are employed, one at each device in the system. The microprocessors are interconnected by a common data communications line. This line may be serial or parallel, asynchronous or synchronous. It may be a standard data communications line, such as RS232, or it may be a hybrid wideband communication technique developed for use in the broadcast industry. Such a hybrid technique might employ a video-like signal, transmitted via coax, which contains lines of digital information instead of picture information. In any case, data is exchanged over this line by means of a well defined pattern or protocol. A protocol is a software construct which specifies a format for data exchange. Examples of protocols are IBM's BISYNC and SDLC, and DEC's DDCMP.

By now at least some readers must be marveling at our extravagance. We've managed to introduce two microprocessors, an additional interface, and a protocol where, as Fig. 1 demonstrates, none were necessary. Bear with us. There is a method to this madness as we shall see, and it concerns the complexity of our system should it grow to contain more than two devices.

While seemingly extravagant, there are some immediate advantages to our elaborate configuration of Fig. 3. Should our editing system be some distance from our frame store, our digital data could be transmitted over Telco lines by simply interposing modems between the microprocessors. Also should we add a new feature to our frame store, the microprocessor attached to the editing system need never be aware of it. This configuration has functionally isolated our device dependent software. The software required to handle the data communications line is identical in both microprocessors, so we really haven't doubled our software job.

Now we have three distinct ways in which our digital "black boxes" can exchange information. Which is best? As always, that depends, and what it depends upon is the shape or topology of our system.

Networks of "Black Boxes"

Our frame store/editing system interface example is intentionally simple in order to illustrate basic interfacing possibilities. This is the level of black box interfacing currently faced by stations and production facilities. However, as digital black boxes and computer control systems proliferate, this simple system will inevitably grow more complex. As a further example what would happen in the future if we decide to up-grade our production capability by adding a titling/graphics generator which may be slaved by the editing system? We may also want the titling/graphics generator to be able to slave the frame store for especially complex title sequences. Also, every two years or so we may want the titling system to be slaved by our business computer which is running a FORTRAN program to process election returns. Finally, we may want our editing system to be able to use the disk-based file management system on our business computer so we can store edit decision lists on disk, and avoid unreliable paper-tape. What now? Based on these expansion possibilities what is the best way to interface our frame store to our editing system?

Once we begin to think about a system involving many elements, we have left the realm of interfacing, and are venturing into what data communications people call a "network," not to be confused by what broadcast people mean by a network. A data communications network consists of multiple digital devices communicating with each other through one or more common protocols. A datacom network might be very close to what broadcast people mean by "Systems of Black Boxes." As we shall see, the method by which those "Black Boxes" communicate should be determined by the topology of the network.

Network topology

The term topology is used to refer to the interconnection pattern within a network. To demonstrate why topology is so important, assume we have N black boxes in a network and we want each black box to be able to be connected to any other black box. Each black box must be equipped with N interfaces, each possibly different. In addition, interconnecting black boxes requires $(N^2-N)/2$ interconnections.

Adding an additional black box requires N additional interconnections. Clearly, as N grows, the number of interconnections becomes astronomical. A direct connection network topology is dictated if random logic interfaces are employed as in Fig. 1. For small N's direct connection is acceptable, however, for numbers much greater than 3 or 4, system designers invariably resort to schemes other than direct connection. The telephone companies realized these sobering facts quite early in the game and adopted the strategy shown in Fig. 4. This is known as a star network.

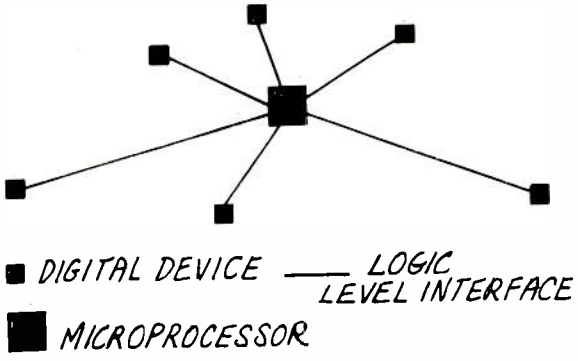


Fig. 4. The star network cuts total number of interconnections.

Star networks

If we go back to our digital video black boxes and pretend each dot or "node" in our star network is a black box, the central node in our star might be the microprocessor of Fig. 2. Except now the microprocessor is talking to several black boxes and has probably turned into a mini-computer. This central processor mini or micro, controls routing of control information between devices. This topology works well, up to a point. Eventually, as we add more nodes to the network (more black boxes to the system) we begin to saturate the I/O capabilities of the central processor. There is a way out of this limitation, and it is illustrated in Fig. 5.

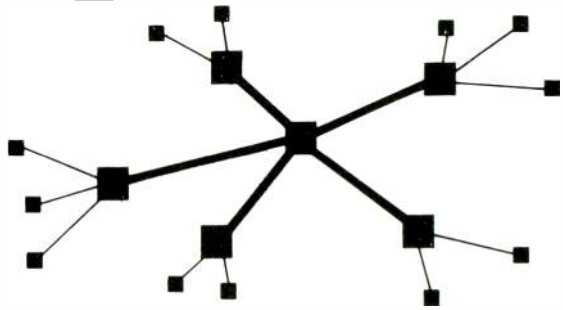


Fig. 5. Hierarchal network is used when a great many nodes are required.

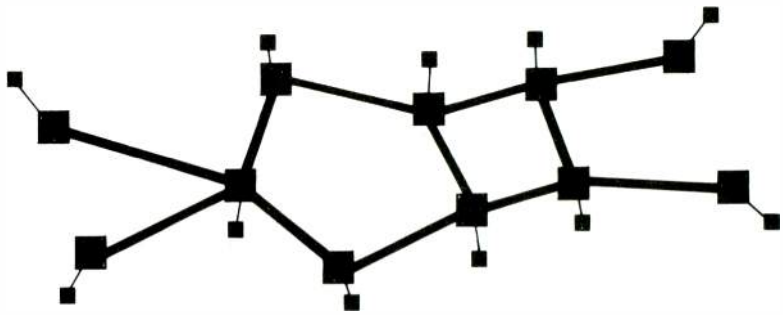


Fig. 6. Distributed networks are the most flexible form of interconnection.

Hierarchal networks

The Hierarchal network is an alternative to star networks when a great many nodes are required. No single processor is overloaded by an excessive number of devices. Each outer processor in the system now communicates with one or more black boxes as well as a central processor. The central processor only communicates with other processors. This central processor now performs the function of relaying packets of digital information between outer processors. This processor is considered a "message switch" and performs a "store and forward" function. If we compare any of the outer processors in Fig. 5 with the interface scheme of Fig. 3, we discover a great deal in common. Each of these processors are interfaced directly to black boxes, and indirectly to another processor via a data communications line. We now can see that if our network can conceivably become complex enough to require a hierarchal topology we had best begin with a distributed microprocessor interface scheme. Unfortunately, both Hierarchal and Star Nets suffer from a common failing. The reliability of the entire network is dependent upon the reliability of the central processor. It is possible to employ a backup processor for the central node, should a failure occur, but these two topologies are not very fault tolerant. The demands of a broadcast environment may preclude the use of either of these topologies for organizing systems of black boxes.

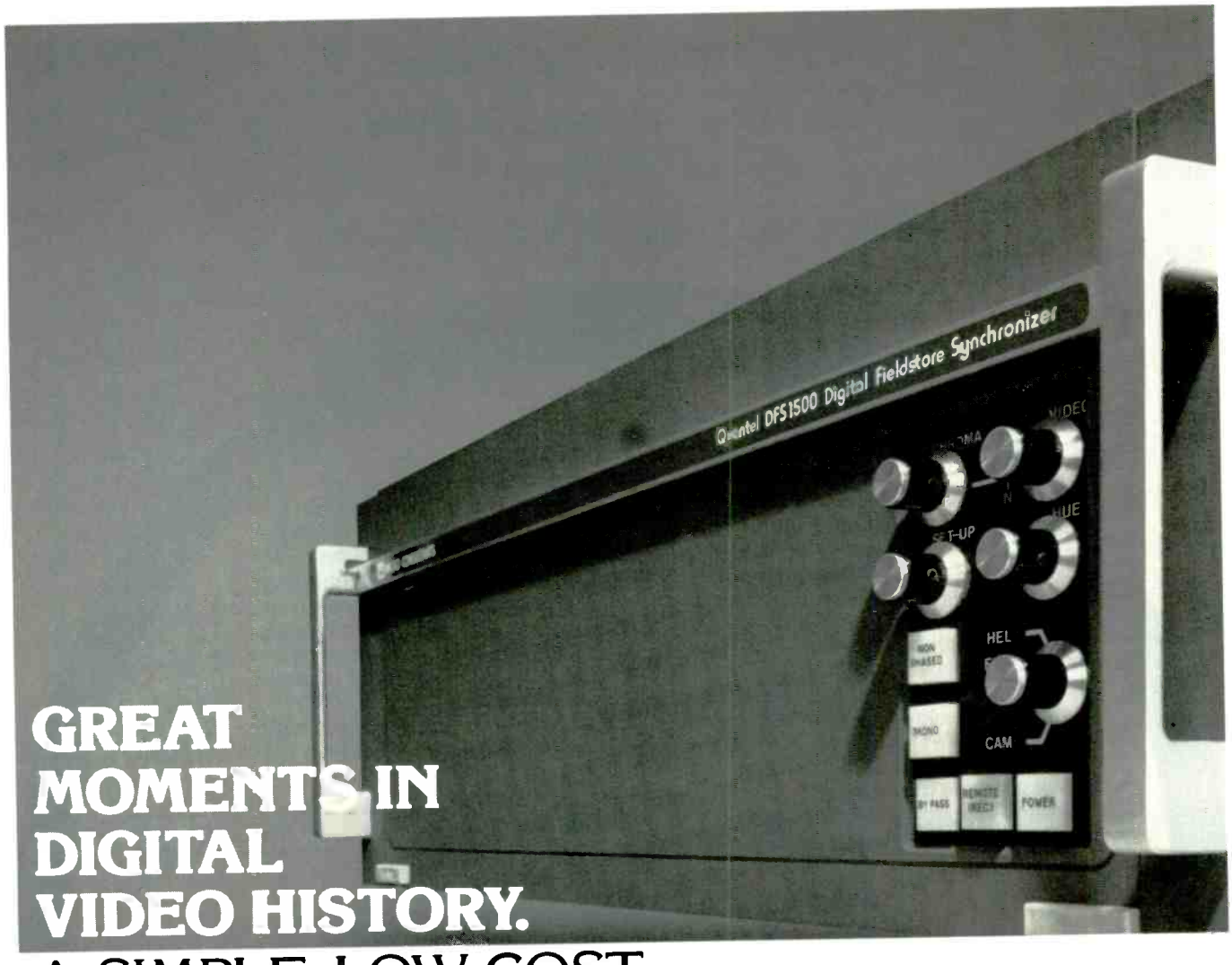
Distributed networks

Fig. 6 illustrates what is known as a distributed network. Distributed networks are the most flexible form of interconnection. Processors are linked where feasible but no restrictions are placed on interconnection. This topology is considered optimal in terms of both interconnection complexity as well as reliability. A correctly structured distributed network can still function if one or more of its nodes are inoperative. The distributed network's fault tolerance is not without its cost. The software required at each node is more complex. Packets of digital data are passed from processor to processor until they arrive at their correct destination. Each processor must therefore possess information about the structure and moment-to-moment status of the entire network. This is known as "packet-switching" and along with the implied store and forward capability, places additional demand on processor through-put. While distributed, packet switched networks are only a recent development. Virtually all new data communications systems in the military sphere are employing this technology, primarily for reasons of reliability.

Black boxes, systems and the future

So what does all this mean to the broadcast industry now? Perhaps a surprising amount. Vendors are already beginning to offer systems solutions based on random logic and/or microprocessor interfacing between black boxes. The GVG/NEC frame store is a prominent example. Station automation packages are beginning to make use of distributed microprocessor systems. The CMX-340 series editing systems can be thought of as a form of hierarchal network. Perhaps most importantly, several mini-computer vendors which supply manufacturers in the broadcast industry have announced modular distributed network packages.

To the broadcaster contemplating a "System of Black Boxes," even as simple as our first example, the watchwords might well be "design for flexibility." The interconnection and systems integration of digital devices may well be the next big influx of digital technology in our industry. **BM/E**



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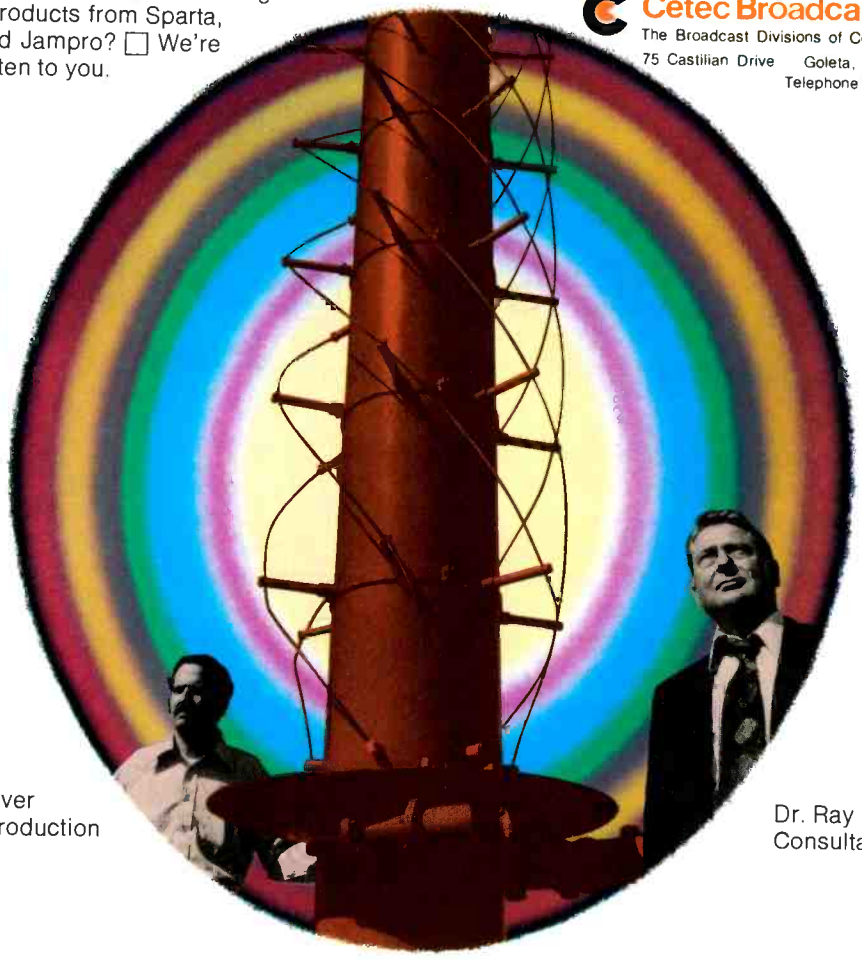

Jim Olver
V.P. Production

Dr. Ray DuHamel
Consultant to CETEC Jampro

KLOC-TV, CH 19, Modesto, California
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Push-Button Music: How Digital Techniques Will Transform Synthesizers

By Ellis D. Cooper

The electronic music synthesizer, already attractive to enterprising broadcasters, will become more flexible, easier to use, wider in musical range than anything we can imagine now, as digital techniques are applied to it. Here are the predictions of an expert in synthesizer design; the instruments he foresees will eventually give broadcasters fantastically resourceful programming sources.

CONVENTIONAL MODULAR, VOLTAGE-CONTROL synthesizers for electronic music (Arp, Buchla, Eμ, Moog, etc.) are intrinsically analog rather than digital tools. Application of digital techniques, until recently, has been to synthesizer peripherals such as sequencers (Oberheim) or audio delay-lines (Eventide Clockworks). The new digital technique involving software, that is, the "microprocessor-based, bus-oriented modular approach," is fast encroaching on the very concept of synthesizer for electronic music.

The synthesizer is a processor, or interface, between a controller system (keyboards, knobs, switches, etc.) and a sound system (audio amplifier, speakers, etc.). Voltages from the controller system control sound-related parameters such as frequency, amplitude, duty-cycle, randomness, sampling-rate, time-envelope, spectral-envelope, etc. The new digital technique involving software is forcing everyone to think very hard. How shall the technique be used to increase the musical power of synthesizers and at the same time bring down their cost? There is a grand flurry of guesses, estimates, plans, and constructions.

Established manufacturers are reluctant to tell us too much about their marketing research and plans, much less about their estimates and constructions. On the other hand, individual musicians and amateurs do overflow at times, with this type of information. Thus, it cannot come as a surprise that many of the examples mentioned below—of digital techniques in synthesizers for electronic music—are simply the forefront of an impending avalanche of computerist and synthesist inventions, plans, and new businesses.

For example, one new product combines a very simple digital technique with a pair of fixed-sound generators to provide the function of calibrated, accent-programmable metronome. With an optional fingertip-actuated controller, this device, the Accenter (C-K Algo Rhythm), is a new kind of rhythm instrument. This is one step beyond the digital technique involving "rhythm-generator chips" used in accessories to many electronic organs for providing rhythmic accompaniment (waltz, rock, rhumba, etc.). Although electronic organs are not, technically speaking, modular voltage-control synthesizers, they certainly deserve to be included in any discussion of digital techniques for electronic music. After all, the whole sound-generation system using a "top-octave generator chip" plus "divider-chains" (ITT) is digital. There are other non-microcomputer digital applications to electronic music, including the digital keyboard (Electronotes Newsletter), the multi-track digital tape recorder, the programmable counter with divider for tape-editing, and the sequencer-to-tape interface module (Jay Lee and Eμ).

Coming closer to computers and synthesizers, the modular sequencer system (Eμ) uses computer-like digital techniques interfaced via digital-to-analog converters to a conventional synthesizer. The only thing that keeps the modular sequencer from falling into the stored-program digital computer category is the absence of stored-program ability. But there are many constructions involving micro-and minicomputers interfaced to conventional synthesizers (Buchla). These are generally called *hybrid synthesizers*. The outstanding question is, what shall the software do? Abstractly, the capability of software is logical processing of memory contents. What the numerical contents of memory are, what these numbers mean in musical terms, and what shall be the logic underlying the processing, are all questions to be answered by software specifications.

For example, memory has been used to hold a record of a performance on the keyboard-controller of a synthesizer. Later, during "playback," the control-voltages and their time-values are recalled from memory and converted to sound by the synthesizer part of the hybrid. This allows editing, hence composing, of music. Memory has also been used to hold the switch—and knob-setting information required to define a

continued on page 48

Dr. Cooper is president of C-K Algo Rhythm, synthesizer design consultants, and is an assistant professor of mathematics at City University of NY.

"patch"—a particular sound-quality—for a synthesizer. Thus, the problem of how to switch quickly from one patch to another, during live performance, is solved.

A more difficult problem with conventional synthesizers, lack of chord-playing ability, or "monophonicity," is just coming under attack by digital techniques. (Eμ, Moog, Oberheim). So far, only partially polyphonic solutions are offered, e.g., at most 4 or 8 or maybe 16 notes may be played at one time—and they must be played according to certain artificial rules, at that. True polyphonicity, such as that of a piano or an organ, is not commonly available in conventional synthesizers, even when they are augmented by computers.

A tradeoff is available, however. It is possible to trade the great sound generating scope of conventional synthesizers for true polyphonicity by interfacing a microcomputer to an electronic organ (C-K Alto Rhythm).

As mentioned above, electronic organs are not modular, voltage-control synthesizers, but they certainly do provide a considerable variety of sounds, what with their rows of adjustable stops, and special vibrato, chorus, wah-wah, tremolo effects, etc. The question pops up again, what shall software do? To answer this, digress momentarily to distinguish two main creative activities of the electronic musician. On one hand, the musician designs sounds or families of sounds, operating in the audio frequency range (pitched timbres and filtered noise). This is what a synthesizer is good for. On the other hand, the musician arranges sounds and families of sounds in musical compositions and performances, operating in the sub-audio frequency range (rhythms and melodies). The digital/analog hybrid composed of a microcomputer and organ readily permits composition and editing of entire rhythmic-melodic phrases whose combinations, repetitions, and alterations are controlled directly from the organ keyboard. This puts new meanings into old keyboards, hence gives rise to brand new musical possibilities.

An increasingly important force acting on the future of digital techniques for synthesizers in electronic music is the mad hunger of microcomputer manufacturers, magazines and users for new applications of hardware and software. Here you have tens of thousands of computerists with powerful microcomputers wondering what to do next. Since there are basically only two types of computer output devices—audio and video—it is natural for many computerists to turn to electronic music applications.

For example, one manufacturer already offers "polyphonic synthesizer boards" (Stillman Research Systems) which can be plugged into a standard microcomputer system, converting it into a musical sound generator. The reciprocal relationship between the microcomputer world and the electronic music world will have a profound impact on both market areas. Similarly, the recent entry of microcomputers into the video-game market (Fairchild) will also have side effects for electronic music. That is, video-games require new, exciting sounds (Atari) to attract customers. This means that semiconductor manufacturers will be offering "sounds-on-a-chip" in a variety of sound families. Undoubtedly,

someone will incorporate such digital, integrated-circuit memories into a new type of electronic music synthesizer.

There are plenty of other possibilities for new electronic music synthesizers based on digital—and specifically on microcomputer—techniques. For example, the new analog technique of voltage-control waveshaping (Bernstein and Cooper) lends itself to microcomputer interfacing, making possible yet another family of electronic music sounds. Then again, someone will probably interface a microcomputer to control the tap-weights of a tapped, audio delay line, creating a wide range electronic music filtering system. Application of a whole battery of computer-oriented speech analysis/synthesis techniques to electronic music is not far off. Indeed, at least one company (Lexicon) offers a digital rate-changer for speech which has musical potential, and another company (Eventide Clockworks) is marketing a digital frequency scaler which preserves harmonic relationships. These digital time and frequency domain processors will surely function in future synthesizers.

The purpose of a synthesizer system, including the controller, processor, and audio sub-systems, is to give to the musician flexible control over the fine structure of musical listening experiences. The musical power of the system is proportional to the degree of flexibility of control and to the scope of possible musical sounds. In the near future, as a result of higher computer speeds coupled to larger memories at lower costs, we may expect a far greater and more versatile application of digital techniques in synthesizers.

New digital controller systems, e.g. digital guitar and percussion controllers, will come into use. There will be microcomputer *simulations* of modular, voltage-control synthesizers, eliminating certain problems intrinsic to the analog way of doing things, e.g. signal-to-noise ratio, long-term stability, and calibration problems, etc. There will be programmable spectral transformers which will "bend" notes much in the way the human voice bends them. Digital simulation of two or more colliding, vibrating bodies of programmable constituency will take care of the difficult percussive-sound systhesis problem.

It is possible that soon we shall be hearing musical sounds generated by a distributed processor synthesizer. This will have several microprocessors devoted simultaneously to different system tasks. For example, one microprocessor will handle a video-graphics controller, signalled by one or more light-wands in the musician's hands. This controller will have pattern recognition capabilities.

Another microprocessor in the system will be an extremely high-speed "number-cruncher," generating complex spectral evolutions in real-time, i.e. life-like sounds. Yet another microprocessor will take care of the bookkeeping details associated with composing and editing rhythms and melodies. We will eventually see the emergence of "musical robots." In other words, the development of artificial musical intelligence (software) with sufficient musical IQ to distinguish and separately analyze, process, and respond to musical lines produced by the members of a group of performers—robots or otherwise.

Somehow, this orgy of prediction has to end, so let me get back to my workshop. **BM/E**

The Future Of Wide Window TBCs

By Bill Miller

The future uses of TBCs by broadcasters will expand. The form that this expansion takes will largely depend on many cost saving technological changes and new ways of employing time base correctors.

SINCE NAB '73, when CVS introduced the first "wide window" digital TBC, at least a dozen companies have entered the TBC market (some only briefly). TBCs have become a 10 to 20 million dollar a year industry; a new television capability—ENG—has emerged; and many quad recorders now *include* digital TBCs.

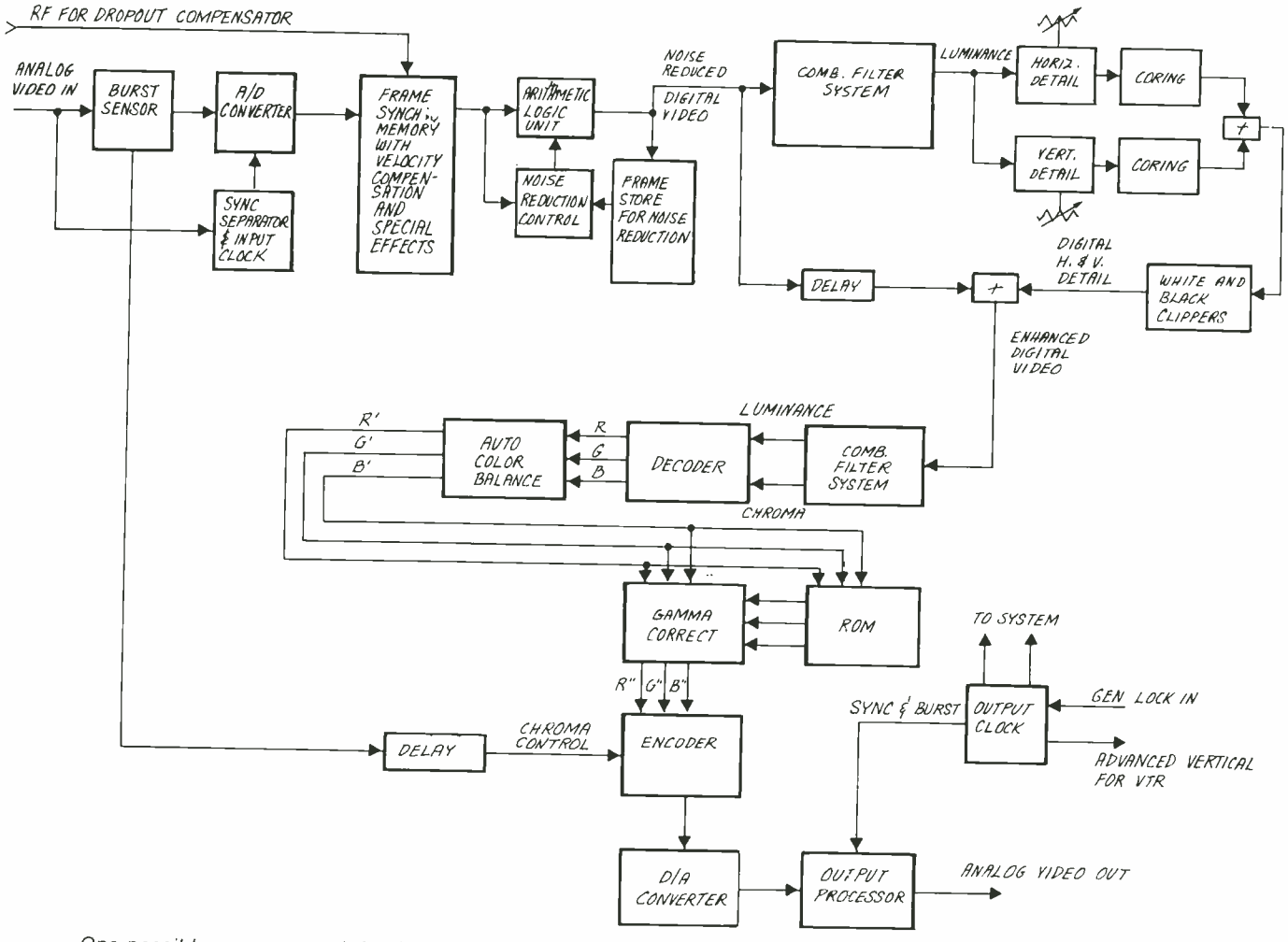
Today, wide window digital TBCs come in an almost overwhelming array of sizes, shapes and technologies. Present day digital units are as small as 3½ inches high with window sizes of up to 32 lines or more. They range upward in both physical size and in memory capacity. Devices are available in 6 bit, 7 bit, 8 bit, and 9 bit configurations with sampling rates of 3x and 4x subcarrier. Prices range from under $6,000 to over $50,000.

As digital technology has advanced, the versatility of these devices has also improved. Early units would only work with direct color, capstan servo VTRs. Many present day TBCs, however, function with all types—including line lock, heterodyne and segmented scan recorders.

In addition, new applications are being found to give further impetus to market growth. For example, frame and field synchronizers have added special effects capabilities such as freeze, picture positioning, and compression to their synchronization role. In another development, one of the newest TBCs includes NTSC to PAL-M (525/60 PAL) standards conversion along with

continued on page 52

Bill Miller is project manager at Consolidated Video Systems, Inc., Sunnyvale, Calif.



One possible new approach for the next application of TBCs might be a "TBC front end" for portable VTRs. It might look like above.

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Wide Window TBC's

Dramatic size reduction of TBCs is demonstrated by the difference between CVS' first TBC, vintage '73, and its Model 520, vintage '76.

PAL-M time base correction. Furthermore, some TBCs now come with noise processing and image enhancement.

What's next . . .

With all this development, the real question is "What's next for wide window time base correctors?" The following discussion is an attempt to answer this by looking at the future implications of technology and market trends.

First of all, any look at the future of digital TBCs can't ignore the recent comeback efforts of analog TBC makers. Once considered almost obsolete for "stand-alone" use, analog units may have a new lease on life thanks to the development of charge storage technology (such as CCDs). This technology offers memory size and cost comparable to that of digital chips without the need for analog to digital (A/D) conversion. At the same time, the cost of A/D units has dropped dramatically (one manufacturer recently advertised compact modules for $1,150 each versus their rack mount $8,750 unit of 8 years ago). Whether CCD units will be able to meet the performance and cost challenge of established digital equipment remains to be seen. At least two manufacturers feel it will, and are offering charge storage TBCs for sale.

Meanwhile, further reductions in size, weight, and power consumption all seem likely for the digital units. Improvements in memory technology will be the principal contributor, since memory storage capacity per IC chip is going up at a rapid rate. Earlier TBCs, for example, used one and two kilobit memories. Now, however, sixteen kilobit random access memory (16K RAM) chips are commercially available, with promises of 32K, 64K and upward RAM memories being talked about by many IC suppliers. While the cost per bit of these new chips is presently the same as lower performing units, savings can be effected in board size, equipment size, and power consumption. Also, digital CCD memories, with lower power consumption per bit than RAM memories, may provide a competitive edge for future digital TBCs, if not for analog.

Another emerging memory technology, magnetic bubbles, may or may not be useful in TBCs. Their main drawback is their slower speed. However, their large memory potential might make them useful as "buffers" or plug-in pre-programmable memories for special effects, still storage, or other applications.

The incredible shrinking TBC

Along with new developments in memories, A/Ds are coming down in cost and size. As a result, it may soon be possible to see complete A/D converters for TV housed on a single IC. Similar advances in output processors, D/A units, etc. are also foreseeable, and a "TBC on a chip" appears as a remote, but real, possibility.

More specifically, size and weight reductions in circuitry will likely lead to at least two changes in future TBCs. One is a shrinking of package size. In fact, some observers have theorized that "stand-alone" TBCs can be developed in 1¾ inch (or smaller) rack mount packages. The second potential change is the packaging of the TBC *within* small, helical VTRs. At least one major manufacturer is currently studying this idea. By combining common VTR and TBC power supplies, processing circuits, etc. it is possible that significant cost and size savings—perhaps 50 percent—over "stand-alone" devices could be realized.

On the other hand, some manufacturers may opt for "specialized" TBCs; units dedicated to a specific kind or type of VTR. One manufacturer of segmented VTRs has already gone this way with some products. In addition, it seems likely that customers involved principally in ENG will soon have an array of vertical lock, heterodyne-only TBCs to choose from. By deleting functions such as direct color and segmented scan capabilities, significant cost savings once again on the order of 50% may be realized.

The 'ultimate' TBC?

Still other TBC manufacturers may decide to upgrade capabilities while maintaining (or increasing) price and package size. One may question whether the market is ready for a TBC with a full frame of memory, dropout and velocity compensation, automatic chroma correction, digital noise reduction, enhancement, color balance, gamma correction, freeze, compression, "zoom," rotation and so forth. However, such a device is feasible given today's technology. (Fig. 2) Microprocessor control of such a unit would make construction and operation much simpler than it would appear.

Another possible direction involves TBCs for applications where on-site technical levels are low. CATV and secondary school ETV might fall into this category. To serve this market, one may expect to see digital TBCs with much lower costs than are common today. Such units will have no operator controls and only two connections: video in and video out.

TV standards conversion is also a potentially large growth area for TBCs. While present day TBCs only convert between like scanning rates, future devices might be built to go beyond this. As just one example, such a unit might accept unstable NTSC inputs and convert them into stabilized European PAL or SECAM signals. The inverse could also be true. Improved circuit

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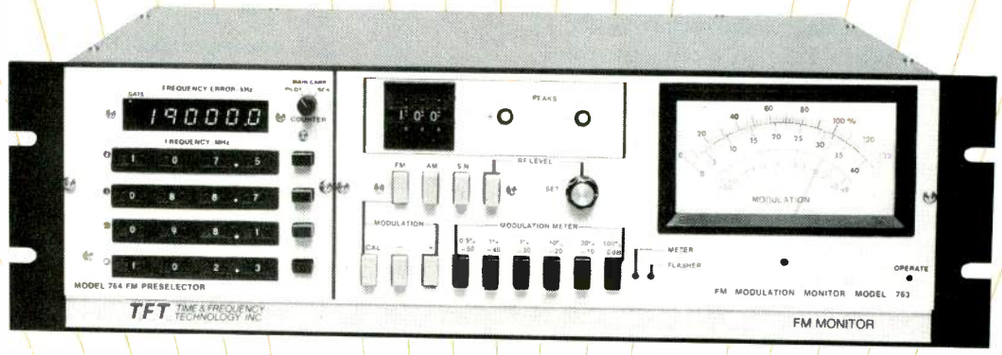

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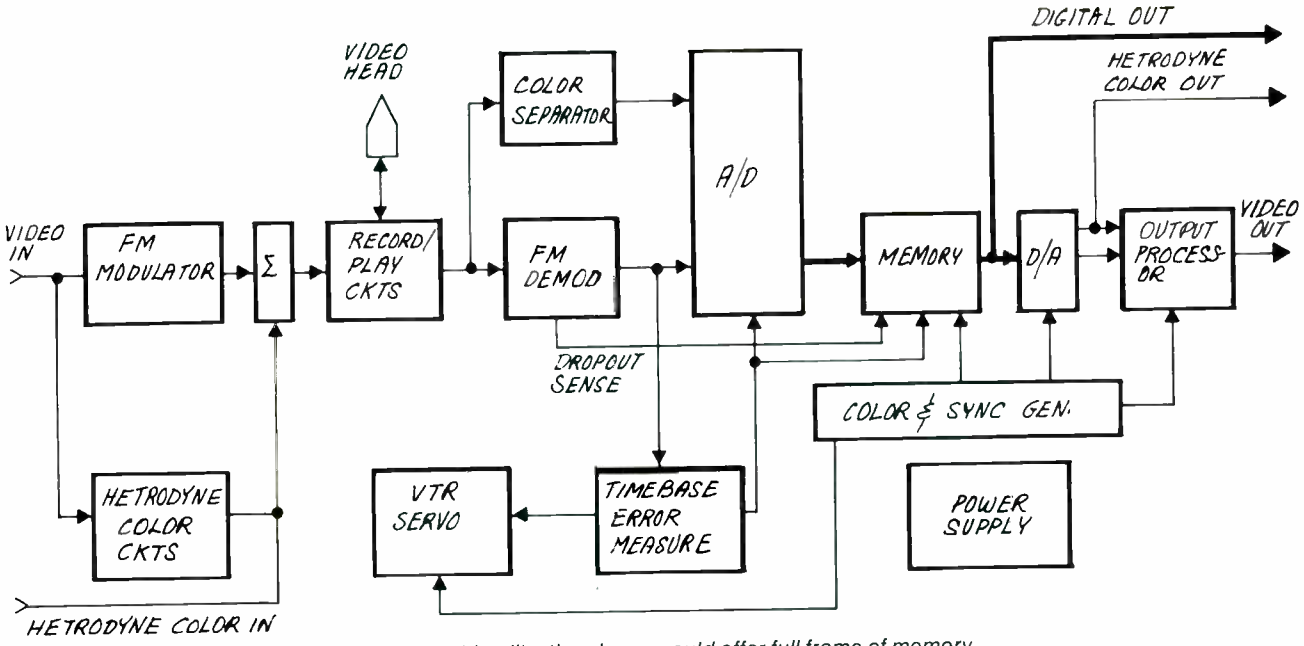

"The Ultimate TBC," which could look something like the above, could offer full frame of memory, dropout compensation, velocity compensation, automatic chroma correction, digital noise reduction, enhancement, color balance, gamma correction, freeze, compression, "zoom" and rotation—and more.

techniques could bring the cost of such units down from their present quarter million dollar level to a more affordable figure.

Systems interfacing

Still another consideration is systems interfacing. Some customers have expressed concern about the difficulty of changing several cables to use a single TBC with multiple VTRs. Since video memories and processing tend to be the more expensive parts of a TBC, one cost effective solution might be to equip each VTR with a relatively inexpensive TBC "front end," and switch digital inputs to a common memory. (Fig. 2) CVS has taken one step which could be useful in such an application. Their new, Model 620 low cost ($20,000) frame synchronizer can accept digital signals from their Model 520 TBC (Fig. 3) *or* the new $5,000 Model 720 "TBC front end." The Model 720 is a rack mounted, 3½-inch high A/D converter that also includes time base measuring circuitry.

Looking farther into the future, perhaps the next generation of VTRs will have both analog *and* digital outputs. This would allow easy interface with TBC memories and a host of other digital devices. Providing dual outputs would be fairly easy since many signals required by a time base corrector are already found within the VTR. So, it might be a practical and economical approach when considered on an overall systems basis.

Taking such a possibility one step further, one can envision future television systems consisting of digital distribution amplifiers (like VDAs or PDAs but in the digital domain), digital switchers, digital special effects, digital keyers, digital processing, digital . . .

Problems of digital standardization

As can be seen, it is easy to get "carried away" with the future for digital TBCs. However, before some of these devices become practical realities, some real work will have to be done on digital standards. This will allow different products by different manufacturers to be interconnected in the digital domain, and give customers more latitude and flexibility, both budgetary and technical.

Areas where differences between manufacturers exist include number of bits, digital "word" configuration, and sampling rate. Of these, the difference in quantity of bits is the easiest to reconcile between products. However, the other two differences are not so readily resolved. The two most common sampling rates in the industry are 10.7 MHz (3x subcarrier) and 14.3 MHz (4x subcarrier). Interconnectiong devices with different sampling rates involves either complex digital circuitry—with its attendant cost—or digital-to-analog-to-digital conversion with degradation in signal quality. Word configuration differences also exist. Some products digitize the entire video signal while others digitize only the active interval. Some products digitize the entire composite video signal from tip-of-sync to peak white. Other devices decode the color signal into its component Y, I and Q parts prior to digitizing it.

As can be seen, the problem is severe. Recognizing this fact, the SMPTE has established a committee on digital standards. Although meetings and discussions have been held, early agreement on digital standards seems unlikely.

However, despite the present lack of such "niceties" as digital standardization "wide window" TBC products will continue to roll out of factories at an increasing rate. As long as electromechanical scanning, as found in VTRs, is used for the storage and retrieval of video data, the TBC will be a vital and continuing part of the modern television system. Even when the long-awaited digital VTR arrives on the scene, the hardware and technology which will make it a success will owe its "life" to the TBC of today! **BM/E**

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An Introduction To Digital Television Part III: A-to-D And D-to-A Converters

By R.N. Hurst

THE RECENT AVAILABILITY of new low-cost-per-bit LSI memories has been responsible for the re-awakened interest in digitizing the video signal. It is now perfectly feasible to do things that were quite impractical a few years earlier. To store and manipulate the video signal in these memories requires that it be converted from its long-familiar analog form into a stream of digital bits. This conversion process is carried out by a device known as an *analog-to-digital converter*, or *A-to-D converter*. It is this device, and its complementary counterpart, the *D-to-A converter*, which are the subjects of this third part of this series.

In February in Part I, we introduced (in that part's Fig. 6) the three basic steps of A-to-D conversion. That figure, which is reproduced here as Fig. 1, shows that the

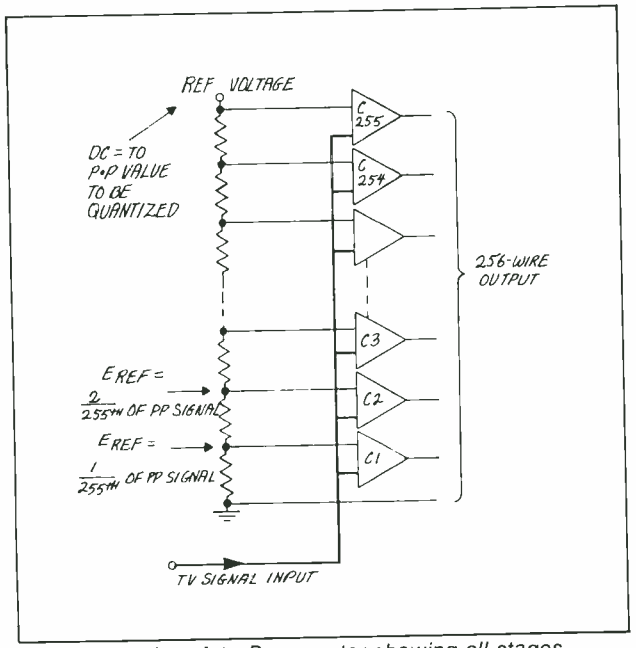

Fig. 1. Complete A-to-D converter showing all stages. Resulting PCM signal is shown in both numeric and waveform formats.

signal is first *sampled*, at a rate three or four times the color subcarrier frequency, and those sample values are *held*, to give time for the values of the samples to be measured by subsequent circuits of the A-to-D converter. This measurement results in the actual value of the sample being forced to assume the nearest one of the 256 allowable values of the (8-bit) digital system. This forcing-to-a-value is called *quantizing*, and is the second step of the A-to-D process.

The quantized signal is then passed into a logic circuit which converts each given level into a specific binary code representing that level. For example, if at some instant the original sampled value lay just below the 173rd allowable level, the output of the quantizer would be right at the 173rd level, and the eight wires from the encoder would carry, at that instant, a pattern of eight highs and lows representing the number 173 in binary code.

Of the three steps in A-to-D conversion—sampling, quantizing, and encoding—we have already treated sampling in some detail in March, in Part II of this series. The sampled-and-held signal described in Part II is the signal which must be quantized.

Fig. 2 shows how a comparator can be used to identify a given level in a TV signal. A fixed reference voltage

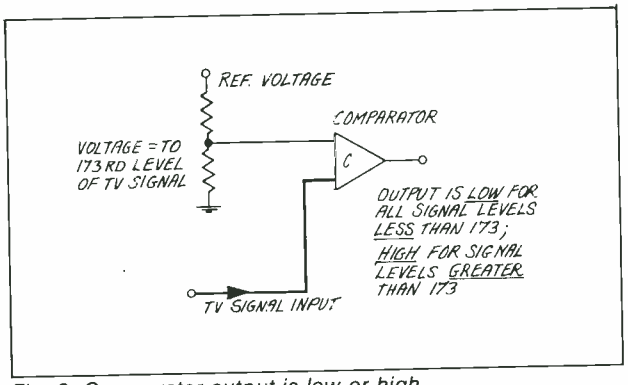

Fig. 2. Comparator output is low or high.

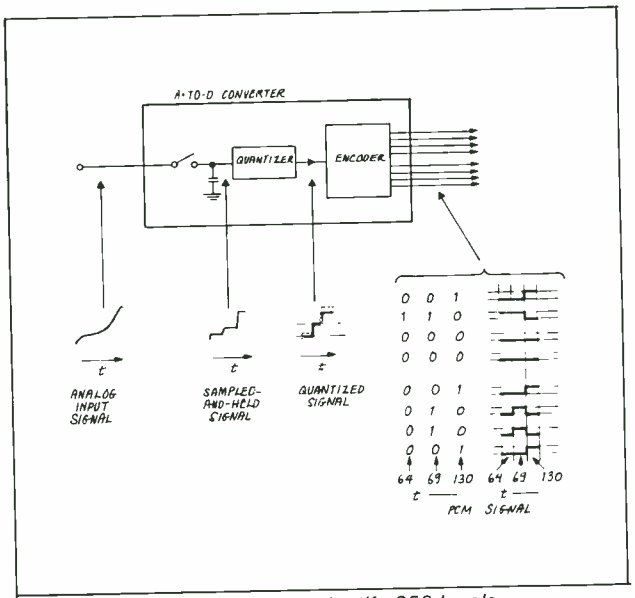

Fig. 3. Comparator circuit to identify 256 levels.

equal to the level to be identified is applied to one input of the comparator, and the TV signal is applied to the other input. The comparator will then provide a HIGH output for all signal input levels greater than the reference voltage, and a LOW output for all signal levels less than the reference. This circuit can identify *one* level; to identify 256 levels, the circuit can be iterated as shown in Fig. 3.

In this figure, the simple single-voltage divider is extended to provide 255 reference levels, one for each level

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to be identified in the quantizing process. In addition, the single comparator has been replaced with 255 comparators—again, one comparator for each level to be identified. This rather impressive configuration results in a circuit capable of identifying 256 levels (including zero, which needs no comparator), but one which, unhappily, provides its output on 256 wires (including ground) instead of the eight wires normally found in an 8-bit binary-encoded system.

The 255 wires from the comparator-string behave like a "thermometer," with all wires below a certain level HIGH, and all above that level, LOW. In fact, if 255 light-emitting diodes were tied to these wires, they would indicate the instantaneous peak level of the video by lighting all the diodes from zero up to that level. This type of circuit is currently coming into use as a volume-level indicator in audio work.

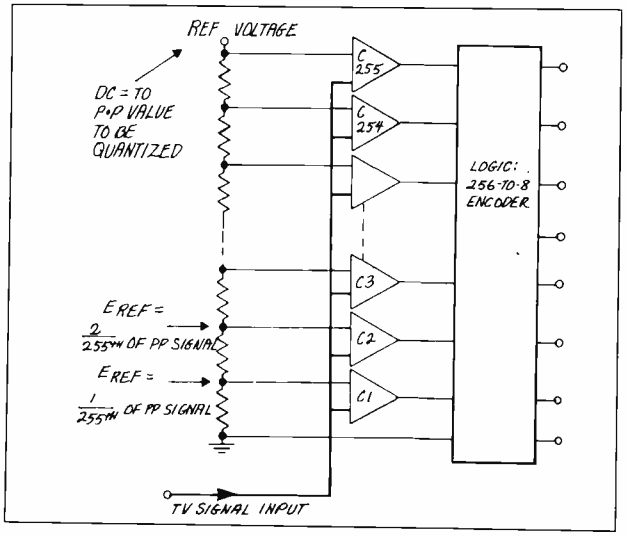

Fig. 4. Comparator feeding encoder to reduce output wires to eight.

However, the 256-wire output is not suitable for use in a digital system, and must be passed through a logic system, as shown in Fig. 4, to transcode the 256 wires to a digitally-acceptable 8-wire format. This logic system, shown here simply as a "black box," is a combination of appropriately-connected AND and OR gates which translate the "thermometer" format to a binary-number format.

This type of A-to-D converter was widely used in the early 1970's because it was reasonable to make such a system operate at the speeds required by digital television. It is, however, a "brute force" approach; the A-to-D converters built with this technique were physically ten times too large to be practical in modern systems, and cost ten times more than the amount the fledgling digital TV industry could reasonably afford. In essence, this was a consequence of the $2^8 = 256$ comparators used to quantize the signal, as well as a result of the extensive decoding circuitry involved.

A more sophisticated approach to A-to-D conversion is shown in Fig. 5. This configuration is, in a way, the opposite of the "brute force" multiple-comparator system of Figs. 3 and 4. There, an 8-bit system required $2^8 - 1 = 255$ comparators; here, in Fig. 5, an 8-bit

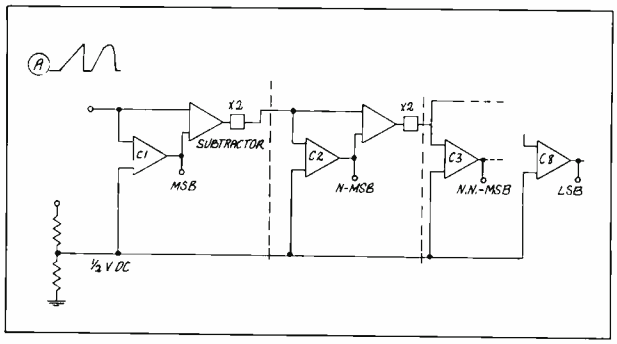

Fig. 5. Sophisticated self-decoding A-to-D converter here is simpler than multiple comparator approach needing only eight comparators.

system requires only 8 comparators. In addition, the system is self-decoding; the comparator outputs are not "thermometers," but are directly the desired binary code.

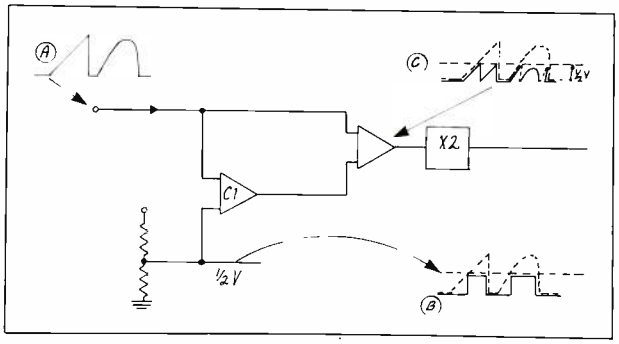

Fig. 6. Waveforms show how multistage comparator works. See text for explanation. Arrangement is called folding A-to-D converter.

To understand the working of this multistage circuit, look at the analysis of a single stage in Fig. 6. One volt of video (waveform A) is applied to one side of the comparator, and a half-volt dc reference is applied to the other side. The comparator output (Waveform B) is HIGH for all video above one-half volt, and LOW for all other video levels. The comparator output is then *subtracted* from the original video, thereby pulling all video *above* a half volt down into the zero-to-half-volt range—effectively collapsing or folding the video into itself. This folded video is only one-half volt high, so a gain of 2 restores it to one-volt amplitude, and it is sent to the next stage, where the above action is repeated. Because of this folding or collapsing action, this type of A-to-D converter is often called a *folding A-to-D converter*.

Since the comparator of the first stage provides a HIGH output when the input video is in the *upper half* of its range, and a LOW for the *lower half* of the range, the comparator output is precisely the signal needed for the

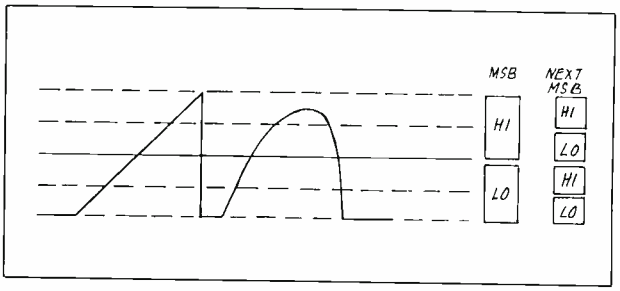

Fig. 7. Illustration showing self-decoding principle. See text for explanation.

most-significant-bit wire from the A-to-D converter. In a like manner, the next stage's Comparator provides HIGHs for the *upper halves* of *each half* of the range—see Fig. 7 for clarification of this statement, which is rather hard to express in prose—and LOWs for the *lower halves* of each half of the range, thereby providing the digital signal needed for the next-most-significant-bit wire of the eight output wires. Similarly, each comparator of each successive stage provides directly the required binary digital signals for the next output wire from the A-to-D; the system is therefore said to be self-decoding.

The folding A-to-D converter looks very attractive at first inspection, since it appears to provide all the performance of the larger, multiple-comparator systems at far less cost. However, any attempt to reduce it to physical circuitry reveals several hard-to-overcome traps. First, the two signals feeding each subtractor must be delay-matched with very precise, stable delay lines, or the accuracy of the A-to-D will suffer. For similar reasons, the subtractor must be a very-wide-band device—usually in the 100-to-200 Mhz region, for best results—and the gain of 2 following the subtractor must be *precisely* a gain of 2, with accuracy and temperature stability better than ±0.1%, for an 8-bit system. These accuracy and stability requirements must be held on every critical element in every stage of the system. For these reasons, the 8-bit folding converter is hard to realize in hardware.

An approach frequently taken in modern A-to-D converters for television is represented by Fig. 8, which is a compromise midway between the hard-to-afford multiple-comparator A-to-D and the hard-to-build folding A-to-D. It uses the best elements of each, and provides the best features of each, while avoiding the majority of the difficulties peculiar to the two extreme systems.

In this compromise system, the input signal is fed first to a *four-bit* A-to-D converter of the multiple-comparator type. Since this is only a low-resolution, four-bit converter, only $2^4 - 1 = 15$ comparators are required. The four output wires from the logic section of this 15-comparator A-to-D bear the four *more-significant-bits* of the desired digital signal. These four wires are not only fed to the box's output terminals, but also are connected (internally) to a *D-to-A converter*, (which we shall discuss in detail below). This converter changes the four digital bits back to analog video, but the result is a *low-resolution* video, in the sense of *brightness* resolution. For example, a one-volt ramp input to the video-in terminal results in a one-volt 16-step staircase at the D-to-A output, because of the limited brightness resolution of the four-bit system.

This 16-step video is subtracted from the original video, (appropriately delayed), and the subtractor's output is the error between the input ramp and the low-resolution video. This error signal, being only one-sixteenth volt in amplitude, is given a precise gain of sixteen and fed to *another* four-bit (15-comparator) A-to-D converter. The four wires from this A-to-D bear the four *less* significant bits of the desired digital output.

Since these last four fine-resolution bits were obtained by converting a small subsidiary voltage range of the signal, this type of converter is often called a sub-ranging converter. It provides a full 8-bit output using 30 comparators instead of 255, and needs only one precise delay and one precise (x16) amplifier.

You may observe that the hard-to-build folding converter of Fig. 5 is a special case of the subranging converter in which each stage provides only one bit, instead of the four bits per stage in the example of Fig. 8. For

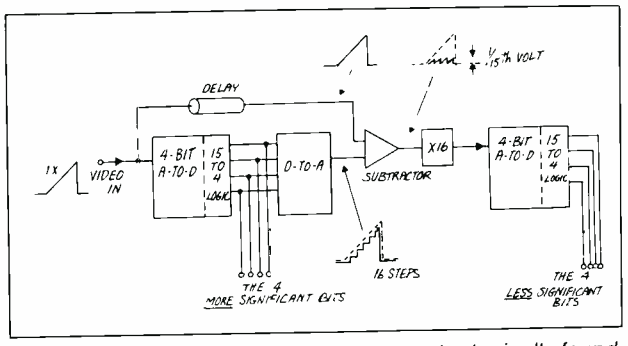

Fig. 8. Practical four-bits per stage converter typically found in equipment today.

that matter, the Fig. 8 converter also "folds" the video, so, in the final analysis, the *subranging* and *folding* terms are actually interchangeable.

Other converters

Of the other methods of A-to-D conversion, at least two more deserve space in even a compact introductory article. The first of these is the *counting-type A-to-D*, shown in Fig. 9.

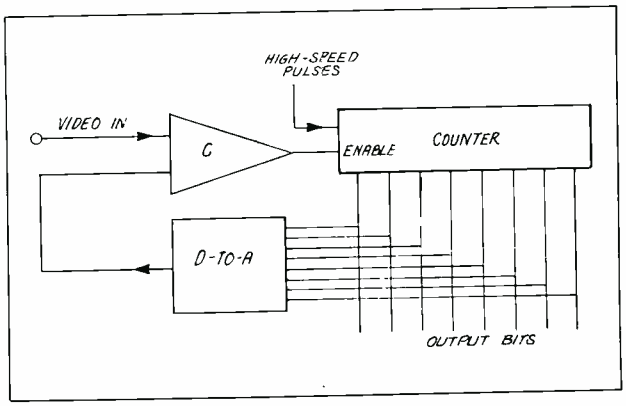

Fig. 9. Counting type A-to-D converter.

Here, an 8-bit digital counter (which can count from zero to 255) is fed from a source of high-speed pulses. Its eight flip-flops, each of which drives one of the eight output wires, will successively generate each possible number (0 to 255) as they count the input pulses. A D-to-A converter looks at these numbers as they go by, and, finding one that corresponds to the input video, turns off the counter, causing that number to be held for the moment on the eight output lines.

The difficulty with this converter at the present state of the art is that an extremely high-speed counter is required. At 14.3 MHz sampling rate, only 70 ns is available to determine the correct value and place it on the output lines. If you wish to hold the output for only 30 ns, then the number must be determined in 40 ns. Since, in the worst (peak white) case, 255 pulses would be counted before the counter would be stopped, the time allowable for each pulse is 1/255th of 40 ns, or 156 picoseconds. This corresponds to a counter frequency of 6.4 GHz! For this reason, counting A-to-D's are present-

ly restricted to very-low-rate, non-video signals.

A distantly-related scheme which is sometimes used for video conversion if the *successive-approximation* converter, or S.A. converter. This is shown in Fig. 10. Here, eight flip-flops, NOT connected as a counter, are successively turned on—experimentally, as it were—and the result is sampled for correctness by the D-to-A converter and video comparator. The most-significant-bit is turned on first, by means of a pulse delivered through switch S_1. If the resultant video from the D-to-A is

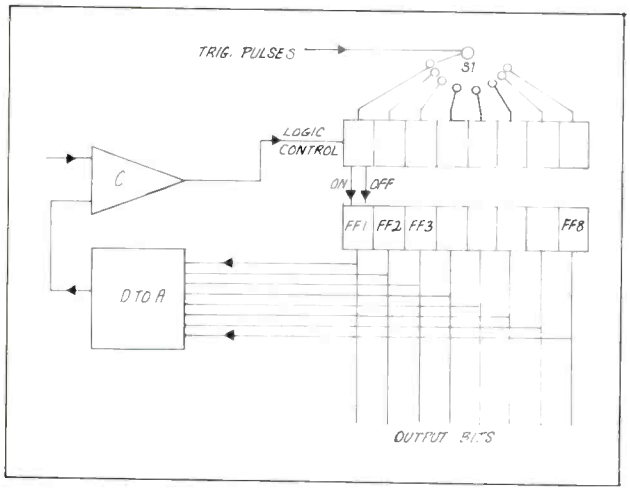

Fig. 10. Successive-approximation A-to-D converter.

greater than the input video, then a second pulse through S_1 turns OFF flip-flop FF_1. If the resultant video is *less* than the input video, then the second pulse is suppressed, and FF_1 remains ON, sending out a HIGH for the MSB. In either event, S_1 moves on to FF_2, which, pulsed ON, provides the next-most-significant-bit. Again, the greater-than/less-than assessment is made, and FF_2 is either left ON or turned OFF. All eight bits are tried this way, and at the conclusion of the eight trials, the resulting pattern of HIGHs and LOWs on the eight output lines is the binary number corresponding to the video at that instant.

This system also requires a very high pulse rate, though not as high as the system described just before. It requires only 16 pulses (ON and OFF) per 70 ns cycle, which, for a 30 ns hold time and 40 ns approximation time, works out to a pulse rate corresponding to about 400 MHz. Though this is fast, it is still feasible at the present state of the art, particularly if all dimensions are kept very small.

Quantizing noise

The quantizing action of any A-to-D converter makes it inherently incapable of transmitting the input signal unharmed, since its output is limited to the allowable values of the quantizing process. However, the damage done to the signal can be forecast exactly, and therefore amounts to a precise imprecision.

In Fig. 11, we show the original signal as a ramp, and the quantized version of that signal as a series of stairsteps of amplitude V_Q. The error can therefore be

continued on page 62

1972 First Standalone TBC—Delta 328

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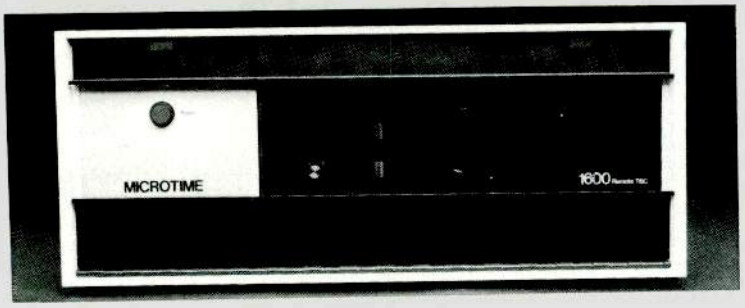

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seen to take the form of a triangular wave of peak-to-peak value V_Q. This error can be thought of as a noise signal; if a triangular wave of this form were deliberately added to the ramp of the original signal, the result would be a stairstep signal identical to that obtained by quantizing.

If we consider the triangular error as noise, we can determine the peak-to-peak-signal-to-RMS-noise ratio of the overall system. If the error signal were a sine wave, its RMS value would be the familiar $V_Q/2\sqrt{2}$. For the triangular wave, the RMS value is $V_Q/2\sqrt{3}$, which is also $V_Q/\sqrt{12}$. The signal-to-RMS-noise ratio is therefore

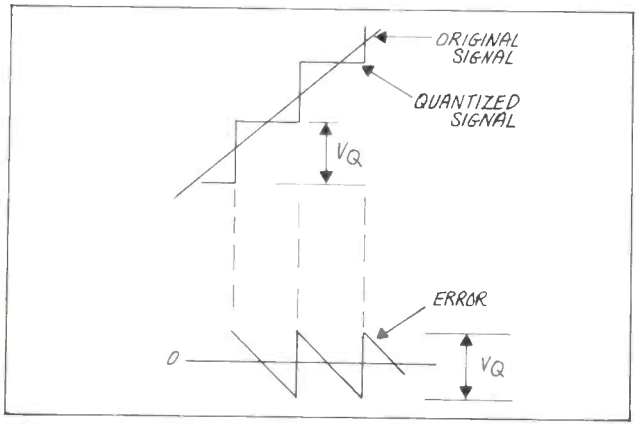


Fig. 11. Error signal generated by quantitizing.

$$S/N_{RMS} = \frac{E_{VIDEO}}{V_Q/\sqrt{12}} = \frac{E_{VIDEO}\sqrt{12}}{V_Q}$$

Expressed in dB, this becomes

$$(S/N_{RMS})_{db} = 20 \log \frac{E_{VIDEO}}{V_Q} + 20 \log\sqrt{12}$$

For an n-bit system, the video signal is $2^n V_Q$; that is, for an 8-bit system, the video is 256 times the quantizing step:

$$(S/N_{RMS})_{db} = 20 \log \frac{2^n V_Q}{V_Q} + 20 \log\sqrt{12}$$

$$= (6.02n + 10.79)\ db$$

which is often approximated as

$$(S/N_{RMS})_{db} = 6n + 11\ db$$

As you might expect, this equation tells us that every time another bit is added, the signal-to-noise ratio improves 6 dB.

D-To-A conversion

The most direct method for carrying out the complementary function of converting digits back to analog video is shown in Fig. 12. The eight wires bearing the binary digital code deliver their HIGHs and LOWs to eight resistors whose far ends are tied together and also connected to a low-impedance sink, such as the emitter of a transistor. Since each resistor is twice as large as the one immediately above it, each resistor will deliver only the half as much current to the sink (for a HIGH at its near end) as will the resistor immediately above it. The

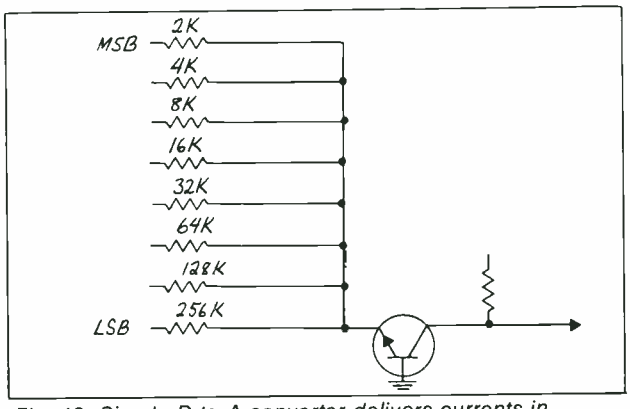


Fig. 12. Simple D-to-A converter delivers currents in proportion to their significance.

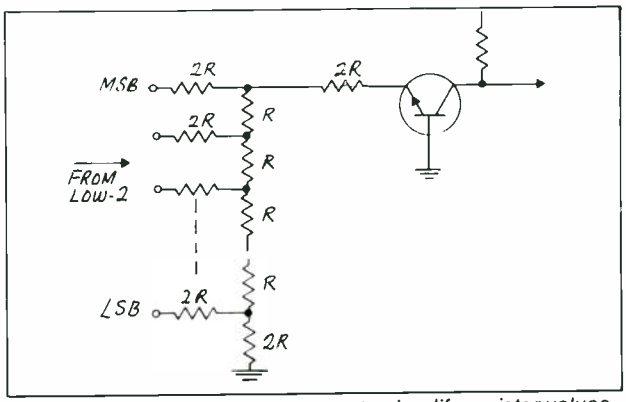


Fig. 13. Practical D-to-A converter to simplify resistor values.

eight lines will therefore delivery currents to the sink in direct proportion to their relative significance, with the most significant bit, connected to the 2K resistor, delivering twice the current as the next-most-significant-bit can push through its 4K resistor, and 128 times as much current as the LSB can pump through its 256K resistor.

Although this simple arrangement will decode the binary signal, it suffers from the fact that the resistor values increase geometrically, so that even if the MSB resistor is chosen to be uncomfortably small, the LSB resistor turns out to be a value which is troublesomely high for handling the 14.3-MHz pulses which will occur on this and all bit lines.

To circumvent this difficulty, a D-to-A converter form known as the R-2R arrangement is often used. This arrangement, which is sketched in Fig. 13 uses only two values of resistors, and these are always in a two-to-one ratio, regardless of the number of bits involved.

Next . . .

In this and the preceding two articles, we have outlined the components of a digital television system, discussed the sampling process and its spectra in detail, and shown how the A-to-D converter produces the digitally-encoded signal which gains us access to the LSI digital memories, whose availability prompted all the digital TV interest in the first place. In the next article in this series, we shall explain how memories are organized and how they are used in present-day digital television equipments. **BM/E**

Mobile Broadcast Operations Have To Be Different

With the number of mobile video vans increasing, a good deal can be learned from ABC vans now being built.

WITH THE INCREASING EMPHASIS on Electronic Field Production (EFP), broadcasters are putting more of their operations on wheels. The broadcasting motor pool consists of almost every manner of vehicle from simple sedans or station wagons, sufficient for getting a two-man ENG crew on the scene, to giant trailers equipped to conduct the full production of a major sporting event. Improved production equipment, smaller payloads, improved studio transmission links and greater audience interest in "live" or on-the-scene programs have helped the broadcasters get out of the studio and on the road.

Mobile operations, however, are not as simple as one might think at first glance. True, the equipment is smaller. True, the equipment is more suitable to field operations than ever before. But, a couple of technologies lag far behind: vehicle construction and air conditioning.

ABC Network is now in its seventh generation of mobile broadcast vans and, as would be expected, they have learned a great deal about what actually ought to go into the creation of a mobile production unit. Frank Haney is currently project director at A.F. Associates where these seventh generation remote production van units are being outfitted. Haney has been involved in the design and construction of most of ABC's earlier vans and possesses a vast storehouse of knowledge on the theory and practice of remote broadcast operations. Haney points out that a viable mobile broadcast facility grows out of a complex formula of trade-offs.

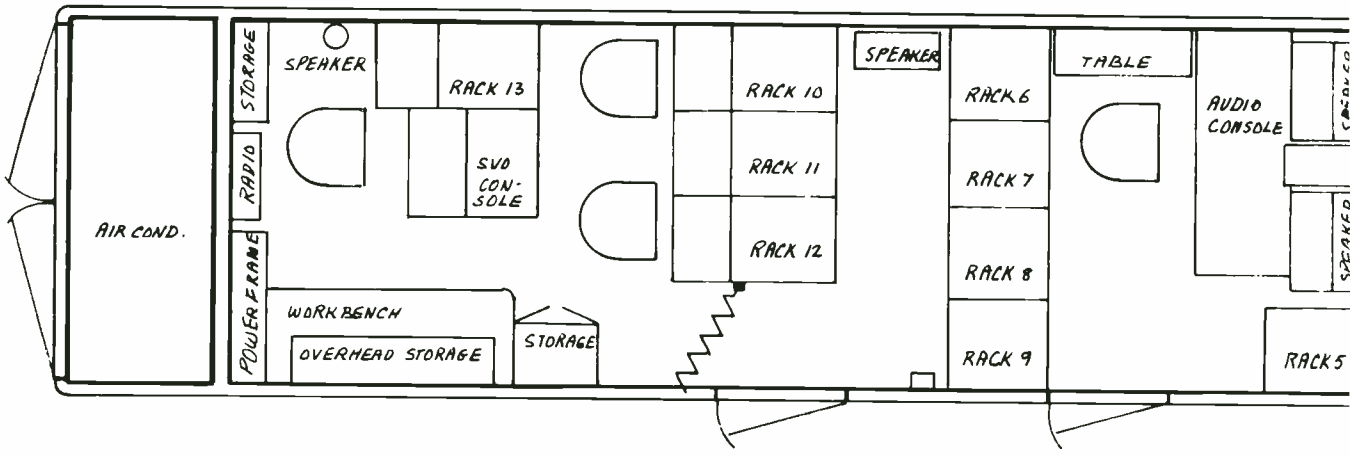
Choosing a van

Obviously, the choice of a van will be greatly influenced by the production capabilities the broadcaster wants. If all that is required is space to carry equipment for an ENG or EFP crew, most of the available light duty vans will be adequate. If, however, the object is to have a fairly full production capability such as multiple cameras and switching facilities along with some audio capability, one is now into a category of vehicle that will have to meet some fairly stringent requirements.

Weight distribution can be the most critical element in choosing a van both because of actual physical stress that an uneven load can cause to the body of the van and for reasons of road handling and legal restrictions. The sleek RVs (Recreational Vehicles) that are often seen have a number of drawbacks as proper remote broadcast vans. First, they may require significant reinforcement to make them structurally sound. The load of several VTRs, several cameras, audio consoles, etc., is probably more than most stock RVs were designed to handle. Hydraulic systems for leveling the loads can be of some help but probably not enough.

Another problem with the RV is that if there is engine trouble, your entire production unit is stranded on the roadside. Moreover, mistuned engines can cause some hassles and introduce unwanted noise to the system if the user tries to have the motor do double duty to provide some electrical energy or enable use of the RV's air conditioning system.

ABC has elected to use the trailer approach in six of the seven generations of mobile vans it has built. For one thing, trailers provide a maximum amount of space for use by the broadcast operation since little or no space is devoted to anything other than the function of carrying cargo. Also, engine trouble is eliminated. If your own



tractor fails, hiring another tractor to do the pulling is not that difficult. But, even trailers have their drawbacks. A number of the earlier ABC vans were either stock or normal "box" construction designs common to over-the-road haulers. This construction is fine for carrying a load of cabbages which are probably evenly distributed over the trailer's frame but in broadcast, the load distribution is determined more by other considerations than by the need for even weight distribution. As a result, some of the earlier ABC vans are suffering structural fatigue and in the current $2.5 million project, ABC has elected to go with custom built trailers using "I" beam construction.

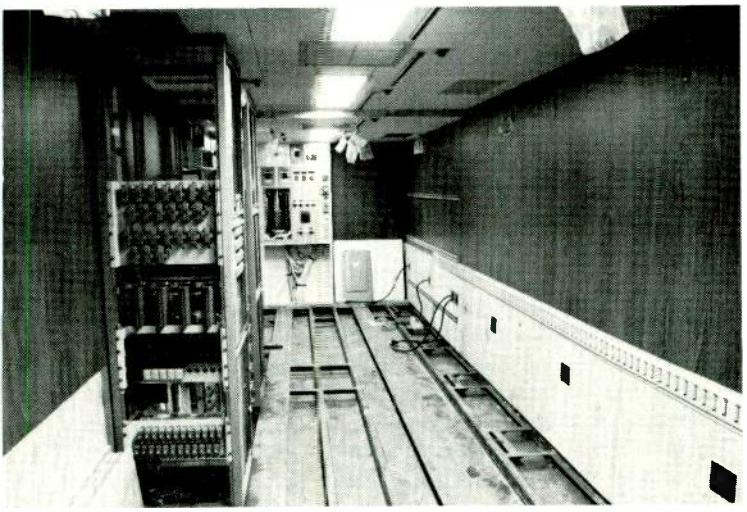
The trailers used in this project are 40 footers built by the prestigious firm of Gerstenslager in Wooster, Ohio. This firm has been in existence since about 1860 when it built custom carriages and has persisted in the custom building field ever since. The use of "I" beams rather than regular box construction is not to be taken lightly. In fact, that's just the point. This is one of the first trade-offs. The "I" beam construction will add hundreds of pounds to your axel weight before you even begin to install equipment.

The issue of axel weight is more than a technicality. The Interstate Commerce Commission (ICC), as well as the many states and localities you may pass through, will have different regulations governing permissible weight. Of course, if you are anticipating only local hauls, only your local requirements will affect you.

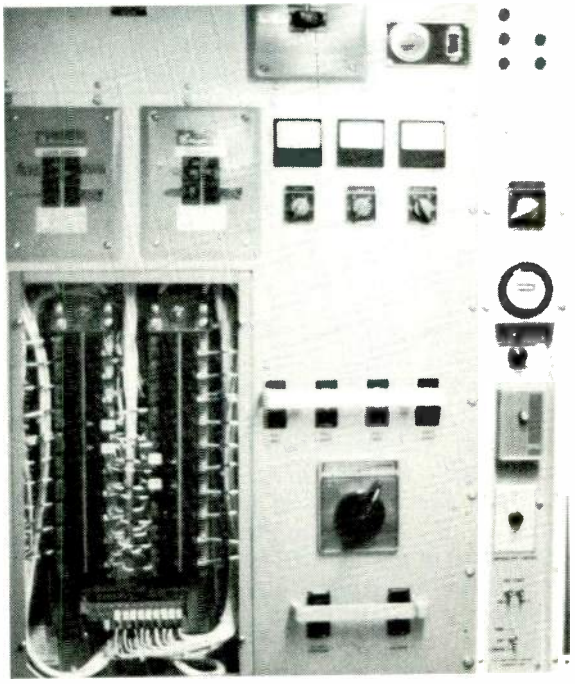
Production and post production goals

ABC's goal, however, in this series of vans, was to have a production van and a tape van with post production capabilities. The production van is equipped to carry 8 LDK-5 cameras (stored in roll-out bins on the under side of the trailer) with the attendent CCUs grouped by function on consoles inside the van. All cameras are equipped with Triax cable to maximize the distance they can be set up from the van. All CCUs, necessary monitoring equipment and test equipment for video and audio, are mounted in custom built racks. In addition, there is a 24-input Ward-Beck audio console, a GVG-1600 production switcher and 26 picture monitors. In addition to the video and audio equipment, considerable space is allocated to the air conditioning system, intercommunications, and AC power.

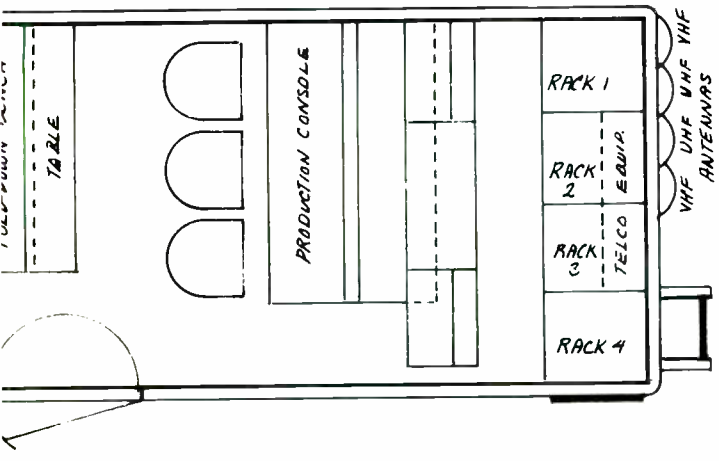
In the tape van, there will be 4 or 5 Ampex AVR-2s, (the fifth VTR may, at times, be replaced with a slo-mo), 2 or 3 HS-1000C slo-mo recorders, 2 Chyron graphics systems and an Arvin/Echo EFS-1 frame store. There will be three consoles in the tape van, 1 for the Chyron operators, 1 for the slo-mo operators and a post produc-



Two "I" beams from the major structural supports. All equipment will rest on either the "I" beams or other members.

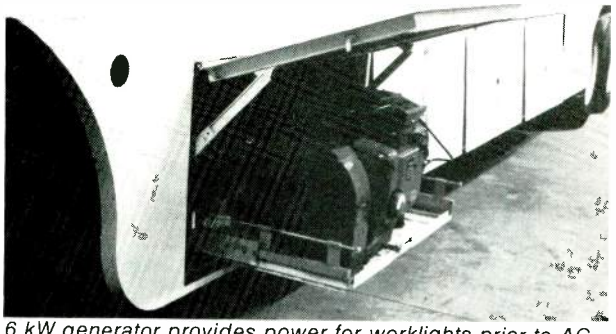


One of the main AC panels. All AC cable is of the standard aviation type.



Basic floor plan for layout of the production van. AC power and air conditioning are at rear (extreme left), then operating engineer's consoles, CCUs, video and audio DAs, audio room and console, announce booth, VIP room, switcher and monitor bank.

24 input Ward-Beck Systems audio console was installed during the basic construction of the trailer itself since it was too large for later installation.



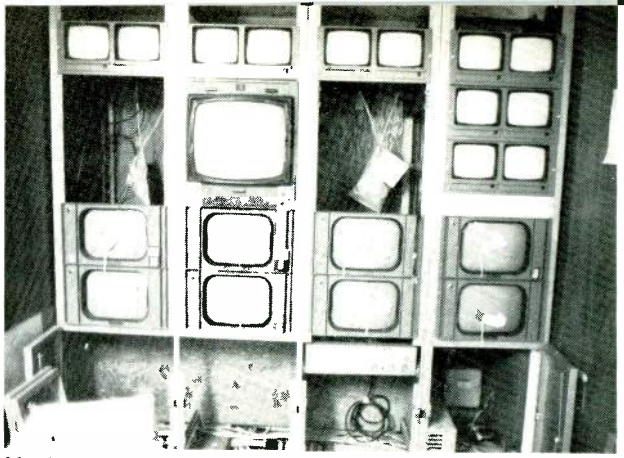
6 kW generator provides power for worklights prior to AC hookup.

tion console.

The addition of post production capabilities is a new extension of ABC's mobile production expectations. Haney, who has witnessed and/or participated in each new generation of ABC vans, feels that this is still experimental. The idea is that some post production tasks can best be completed in the field while the personnel still have everything fresh in their minds and all the necessary elements are in place. Right now the facility will consist of a small CDL post production switcher, a Shure mixer and required monitors. Because the van is equipped with full blown video and audio routing switchers, it will be possible to delegate some of the VTRs to post production even while a production is in progress. The routing switchers are a GVG 1400 and a Ward-Beck audio routing switcher.

Utilizing space and trade-offs

Haney explains that as the size of the van decreases, every cubic inch of space increases in value. This is one of the factors that makes the broadcaster deal with difficult trade-offs. Some factors are just not easily reduced in size. Air conditioning and its attendant ducts tend to exhaust a certain portion of the available space. First, operating temperature for the equipment has to be considered. In this particular construction, it was determined that separate air conditioning systems would be provided for equipment and personnel. Not much space can be saved by using smaller duct work since a relationship exists between the volume of air carried through the



Monitor bank still under construction, will eventually have 24 monitors.

ducts and the velocity at which it is carried. To take advantage of a low velocity air stream that will be less noisy and more comfortable, the size of the ducts has to be kept relatively large. Though it is tempting to some designers to use the air conditioning ducts as cable ways, this must be kept to a minimum since the cable will cut down on the volume of air that can pass.

Another temptation is to dump the cold air (50 deg.) at the bottom of the machines. This approach was used in the sixth generation vans but proved too disturbing to personnel. Now the air is dumped at the top and forced down. Still, 50 degree air is a bit cool for the personnel, so a number of steps have been taken to ease their plight. First, the personnel air conditioning system is broken into as many zones as possible to allow the personnel at each location some control over the temperature. Reheaters are also provided in each zone to permit the use of heat generated by the condenser of the air conditioner.

The decision to use the heat generated by the condenser was, of course, a power conservation move. In mobile operations, power consumption is a constant concern. Air conditioning is a large power consumer and it is very hard to reduce it. A "rule of thumb" that Haney suggests can be used, is that for every unit of energy used to operate equipment that produces a unit of heat, two units of energy are needed to remove that heat. Therefore the use of more energy efficient equipment will help reduce the size and power of the air conditioning system required.

Electrical system considerations

The two vans each have a 6 kW generator for auxilliary power. The main AC power is supplied by tapping into AC at the location. The generators supply power for work lights that are both inside and outside the van to help illuminate the work areas until power can be attached. Isolation transformers are used to protect the overall system and separate the AC needed for technical operations from the AC needed for utilities.

Most of the internal cable is of a stranded aircraft type since regular cable would be more vulnerable to vibration and fatigue. The majority of the cable is run under the floor in the space between the structural members upon which the floor rests.

The transformers, which in previous editions of these vans, were located in bays at the rear, have now been moved forward to ease rear axel weight. Each van is electrically separate and each can operate independently though they are designed to operate as a pair under

continued on page 68

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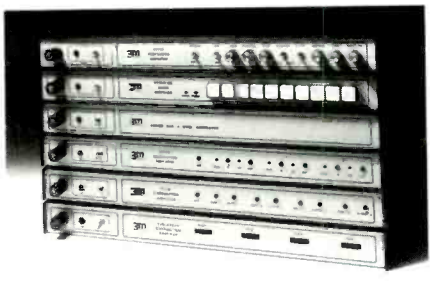

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normal conditions. For technical operations, two transformers are used so that in the case of failure, only about half of the tech operation would go down.

Exploring internal space

Space is, of course, at a premium. Nearly every cubic inch that is not allocated to housing some piece of equipment automatically becomes "storage space." These vans have been extremely well thought out. Bays on the underside of the trailer are utilized for carrying cameras, housing transformers, generators, electrical connections, systems connectors, and telephone connections. The equipment, which must be removable, sits on heavy duty cast aluminum slides and rollers so that it can be rolled out easily for more convenient access. The lift-up doors that cover the bays are equipped with specially designed rubber gutters so that in foul weather when the technicians are working at the bays, rain water cannot collect and drip onto the workers.

The LDK-5 cameras are mounted on specially designed hand trucks that snap into the bays without disassembly. In the tape van which is particularly crowded, a "doggie door" provides access between the forward compartment and engineering area. The doggie door is used rather than a walkway for two reasons. The first reason is, of course, space. The doggie door takes up less room than would a full doorway. The other reason is that the Chyron and still store operators ought to be isolated from the tape machine room noise as they tend to make a great deal of noise that is annoying to the other technicians in the engineering section.

Noise is one of the major factors that has determined the layout of equipment. In the production van, the air conditioning unit is confined to the extreme rear end of the trailer while the audio booth and production switcher is isolated by sound proofed walls at the front end of the van. Also in the switcher area is a VIP room that is probably less spacious than most VIPs are ready for. Another move that will probably be made to reduce noise will be the installation of carpeting, wall-to-wall and floor-to-ceiling.

Considering what Haney and his engineering manager, Harry (Bud) Pearson, have accomplished in the way of design, the judicious use of space and creative carpentry, the ABC vans being built at A.F. Associates have overcome many of the limitations inherent in mobile van construction. Both Haney and Pearson admit, however, that there is one limitation that they can't do very much about. Everything must be done in the design of mobile video units to accommodate the needs and comfort of the people who must staff these units. Access to equipment for maintainance must be considered but not above the need for normal working space for the creative personnel. Amenities must be provided in a pleasant environment to help reduce fatigue. The amount of space required for human beings is enormous and must have priority over certain other aspects. When asked if there was a single "technological breakthrough" that would make mobile operations simpler, Haney responded, "yes, smaller people." **BM/E**

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Three kinds of camera freedom, each in NTSC, PAL or SECAM.

The brand-new *TK-760* is an example of RCA advanced technology. It has created a studio camera with the ruggedness, stability and light weight that makes it a natural for field production, too.

A light camera body, a very compact CCU and a single camera cable give the TK-760 the flexibility you need for virtually any camera assignment.

Other advantages: a warm-up time of 5 to 7 seconds, automatic cable equalization and automatic timing, "firsts" for a camera in the TK-760 price range; and more automatic adjustments so that less experienced operators can obtain excellent pictures.

Another perfect example is the *TK-76* portable camera. It uses no backpack of CCU, and gives you all the freedom of a 16-mm film camera.

But the TK-76 can do a few things film can never do, like providing live or taped coverage without the time delay of film processing.

The *TKP-45* is freedom in a portable production camera with almost limitless applications, inside and out. An array of accessories from a truly portable Minipack CCU to a Minimax full-size lens adapter builds a versatile system all your own.

Quality TKP-45 features include 25 mm tubes, shock-mounted optics, Scene Contrast Compression, and a full complement of automatic operating features.

Video freedom in a VTR: TR-600A.

Here's exceptional integrated circuit design that lets you enhance

ology from RCA video freedom.

the considerable basic capabilities of the *TR-600A* with the simple addition of plug-in modules.

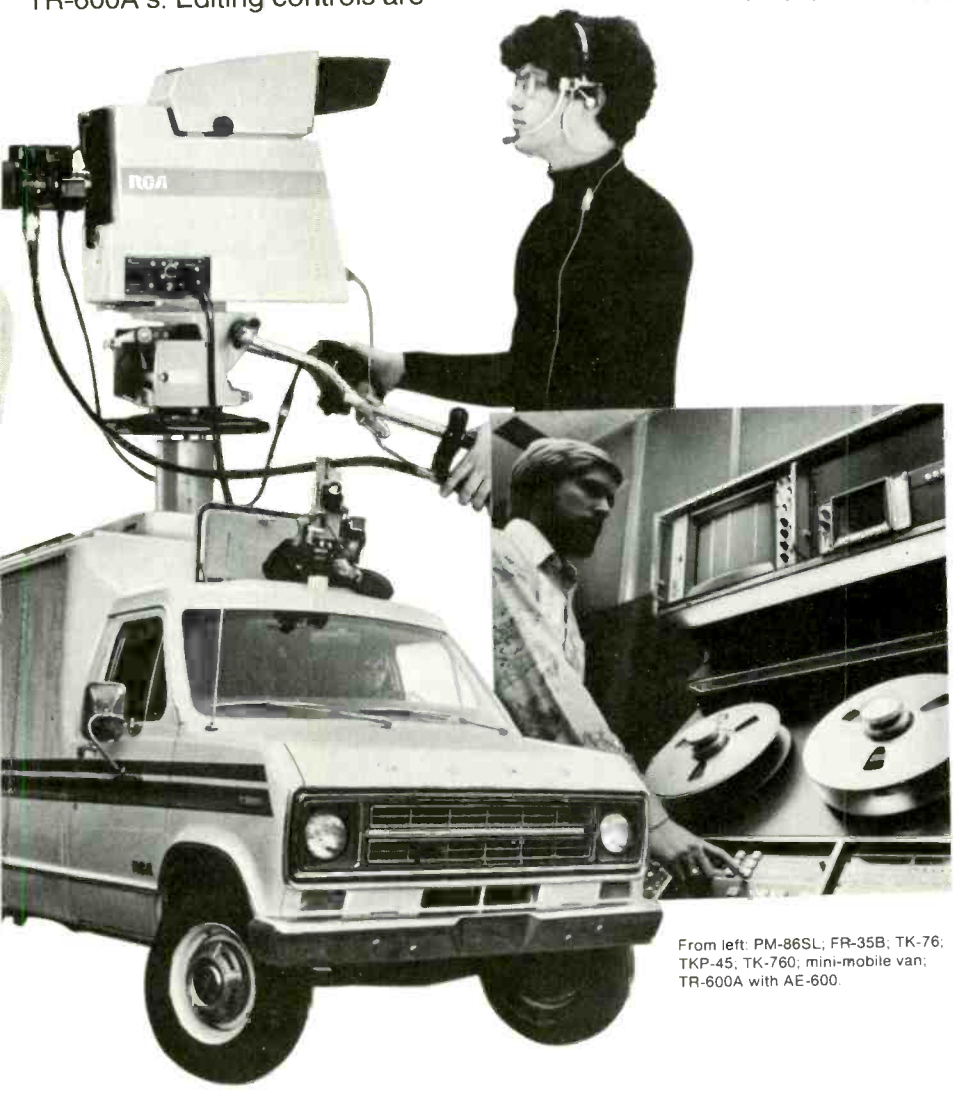
There's a choice of two microprocessor-controlled editing systems. SE-1 is a low-cost, previewable basic editor which allows editing to single-frame accuracy. AE-600 is a complete electronic Time Code Editing system that brings sophisticated, versatile automation to editing at half the price of previous equipment with comparable capability.

It can control one record TR-600A, and up to eight playback TR-600A's. Editing controls are mounted on the recorder's main control panel, or in a remote console.

A third option is Super High-band/Pilot for NTSC and PAL models. Such operation results in improved moiré and reduced banding—at 7½ ips or 15 ips.

And for true quad performance, the TR-600A includes a long list of automatic subsystems, many of which would be costly options on competitive recorders.

The TR-600A is designed to meet the different needs of almost any user, and is available in NTSC, PAL or SECAM.



From left: PM-86SL; FR-35B; TK-76; TKP-45; TK-760; mini-mobile van; TR-600A with AE-600.

New video freedom in film-to-tape conversion.

A key element is the *TK-28* camera. Circuitry corrects errors in color balance, color levels and mid-gray gamma. It operates automatically, or manually to give the results you want.

As the TK-28 applies color corrections scene by scene, the *FR-35B* projector lets you handle 35 mm film with unprecedented ease, thanks to a solid-state logic servo-control, cine or 6x cine speeds, fast shuttle, variable speed (0 to 48 fps), cueing on frame (24/25 fps), freeze frame and instant start and stop.

Companion to FR-35B is the *PM-86SL* magnetic sound recorder which features an electric interlock for precise synchronization.

Both operate on worldwide standards with no conversion necessary.

Mini-mobile van: video freedom on the go.

This RCA mini-mobile unit is designed for interchangeable use in ENG, sports pickup and on-site shooting of commercials and documentaries.

The standard complement of major equipment includes a TR-600A or HR-400 helical-scan VTR, plus a pair of TKP-45 cameras for shooting through a cab hatch, from the roof or rear platform, or as far afield as a mile with a Triax adapter.

With RCA, it's freedom of choice for the new video freedom. And it's yours to try at Montreux.

RCA

Simplifying Carrier Frequency Measurements

By James F. Lawrence, Jr.

(Editor's Note: In the April, 1974 issue, BM/E described the revised FCC rules for monitoring the carrier frequencies of broadcast stations, and pointed out that the rise of the digital counter had made it possible for every station to keep track of its carrier, simply and inexpensively. In this article, Mr. Lawrence updates that story and gives valuable detail on using the NBS time signals, plus a counter, for carrier measurement.)

CARRIER FREQUENCY MEASUREMENTS have been a station routine for as long as most of us can remember. In the past, stations often scheduled frequency measurements at 30 day intervals, but some had them made only when the station monitor indicated an off-frequency condition, or when the station engineer decided that it might be a good idea to see if the monitor was still telling the truth. He would call the local measurement service and schedule a frequency measurement, although he would probably not be too concerned with the results—after all, the transmitter had been more stable than the frequency monitor in the past, so why worry.

This was probably pretty safe reasoning until we became involved with FM and TV frequencies. Many of the FM exciters used automatic frequency control techniques with a much greater chance of out-of-tolerance carrier frequencies. It became more or less standard operating procedure to obtain monthly measurements. Until a few years ago the rules required measurements only as frequently as was necessary to insure that the carrier frequency stayed within the tolerance. The new rules, though, make *monthly* measurements necessary for each carrier, and the accuracy of such measurements is now specified.

The new rules

In 1973 the Federal Communications Commission amended its rules, deleting the requirement for the use of a frequency monitor at radio and television stations. Sections 73.60 and 73.252 of the Rules and Regulations, pertaining to AM and FM stations, now read as follows:

"(A) The carrier frequency of the transmitter shall be measured as often as is necessary to insure that it is maintained within the prescribed tolerance. However, in any event, the measurement shall be made at least once each calendar month with not more than 40 days expiring between successive measurements.

"(B) The primary standard of frequency for radio frequency measurements shall be the national standard of frequency maintained by the National Bureau of Standards, Department of Commerce, Washington, D.C. The operating frequency of all radio stations will be determined by comparison with this standard or with the standard signals of stations WWV, WWVB, WWVH, and WWVL of the National Bureau of Standards."

•For television stations section 73.690 applies. It reads as follows:

"(A) The visual carrier frequency and the difference between the visual carrier frequency and the center frequency of the aural transmitter shall be measured as often as is necessary to insure that they are maintained within the prescribed tolerance. However, in any event, the measurement shall be made at least once each calendar month with not more than 40 days expiring between successive measurements."

Paragraph (B) of this section is identical with paragraph (B) above pertaining to the AM and FM stations.

Therefore, frequency monitors are no longer necessary, but the carrier frequency (not deviation from assigned frequency) must be measured and recorded in the maintenance log at intervals not exceeding 40 days. The measurement can be made by anyone, providing that the measurement standard is the National Bureau of Standards. This last requirement sounds complicated, but it really is not. Everyone has the NBS primary standard frequency available to him free of charge.

Commercial services

The early commercial measuring services generally used the so called interpolation system, which consisted of a complex scheme of markers, spaced 1 or 10 kHz apart, derived from a standard crystal oscillator, usually 1 MHz. The difference between the measured frequency and the nearest marker was determined by the use of an oscilloscope and audio oscillator. This method is rather impractical for measurements in the FM and TV portions of the spectrum. It is difficult to keep track of the interpolation markers and errors are likely to occur. But in spite of these complications it was still quite possible to obtain accuracies of better than one part in 10^6.

However, commercial monitor services now use digital counters, with the time base locked to the Bureau of Standards transmissions from WWV, WWVH, or WWVB. The system used by the author's measurement service is illustrated in Fig. 1. It is common practice to read AM carriers to 0.1 Hz, and FM and TV carriers to 10 Hz. It's possible of course, to read closer, but from a practical standpoint, it isn't necessary.

FM and TV aural carriers will never hold to an exact center frequency because some modulation is always present in the form of hum or other noise. An FM carrier

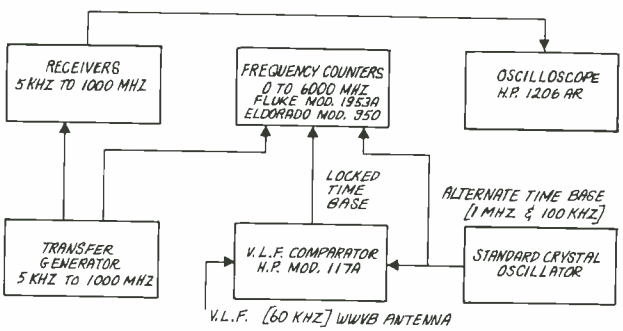
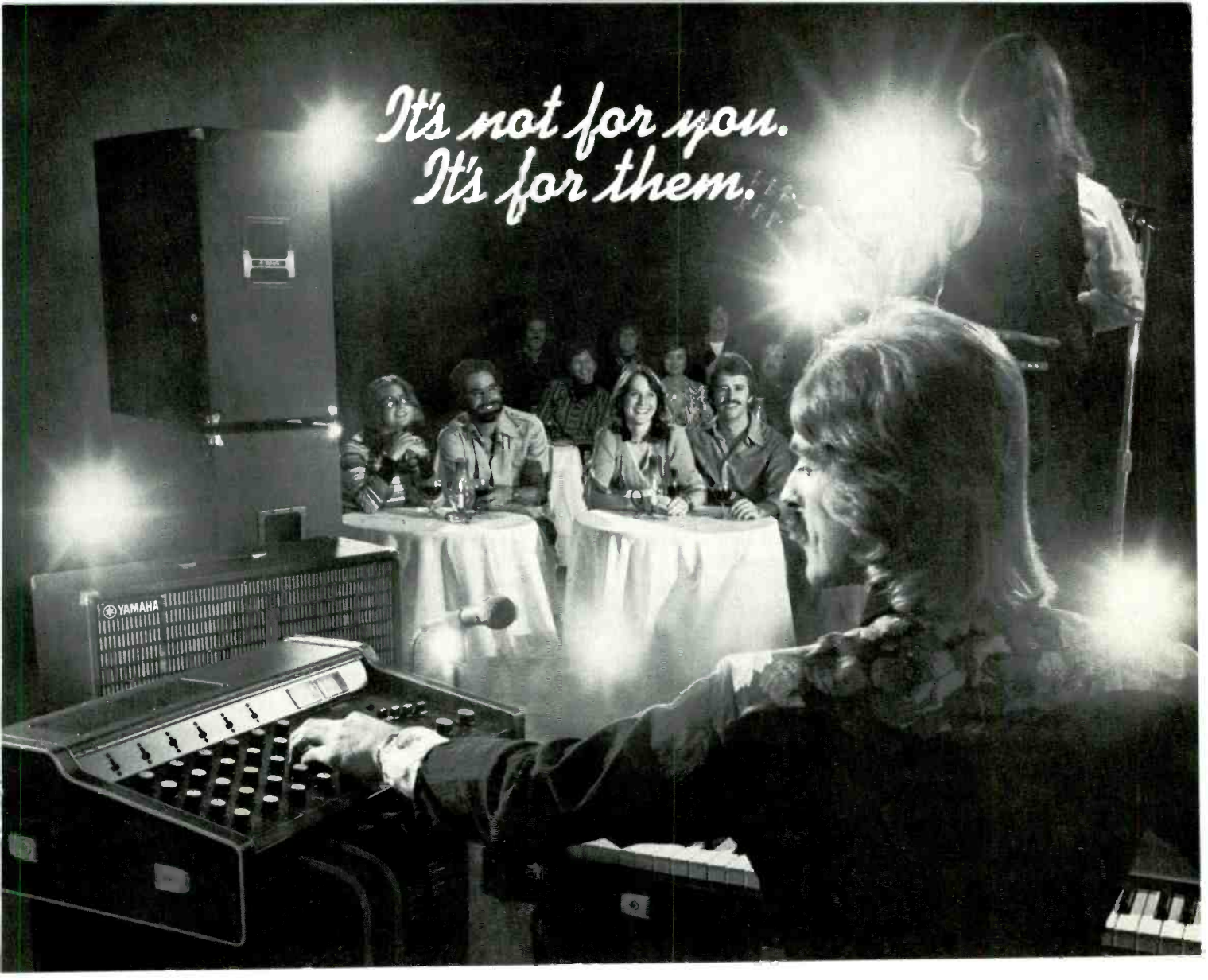


Fig. 1. Elcom Engineering Co. commercial frequency measurement system.

Mr. Lawrence is owner, Elcom Engineering Co., Santa Ana, CA.



Why do you think it's called public address?

The audience is there to have a good time. You're there to work. But, if you're not projecting the sound you've worked so hard to perfect, you just wasted all those long hours in rehearsal.

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The EM-80, 100 and 150 integrated mixer/amplifiers. From four to six input channels, from 60- to 150-watts RMS. Link them together for even greater flexibility. They're reliable and roadable because they're built Yamaha tough.

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For all the facts, send this ad along with four dollars. (Please, certified check or money order only. No cash or personal checks.) We'll rush you an operation manual complete with block diagrams on our EM-Series. Or better yet, see your Yamaha dealer and plug-in to an EM. It may be for your audiences, but their enjoyment is going to pay off for you.

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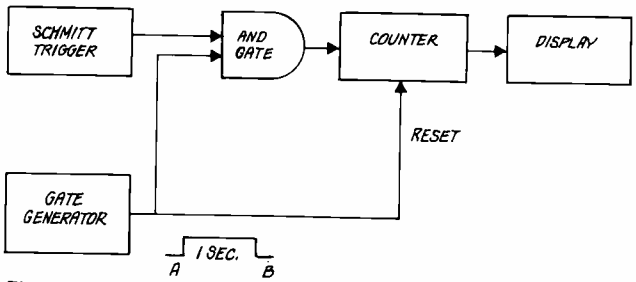


Fig. 2. Basic frequency counter.

with noise 60 dB below 100% modulation will have a 75 Hz deviation due to noise. If we attempt to read to 10 Hz, the best we can do is to try to zero beat with the center of the noise deviation, and hope that the frequency swing is symetrical about the center.

The digital counter

Basic operation of a digital counter is illustrated in Fig. 2. The unknown frequency is converted to a square wave by the Schmitt Trigger, and applied to one input of TNE "AND" gate. The other input to the "AND" gate is an accurate one second gating pulse. During the one second gating time starting at point A, the counter counts the number of cycles that occur. At time B, the "AND" gate is disabled, and the counter stops counting. The number stored in the counter is the number of cycles per second, or the frequency of the unknown signal. Accuracy of the counter is determined mainly by the accuracy of the gating generator, which is usually a crystal controlled oscillator. A typical counter accuracy specification might read, "±(1 count + time base accuracy)." The "±1 count" accuracy limitation refers to the ambiguity of a cycle which can occur at the instants of transition of the gate on and off states in the total number of counts or cycles passed through the gate between the turn-on (point A) and the turn-off (point B). For a one second count period and a 1 MHz input signal the error could be ±1 Hz, or one part in 10^6. If the gate time is extended to 10 seconds the error will be reduced to 0.1 Hz, or one part in 10^7. Typically, time base accuracy for a 10 MHz crystal will range from ±5 or 6 parts in 10^7 to better than ±1 part in 10^7 per month for an oven controlled crystal.

For extremely high precision, beyond that needed for routine carrier frequency measurement, many commercial measuring services use the signals of the National Bureau of Standards station WWVB to produce a time base frequency which is phase locked to a derivative of the WWVB 60 kHz standard frequency carrier. This can be used in place of the crystal frequency in a counter to provide time base accuracy of one part in 10.

Making use of NBS radio for carrier measurement

Several NBS radio stations transmit continuous standard frequency and time information. WWV began broadcasting in 1923, originally from Greenbelt, Maryland, and since 1966 from Fort Collins, Colorado. One or more of the NBS stations can be heard at almost any time and place in the United States. WWV transmits on 2.5, 5, 10, 15, 20, and 25 MHz from Fort Collins. The 5, 10, and 15 MHz transmitters operate at a power of 10 kW, and the others operate at 2.5 kW. The WWVH transmitter in Hawaii operates on all of the above frequencies except 25 MHz. The Hawaiian transmitters produce 5 kW on 2.5 MHz, 2.5 kW on 20 MHz, and 10 kW on the remaining three frequencies.

Another very useful, but probably less familiar service, is that of WWVB referred to above, which transmits on 60 kHz. WWVB is located at the WWV site in Fort Collins. The radiator is a 122 meter top loaded vertical. The radiated power is 13 kW. The carrier frequency is accurate to two parts in 10^{11}. This low-frequency carrier relies entirely on ground wave propagation and is therefore not subject to the slight shifts in received carrier frequency due to Doppler effects found in the high frequencies of WWV and WWVH. The Doppler shift is caused by sky wave reflection from the continuously changing distance to the reflecting ionized layers surrounding the earth. The small frequency shift is of little importance for broadcast frequency measurements, but may be of concern for other more precise measurements.

Another useful service is the time of day transmission. Time is given as coordinated universal time. This is a 0-to-24-hour system, starting with 0000 for midnight at longitude zero. The first two figures announced the hour, and the last two figures give the number of minutes past the hour when the tone returns. Time announcements are given each minute.

Time information is also present in a 100 Hz subcarrier. A binary-coded decimal system is used. This is useful for digital time readout and for time markers on strip recorders, and even synchronization of events thousands of miles apart. Information about major storms in the Atlantic and Pacific areas, propagation forecasts, and geological alerts are also broadcast. Details of the various services are available from the National Bureau of Standards in Boulder, Colorado 80302.

Practical "in-station" measurements

To use one of the NBS transmissions for legal carrier measurements, you need only a sensitive receiver and a frequency counter. In most areas, the transmission on 5 MHz is dominant during the nighttime hours and 10 MHz is best during the daytime. The digital counter must have a time base oscillator that can be adjusted to zero beat with the standard frequency transmission.

An inexpensive monitor system of this type developed recently for the broadcaster is the Elcom Engineering Co. model 300. It consists of a two-channel WWV receiver and a digital counter capable of direct read-out of frequencies up to 300 MHz. The counter time base can be synchronized with the NBS standard frequency transmissions on 5 or 10 MHz. A sample of the transmitter carrier is applied to the counter input and the frequency is displayed, ready to place in the maintenance log.

Having your own in-station system has some additional advantages. The counter is an invaluable piece of test equipment for audio and R.F. measurements. It can accurately measure modulating frequency for FM deviation measurements using the carrier null method to calibrate the modulation monitor; check cue tones for carts and automation; and measure EBS tone frequencies, to name a few things it can do.

The WWV receiver is also a handy piece of equipment. The voice time announcements are always useful. Thanks to digital technology, we now have practical equipment to keep every station on frequency and on time. **BM/E**

HITACHI SK-70

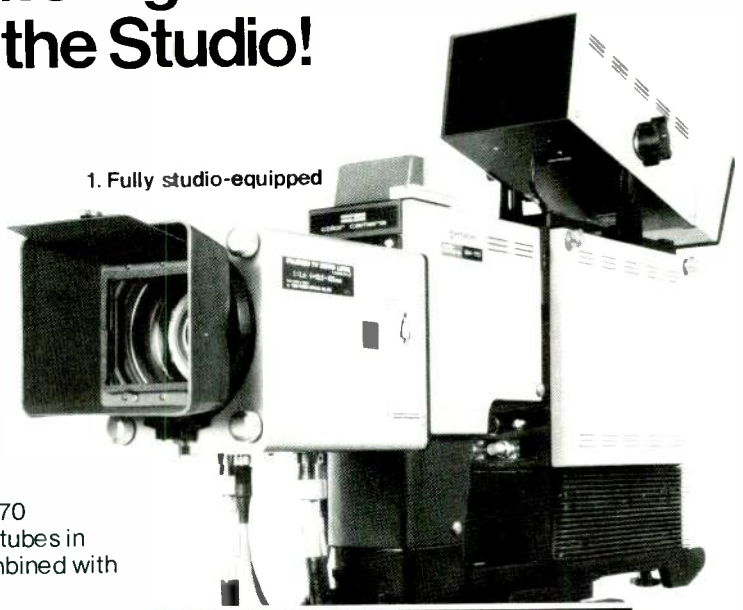
The One Camera That's Right for Both Field Production and the Studio!

The modular SK-70 converts easily from a fully equipped, self-contained color studio camera to a modified studio camera. In the field, the studio version of the SK-70 can be connected directly to a VTR with only a co-axial cable. And for hand-held portability, the camera head features a shoulder mount, an auto-iris portable zoom lens, and a 1.5" viewfinder, along with a DC and process pack. The Digital Command Unit (DCU) with up to 3000 feet of single co-axial cable strongly enhances the capability of the SK-70. Another striking option is a 22:1 zoom lens that can be used for the studio version of the SK-70 in the field.

No matter which configuration you choose from those shown in the photo and three diagrams, the Hitachi SK-70 offers the precision and reliability of three 2/3" Saticon tubes in the camera head to insure excellent picture quality, combined with all the latest advances in broadcast camera technology.

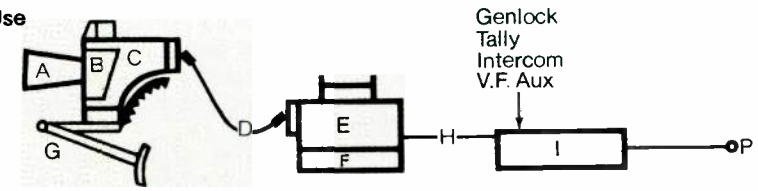
As you can see, our outstanding Hitachi SK-70 is a sound investment for broadcasters, production studios, and universities who need broadcast quality performance in a wide variety of assignments, all for the price of a single camera. We'd be pleased to arrange a demonstration of how the SK-70 can fit the following camera requirements inside or outside your TV studio, and more:

1. Fully studio-equipped

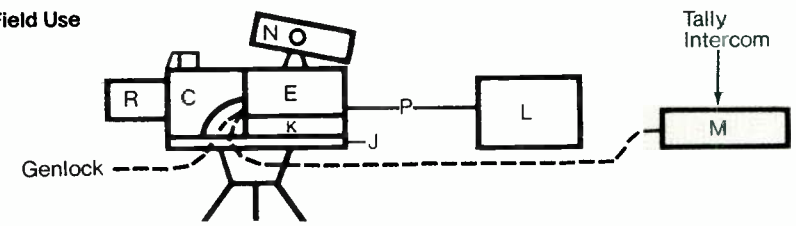


Digital Command Unit (DCU)

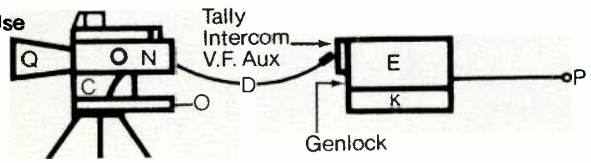
2. Portable Use



3. Field Use



4. Modified Studio Use



A)	Portable lens
B)	1.5" viewfinder
C)	Camera head pack
D)	Camera cable (300 ft.)
E)	Process pack
F)	D.C. pack
G)	Shoulder Mount
H)	Co-axial cable (3000 ft.)
I)	DCU
J)	Mount adapter
K)	A.C. pack
L)	VTR or FPU
M)	Operation panel
N)	5" viewfinder
O)	5" V.F. Mounting Plate
P)	Co-axial cable (video)
Q)	Portable lens w/conversion adapter
R)	Studio lens

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Hans Schmid Says VU Meters Give Confusing Program Level Readings

Hans Schmid, as head of ABC's Engineering Labs, is a measurement expert. He has written a number of technical papers and frequently participates as a panel member at NAB, IEEE and AES meetings. In the March 1977 issue of IEEE Transactions on Broadcasting, *Schmid looks at the accuracies of VU meters and peak program meters in indicating program levels. Because Schmid feels PPMs should replace VU meters, BM/E asked him to speak out on the subject, and indeed he does!*

We want you, our readers, to Speak Out too. If you have a pet peeve about an industry practice you don't like, get it off your chest. If you don't want to sound off yourself but know somebody who might (or should), send his/her name along—we'll invite them to do a guest column. Incidentally, if you support Schmid, tell us so—simply jot a note on the Reader Service Card. If you have a different view, tell us that too. Speak Out—help change something.

THE ELECTRICAL INTENSITY of a program signal as measured with a meter is one thing, the loudness of a program signal as perceived by a listener's ears is another.

Loudness depends on many complicated psycho/physiological factors. These, however, need not concern us here, because clearly the electrical program level is the most outstanding single factor that contributes to loudness. Therefore measurement (or metering) of the electrical intensity of program levels must be accurate and meaningful.

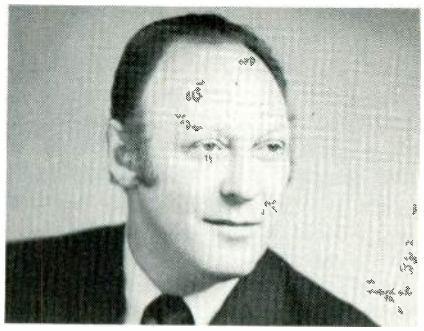
I have been invited by the editors of *BM/E* to speak out ("and be as blunt as I can") on the idea that the Peak Program (PPG) meter should replace the VU meter for metering program levels.

So let me be blunt and say at the outset that in my opinion the VU meter is the sole reason for the confusion regarding appropriate program levels in audio broadcasting and recording. Or, equally blunt, if audio engineers had had the use of PPG meters from the beginning there would never have been the confusion and the terms that plague us today, such as, program peaks, VU peaks, headroom, OVU equals +8, 0 at 8dB, zero level, etc. would not exist. Nor would there be any questions regarding S/N ratios or at what level to measure harmonic distortion.

The VU meter was introduced to the industry some 40 years ago, by the combined efforts of Broadcast and Telco Engineers. At that time the VU meter was a much needed and well intended standard to overcome the difficulties (if not chaos) created by a multitude of differing meters and methods for measuring the electrical intensity of audio program levels.

To this day, the VU meter still performs well when properly used as intended, namely to measure and compare the electrical intensity or level of a given program at two or more separate locations (such as New York and Chicago or broadcast studio and Telco plant).

But what if several program sections (e.g. music and speech or differing types of music and/or speech) have to



be assembled into a single program?

In this situation the VU meter is inadequate because it is tone-duration dependent, that is, it gives high indications of electrical intensity for long tones and low indications for short tones. Let me be more precise. Over the range of musical tempi, from largo (very slow) to moderato to presto (very fast), the VU meter registers ¼, ½, whole and sustained notes at a constant scale deflection (let's say OdB) while, for instance, a 1/64 note (the shortest playable) registers −7dB at largo, −13dB at moderato and −20dB at presto. Needless to say, such a tone duration dependency does not exist with a PPG meter. Its 10ms integration time assures that even a 1/64 note at allegro tempo (μ23ms) registers at the same scale deflection as a sustained tone.

The significance of the above becomes clear when we study Fig. 1, which shows a simultaneous dual strip chart recording of VU meter and PPG meter deflections of two different pro-

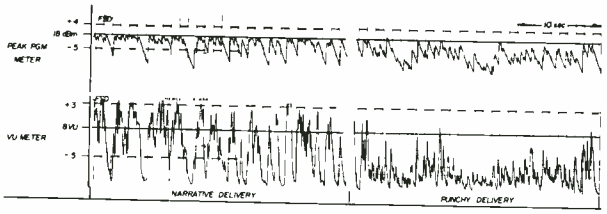
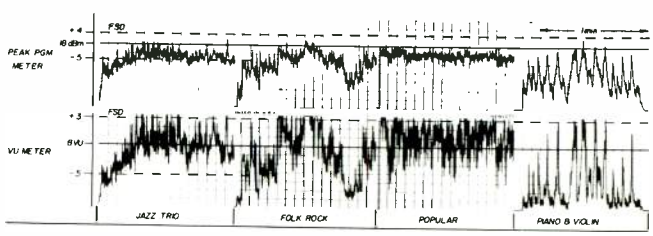


Fig. 1, above, shows VU meter and peak program meter readings of male voice at different deliveries. Fig. 2, right, shows VU meter and peak progam meter readings of different programs.



gram materials. The first is a male voice with a narrative delivery that is, slow and measured—like reading drama. The second is again a male voice with a punchy (that is, fast or staccato-like) delivery that may occur while reading a hard-sell commercial. The recordings show that for both deliveries the PPG meter registers a uniform level of 18dBm while the VU meter registers high (even off-scale) for the narrative delivery and low for the punchy delivery. Thus an audio operator reading a PPG meter will make no level adjustment for either of the two voice deliveries.

But an audio operator reading a VU meter will reduce the level of the narrative delivery by about 3-5 dB, and increase the level of the punchy delivery by about 3-4 dB. Thus, using a VU meter, the punchy delivery is 6-9 dB higher than the narrative delivery!

SPEAK OUT!

Let's Hear What's On *Your* Mind

Obviously this is a very significant contribution to the "loudness of commercials" for which broadcasters are critized. Of course other, more subtle factors contribute to this problem, but how can we ever hope to control these if we continue to use the VU meter which does not tell the truth? How can we hope to bring order to the mess in audio processing (limiters, AGC, compressors etc.,) where there are as many opinions as there are users? Imagine a house whose builder used a rubber yard stick, long beams cut longer and short beams cut shorter than what they ought to be! Well, that is what our house of audio looks like using the VU meter, a rubber instrument.

The above clearly shows why a PPG meter is to be preferred over a VU meter when assembling different program materials into an integrated program. But there is more, as we can see in Fig. 2, which shows simultaneous dual strip chart recordings of VU meter and PPG meter deflections of four different program materials. The recordings show that again the PPG meter registers a nearly uniform level of 18dBm, while the VU meter consistently registers off-scale. Thus an audio operator reading a VU meter will reduce the level by about 3-5 dB while by reading a PPG meter no level adjustment is necessary. This clearly shows that using a PPG meter results in an overall level increase, with its resultant improvement of S/N ratio, and greater modulation capability of transmitters.

And last but not least the PPG meter is human-engineered. Its linear dB scale and its long fallback time make for very even and smooth deflections while the VU meter deflections are "all over the map" as shown in both figures.

Thus using a PPG meter reduces operator fatigue, makes for easier "riding of level" and makes for consistent level reading, which makes "woofing" unnecessary.

The reader who is interested in more details on this subject will find them in my paper, Audio Program Level, The VU Meter and The Peak Program Meter, in the IEEE Transaction on Broadcasting, March 1977, reprints of which are available from me.

Finally let me say that the PPG meter referred to here is the European Broadcasting Union (EBU) standard PPG meter. It is my hope that the EBU meter will find acceptance in the United States. I would hope that it not be the victim of NIH (not invented here) disease, and that it will be unnecessary to "reinvent the wheel." **BM/E**

INTERPRETING THE FCC RULES & REGULATIONS

The Pacifica Case: George Carlin And His Seven Four-Letter Words

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

The United States Court of Appeals for the District of Columbia Circuit has taken the Federal Communications Commission to task in a number of important cases over the past several months. The Court of Appeals has overturned the Commission's pay cable rules and its portions of its broadcast-newspaper cross-ownership rules. The same Court reversed the Commission in three license renewal cases involving equal employment opportunity issues. In addition, a Federal District Court in California held the Family Viewing Hour to be an unconstitutional restriction on broadcast licensees' First Amendment right to freedom of speech.

The Court of Appeals overturned the Commission again in the *Pacifica* case[1]. The case has significance concerning the broadcast of sex-oriented material for all broadcasters and, by implication, for all cable television system operators.

Background

In 1973, WBAI, New York, broadcast a discussion of societal attitudes toward the use of language in everyday conversation. As part of this discussion, WBAI broadcast George Carlin's now famous "Seven Dirty Words" monologue taken from the album entitled "George Carlin, Occupation, Foole." Prior to broadcasting the monologue, WBAI broadcast a warning to listeners, advising them that the monologue contained language which might be deemed offensive to some people. The announcer indicated that listeners not wishing to hear the monologue could switch stations for approximately 15 minutes to avoid exposure to the Carlin routine.

Ironically, the monologue was really a commentary on words that could not be uttered on broadcast radio and television stations. Carlin used seven four-letter words which depict (in their literal sense) "sexual or excretory organs and activities."

A man who was driving with his young son heard the Carlin monologue and lodged a complaint with the Commission against WBAI. After an investigation, the Commission issued an order against Pacifica Foundation, the licensee of WBAI. Therein, the Commission clarified its definition of indecent language as that which:

> . . . describes, in terms patently offensive as measured by contemporary community standards for the broadcast medium, sexual or excretory activities and organs, at times of the day where there is a reasonable risk that children may be in the audience. (See June 1975 BM/E "Interpreting FCC Rules And Regulations" column, entitled "Programming Of Violent, Indecent And Obscene Material.")

Using this definition, the Commission found the Carlin monologue to be indecent and prohibited WBAI from broadcasting the seven four-letter words contained in the monologue.[2]

The Commission's Rationale

A basic rationale underlying the Commission's Order has to do with broadcasting's uniqueness among communications media. Broadcasting is unique because (1) the electromagnetic spectrum *limits* the *number* of broadcast facilities that may operate and (2) broadcasting is extremely *intrusive* in nature; that is, listeners need not take any "significant affirmative activity" to bring broadcast communications directly into the home. The Commission laid great weight upon the intrusive nature of broadcasting because:

(1) "Children have access to radios and in some cases are unsupervised by parents; (2) "radio receivers are in the home, a place where people's privacy interest is entitled to extra deference; (3) "unconsenting adults may tune into stations without any warning that offensive language is being or will be broadcast; and (4) "there is a scarcity of spectrum space, the use of which the government must therefore license in the public interest."

Because of these considerations, the Commission determined that it should apply the principal of "channel-

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[1]*The Pacifica Foundation* v. *Federal Communications Commission and the United States*, U.S. Court of Appeals, District of Columbia Circuit, Case No. 75-1391, March 16, 1977.

[2]The Commission's authority for prohibiting broadcast of these words is contained in 18 USC §1464, which states: "Whoever utters any obscene, indecent or profane language by means of radio communication shall be fined not more than $10,000, or imprisoned not more than two years, or both."

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Here is the new recorder you can't miss . . . adding to your studio, replacing your present equipment or just opening your own studio. You are well aware that even the professional musicians who come to you for recording with limited budget, yet they want professional quality – perfect reproduction, easy to use, extreme accuracy, durability and easy-to-afford cost per performance. Well, OTARI has the answer to the new trend . . . the new MX-7308 multi-channel recorder.

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- **Singapore**: Otari Electric Co., Ltd., Singapore Representative Office, 2701—A 27th Floor, International Plaza, 10 Anson Road, Singapore (2)

Circle 147 on Reader Service Card

FCC Rules & Regs

ing'' whereby stations would be required to broadcast offensive material (possibly indecent, but not rising to the level of obscene) at ''times of the day when it would offend the fewest number of listeners.'' Thus, the Commission declared that it would be permissible to broadcast some material that has serious literary, artistic, political or scientific value later at night when the number of children in the audience is ''reduced to a minumum.''

Pacifica Appeals

Pacifica appealed the Order to the Court of Appeals and argued that Section 1464 is ''unconstitutional vague unless the term indecent is subsumed by the term obscene as defined in *Miller v. California*.[3] Pacifica also advanced two additional arguments. First, the Carlin monologue was not obscene because it simply does not appeal to any prurient interests and because, in context, it *has* literary and political value. Second, Pacifica also contended that the Commission's indecency standard as described in the order was *overbroad* because it does not assure that ''programs of serious literary, artistic, political or scientific value will be allowed to air.''

The Court Of Appeals' Decision

The Court of Appeals reversed the Commission's Order.

> "As we find that the Commission's Order is in violation of its duty to avoid censorship of radio communications under 47 USC §326 and that even assuming, arguendo, that the Commission may regulate non-obscene speech, nevertheless, its Order is overbroad and vague, therefore we must reverse the Order. We should continue to trust the licensee to exercise judgment, responsibility and sensitivity to the community's needs, interests and tastes. To whatever extent we err, or the Commission errs in balancing its duties, it must be in the favor or preserving the values of free expression and freedom from governmental interference in the matters of taste.
>
> Despite the Commission's professed intention, the direct effect of its Order is to inhibit the free and robust exchange of ideas on a wide range of issues and subjects by means of radio and television communications. In promulgating the Order, the Commission has ignored both the statute which forbids it to censor radio communications [47 USC §326; . . .] and its own previous decisions and orders which leave the question of program content to the discretion of the licensee [Footnote omitted]."

The Court found that the Commission's Order which mandated channeling actually constituted censorship despite Commission protestations to the contrary. The Court based this conclusion upon the Commission's aim to keep language that described sexual or excretory organs and activities out of broadcast media at those times of the day when there is reasonable risk that children may be part of the audience. The Court focused on the Commission's statement that the seven four-letter words used by Carlin constitute language that has ''no place on radio,'' despite the fact that the language might have literary, artistic, political or scientific value when viewed *in context*.

[3] 413 US 15 (1973). See Footnote 2. The *Miller* standard for determining obscenity is:

(a) ''Whether the average person, applying contemporary community standards would find that the work, taken as a whole, appeals to the prurient interest.
(b) ''The work depicts or describes in a patently offensive way, sexual conduct specifically defined by the applicable state law;
(c) ''Whether the work, taken as a whole, lacked serious literary, artistic or scientific value.''

The Court further dismissed the Commission's attempt at channeling by citing a study which indicates that a large number of children remain in the broadcast audience until 1:30 A.M. Many broadcasters may be unaware that an unexpectedly large proportion of children make up the late evening broadcast audience.

In discussing overbreadth of the Commission's proscription, the Court stated that such proscriptions would preclude the broadcast of many great literary works, including those of Shakespeare and the Bible. This overbroad attempt on the part of the Commission to regulate indecent language also violates Section 326 of the Communications Act, which "specifically prohibits the FCC from interfering with licensee discretion in programming." Simply stated, in adopting the Communications Act, the Congress *specifically* withheld from the Commission any and all power to censor broadcasts. This is especially so in situations involving "prior restraint" (e.g., banning in advance expression of ideas determined to be inimical to the public interest). Rather, said the Court, individual broadcast licensees have the duty to ascertain community problems, needs and interests and program to meet the needs of their service areas.

The Court declined to address the question of whether the term "indecent" can be more narrowly defined than the term "obscene" because it determined that Section 326 of the Communications Act (prohibiting censorship of broadcast matter by the Commission) was depositive of the *Pacifica* case. It appears likely that this question will be resolved at some future time by the Court of Appeals or the Supreme Court. But even if the FCC had the power to prohibit non-obscene speech from being broadcast, the Court concluded that the Order still suffers from vagueness and overbreadth.

Finally, the Court, in deferring to the programming discretion of broadcast licensees, stated that the Commission underestimated the forces of economics and of ratings on the substance of programming. Licensees or businesses depend upon advertising revenues for survival. If indecent programming is truly abhorrent to the public, such shows will suffer low audience ratings and will be dropped by radio and TV stations. "The corporate profit motive and the connection between advertising revenue and audience size suggest that the dike will hold as long as the community remains actually offended by what it sees or hears."

What The Decision Does Not Mean

Broadcasters should be elated that the Court limited, to some extent, the Commission's subtle but growing control over programming content. However, it is important to realize what the *Pacifica* case does *not* mean. First, the Court did *not* hold that the Commission, because of the unique characteristics of radio and TV, cannot prohibit non-obscene speech or speech that normally would be constitutionally protected. This issue remains to be decided. Second, the Commission could very well regulate *obscenity* that is broadcast by applying the Federal obscenity statute (Section 1467) as long as such regulation is narrowly drawn and is not vague or overbroad. Indeed, the Commission may attempt to recoup from its loss before the Court of Appeals by prohibiting the broadcast of certain words that (1) fall within a narrowly defined, unacceptable context, and (2) fall outside of an innocent or educational context.

In the final analysis, broadcast licensees should realize that they have the responsibility to broadcast in the public interest. It is up to them to determine what program material is of value to their listening public and what material is offensive to the standards of their service area listeners. The Court of Appeals, for one, has a great deal of confidence in broadcast licensees to do what is *right*. **BM/E**

GREAT IDEA CONTEST

11. An After-Hours Door Status Alarm For On-Duty Announcer.

Jon Bennett, Chief Engineer, KYND, Pasadena, TX

Problem: Our studio is located in a 12 story bank building. So after regular business hours, it is desirable to lock the hall foor entrance. On many an occasion, one of the KYND staff members would drop by for one reason or another and scare the wits out of the man on duty, who may not be expecting a visitor at 2 A.M.

Solution: The schematic shown is an SCR arrangement triggering a LED and a Mallory Sonalert. It is highly recommended that you interlock the Sonalert through the console in use. For the door button, I used a good quality home-type button outside and marked it "After Hours." The reed switch that signals the "Door Open" was a GC #30-9205. You could expand the system design to cover any other door on the premises.

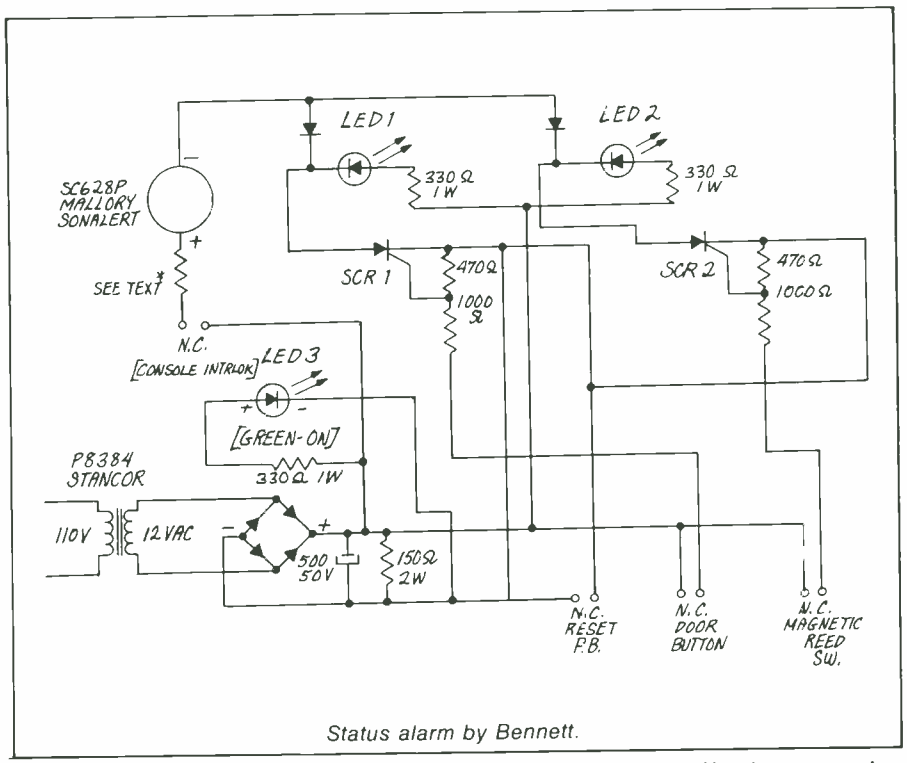
For the resistor below the Sonalert in the schematic, insert the value that gives the desired loudness. I wound up with a 10k and it worked nicely. Construction was done on a piece of vector board #169P44-062 with flea clips. I used the SCR's which were on the shelf, IF #5RC10A. Lettering on the finished box was completed with

VOTE NOW!

GREAT IDEA CONTEST BALLOT ON READER SERVICE CARD

A note about Great Idea No. 7 "Push to start-stop" circuit

Michael Callaghan reports that part of his idea was left out. The remainder of the idea is as follows: Experimentation with the values of the resistors and the capacitor is encouraged. The circuit relies upon hysteresis in the relay to operate. (The fact that the relay requires more current to pull in than to hold.) Therefore, different relays will require different component values. The values specified operate with a Potter & Brumfield KHP series relay, and allow up to three complete on-off cycles per second. A larger relay will require a larger value of C, with a corresponding increase in cycling time. Shorter cycling time is an advantage, so if the relay is kept reasonably small, the circuit will prove advantageous in its simplicity and low cost.



Status alarm by Bennett.

Datamark Dry Transfer letters.

Here's what happens: When the button is pushed, the unit LED marked "Door Signal" lights and the beeper goes on. If the microphone is open on the console, the light only comes on and the beeper will sound when the microphone goes off. The same when the "Door Open" signal occurs.

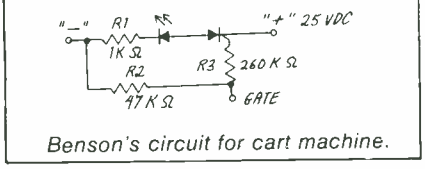
This has been a valuable addition to KYND, as now when deliveries or visitors come after hours, the announcer is aware of someone being in the studio or someone wanting in.

12. An LED, Cart, Status Circuit.

Ricky Benson, Chief Engineer, KHOM-FM, Houma, LA

Problem: Our announcers sometimes get caught up in the fast moving routine of the control room and forget things. This usually shows up on the air as a spot played twice. Therefore a visual indication of cart status was needed.

Solution: The circuit I designed was for an ITC, single deck, cart machine. By using three such circuits, it worked equally as well in our triple deck machine.



Benson's circuit for cart machine.

The LEDs are mounted in the black section of the front panel and show up very well. The LED will light when the start button is pressed and extinguish only when the cart is removed, thus giving the announcer an indication that the cart has been

played.

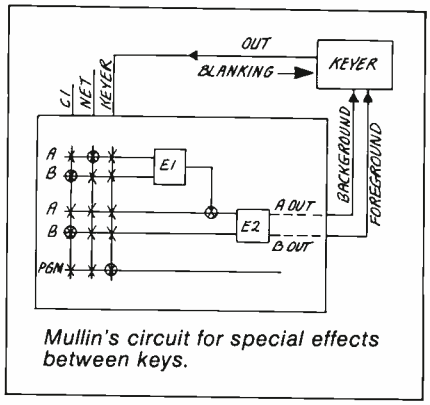
The "−" should be connected to J 1, pin 4; "+" should be connected to J 1, pin 8 (on the triple deck, all three "+" may be connected to one point); the gate should be connected to J 1, pin 7. I have the value of resistor R 1 figured for an LED with an average current of 25 ma. R2 is to bypass any false signals to ground. R3 limits the current to the gate. The SCR is an ECG 5404.

13. Special Effects Between Keys.

Gerard Mullin, Technician, WJBK-TV, Southfield, MI.

Problem: Using a composite chroma keyer without an H shift.

Solution: A close study of the drawing will reveal the secret: mix/wipe the background "upstream" on E1. For example, to dissolve out of chroma key; dissolve to the chroma key source



Mullin's circuit for special effects between keys.

(C1 in this case) on E1. (We are still in chroma key; but, here C1 is filling both the foreground and background.) Also, E1 can be used to A-B mix or A-B wipe behind the chroma key or wipe to a chroma key.

14. Uses of An FM Tuner And Oscilloscope.

Stephen R. Waldee, Broadcasting Consultant, Waldee Audio Productions, San Maeto, CA

Problem: FM stereo maintenance.

Solution: Here's how I use an FM tuner and an oscilloscope to aid in FM stereo maintenance.

The station's FM stereo modulation monitor will dramatically register microsecond-fast pulses on its peak light, but even the slower-acting modulation meter will not tell the full story of modulation density and loudness, especially since the meter will respond to only one polarity of modulation at a time. So, to get a fuller picture of the effectiveness of the FM limiter, an oscilloscope should be connected to the wide-band output of the monitor. Feed the transmitter with a tone to precisely 100% modulation as read on the meter, and set the vertical gain of the scope to show a waveform you can reference on the scope graticule for ±75 kHz deviation. Then with normal programming, you can see the density of the mdoulation envelope, and with a little practice while changing scope sweep times, you can discern how often the important midrange and low-frequency material nears the 100% point. You may discover that the only time you hit full modulation is with high-frequency transients, and particularly the troublesome highs that cause stereo generator lowpass filter overshoot, and the midrange and lows seldom register higher than 40 to 60%. At this point you can check your limiter pre-emphasis tracking and sweep your audio system-limiter-exciter frequency response with square waves. Or you may be able to get more effective loudness and mod-

ulation density by modifying your limiter, readjusting its threshold, or replacing it with a state-of-the-art device.

The scope is also handy for checking your station in relation to the competition. Use a modern wide-band FM tuner, and DC-couple your scope to the ratio detector or discriminator ahead of the stereo demodulator or de-emphasis circuits (most modern tuners now have a composite output labelled "4-channel"). Be certain that the tuner bandwidth is wide enough to at least pass the 53 kHz stereo information. Calibrate your scope with your own mod meter and transmitter, and then tune around the dial, checking strong stations that fully limit your receiver. You can tell when you are precisely tuned in, as the scope trace will exactly center on the scope graticule if the scope is DC-coupled to the receiver's detector. A most important warning is *not* to rely too strongly on what you see, because the tuner bandwidth will not be as linear as a 300 kHz wide modulation monitor, and high-frequency attenuation will reduce the amplitude of stereo and SCA sidebands. Furthermore, multipath in your reception will also distort the waveform and amplitude relationships. But you can at least see, in a relatively crude representation, if that louder station up the dial is modulating well beyond legal limits, or merely has more effective modulation control and signal processing. This information may help you induce the station to invest in better signal-processing equipment.

If your tuner has a special AM-output from the FM IF-strip, you can use the horizontal and vertical amplifiers on your scope to look at the amplitude-versus-frequency modulation of the received FM signal. Many of us have seen the tuning display on the Marantz tuners with oscilloscopes, and know how handy this AM-FM plot is for turning an FM antenna for minimum multipath (simply rotate the aerial for the straightest line). If your remote FM stereo modulation monitor is giving different readings at the studio than at the transmitter site, it may be due to multipath which may be reduced or eliminated by antenna rotation or re-location.

An FM stereo-SCA operation will benefit from oscilloscope observation of the baseband signal without aural modulation. Sync on to the 19 kHz pilot tone. Is it sinusoidal? Or is the pilot distorted by presence of second and third-order harmonics due to misbalance of the stereo generator 38 kHz suppression? The cleaner the pilot and the lower the 38 kHz suppressed subcarrier, the lower the crosstalk from the pilot's third harmonic and the 67 kHz SCA carrier. In one case involving an old transmitter, it was necessary to stagger-tune the IPA and driver stages slightly due to bandwidth limitations in the transmitter itself. Watching the pilot signal on the scope greatly simplified this procedure. Then when the tuning was completed, the station was fully modulated and the amplitude-versus-frequency display was consulted. Any rounding-off of the straight line on the scope indicates mistuning or poor RF-stage bandwidth (do this test at the transmitter site to avoid picking up any multipath that might contribute errors).

The degree of usefullness and accuracy of the above procedures is dependent upon: (1) the calibration accuracy of the station's modulation monitor; (2) the bandwidth of the tuner utilized; (3) the bandwidth of the scope, and proper connection to the tuner; and (4) the alignment of the tuner's IF strip and detector. Be certain that before you make adjustments to the transmitting equipment in response to your observations, the above four conditions have been thoroughly checked.

BROADCAST EQUIPMENT

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

Rubidium Standard 300

Rubidium frequency standard includes output at color TV subcarrier frequency of 3.5795 . . . MHz, at 2.5 Vpp, variation less than 2% through 360° of phase at constant temperature with harmonic distortion below −40dB and non-harmonic below −70dB, continuously phase shiftable. Model FRT-TV also has output at 10 MHz, sinewave, 0.5 Vrms into 50 ohms, floating ground, short circuit protected. Long-term stability is rated ±1 in 10^{-11}/month. Tunability range is $\pm 1221 \times 10^{-11}$ to $\pm 5000 \times 10^{-11}$ EFRATOM CALIFORNIA, INC.

Time Lapse Video Recorder 301

Time-lapse video tape recorder gives up to 99 hours of recording. Model TC310 is remotely switchable to real time, records at 44 intermediate speeds. Horizontal resolution is more than 300 lines; S/N 40 dB; reel, 7 inch EIAH-1 standard; tape, one-half inch. Thumbwheel sets recording time. Single lever controls tape motion; line-locked vertical sync output. $2395.00. RCA.

Stand-By Power System 302

Uninterruptible power system, 5 KVA, uses solid-state circuitry throughout. System efficiency is rated 85% (80% at 20% of load), distortion under 5%, frequency regulation ±0.15%, voltage regulation ±1%. Output is 115 v or 230 v, selectable. Unit provides 15 minutes of standby time from a 50-ampere-hour battery. $4995.00. NOVA ELECTRIC MFG. CO.

Mobile TV Production 303

Mobile color television production center has two Panasonic color studio cameras on Quick Set carriers. The Studi-All V has all electronics in a mobile rack cabinet, including triple monitors for Camera 1, Camera 2 and preview, plus large-screen color/receiver monitor for program, off-air record. Also included is an audio mixer, sync generator with genlock, and color special effects generator. Other features are a pop-out writing shelf, six-position switcher, camera control units. $16,990.00. COLUMBIA VIDEO SYSTEMS.

TV Modulator 304

TV modulator covers all standard and special channels, 6 to 270 MHz. Model TM-2400 uses IF modulation, has standard output level of +54 dBmV, differential gain ±0.5 dB, differential phase ±1 degree. Operating channels can be changed in the field by one PC board substitution. IF design allows modulation at a fixed frequency, so filters are optimized for true vestigial sideband signal. Under $900. A microwave version is also available. CATEL.

30-Minute KCS Cassette 305

Long-playing U-Matic video cassette in the KCS package has 30 minute playing time. KCS-30, designed primarily for the Sony VO-3800 and VP-3000, can be used in any machine that accepts the KCS package. Other U-Matic cassettes also introduced are the full size KCA-70, 70 minutes, and KCA-90, 90 minutes. All three use new thin-tape technology. DUPONT COMPANY.

Fluid Camera Head

Universal fluid head and tripod for film and video cameras weighing up to 12 pounds has a quick-leveling claw ball and cavity system. Model 808 has a AUTOSLIP self-adjusting breakaway

New Products

free pan, and HYDRALOK, providing secure locking in any tilt position. Fluid remains operative from −4°F to +167°F. $300. CINEMA PRODUCTS CORP., 2037 Granville Ave., Los Angeles, CA 90025.

Audio Processor 306

Multiband audio processor allows setting of compression ratio, threshold, and output separately on each of three bands. TA Discriminate Audio Processor II does not include a peak limiter, can be used with improved limiters as they become available. Unit uses an electro-optical attenuating device in the leveling section. TRACK AUDIO.

Communications Receiver 307

Communications receiver for 50 kHz to 29.7 MHz is fully synthesized, has five-digit readout of frequency tuned in. Model DR-22 has switch selectable 4 or 8 kHz bandwidth, with ceramic filters. In addition, crystal filters at 30 MHz and 10.7 MHz provide high selectivity, freedom from intermodulation and cross modulation interference. Digital phase-locked loop tuning system has crystal accuracy and stability; frequency is selected by four rotary switches, plus a fine-tuning control. $995.00. DYMEK.

Audio Record Card 308

Directly installable audio record card for Ampex VR-1200 and VR-2000 has high rejection of thumps, clicks, pops

or holes during audio edits. Model AR-1200 claims lower distortion, lower noise, and better headroom than the original cards. $295.00. N.O.V.A. CORP.

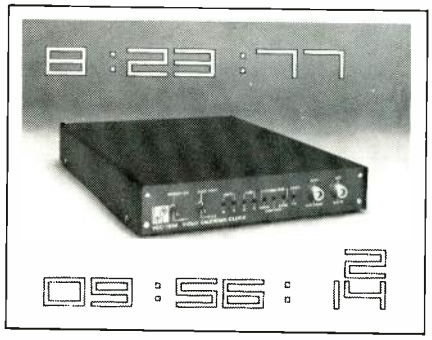
Date/Time Video Generator 309

Calendar/clock generator puts the month, day, year, hour, minute and second on a video screen. Model 1224 operates on 12 volts, has step and set buttons on front panel. Date and time

continued on page 80

New Products

are independently positionable over 100% of the video screen. Trickle-charged batteries that will operate unit



up to eight days after a power failure are optional. $690.00. UNIVERSAL PRODUCTS.

Surge Protector 310

Line surge protector has a suppressor to absorb energy from transients above the protection level. It also has a ferrite filter to suppress transients and spikes below that level. Unit plugs into standard AC outlet; protected equipment plugs into unit. $14.95. DYMA ENGINEERING.

Video-Activated Switch 311

Video-activated power switch turns monitors and other devices on and off automatically by sensing the presence or absence of the horizontal sync in a composite signal. Model VPS-1 has a turn-on time of 0.5 second with 1 volt video input, plus 3 dB minus 6 dB. Turnoff time is 12 seconds minimum; switch will not turn off when color black is present. $95.00. VIDEO AIDS OF COLORADO.

Audio Recorder 312

Audio tape recorder has DC capstan with phase-locking to crystal control.

Model F-400 has speed stability of 0.02%, wow and flutter, 0.25%. Modular mechanical and electrical components allow easy servicing. The heads are "hard topped" for long life. SCHLUMBERGER.

Radio Programming

continued from page 22

After recording all the scene separately, but in sequence, edit the good takes together to form a dialog reel.

Effects and music

We've already eschewed overuse of effects, now some words of caution about music. Appropriate music is essential to the success of your production. This means commercial mood bridges, stings, stabs, underscores specifically designed for dramatic radio. Do not use any music the audience can identify, as what they associate that music with will distract them and detract from the mood you are trying to establish.

Recorded background music and special effects are available from many sources. But you'll find that not all needed effects are available on records. Here's where your own ingenuity comes into play. You might begin by constructing an all-terrain open box from ¾-in. plywood, 4 ft. long by 2 ft. wide by 10 in. deep. Divide the 4-ft. length into three separate felt-lined compartments. Fill one compartment with a mixture of clay and sandy soil, another compartment

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with fine gravel mixed with a few small to medium size rocks, and the third with dried leaves and twigs. Four-footed critters "walk" by means of short-handle rubber plungers or hollowed, halved coconut shells over the different terrain. Invert the plungers or shells for two-footed critters.

Changes in volume and playback speed will allow different uses for the same effect. Wind or surf that is gentle at low level becomes hurricane and raging torrent respectively at full volume, with the actors' voices trying to "top" the effect. A vacuum cleaner played back at half speed makes a convincing moving space ship interior.

A spring reverb and a variable hi-lo sound effects filter are useful tools, too.

Editing and mixing

Most college and university audio departments will have the two or three tape recorders and the turntable needed to do the final editing job, and the radio station to put the program on the air. With hard work and any luck at all in your available talent, you will have a program that listeners of every age will rate high. **BM/E**

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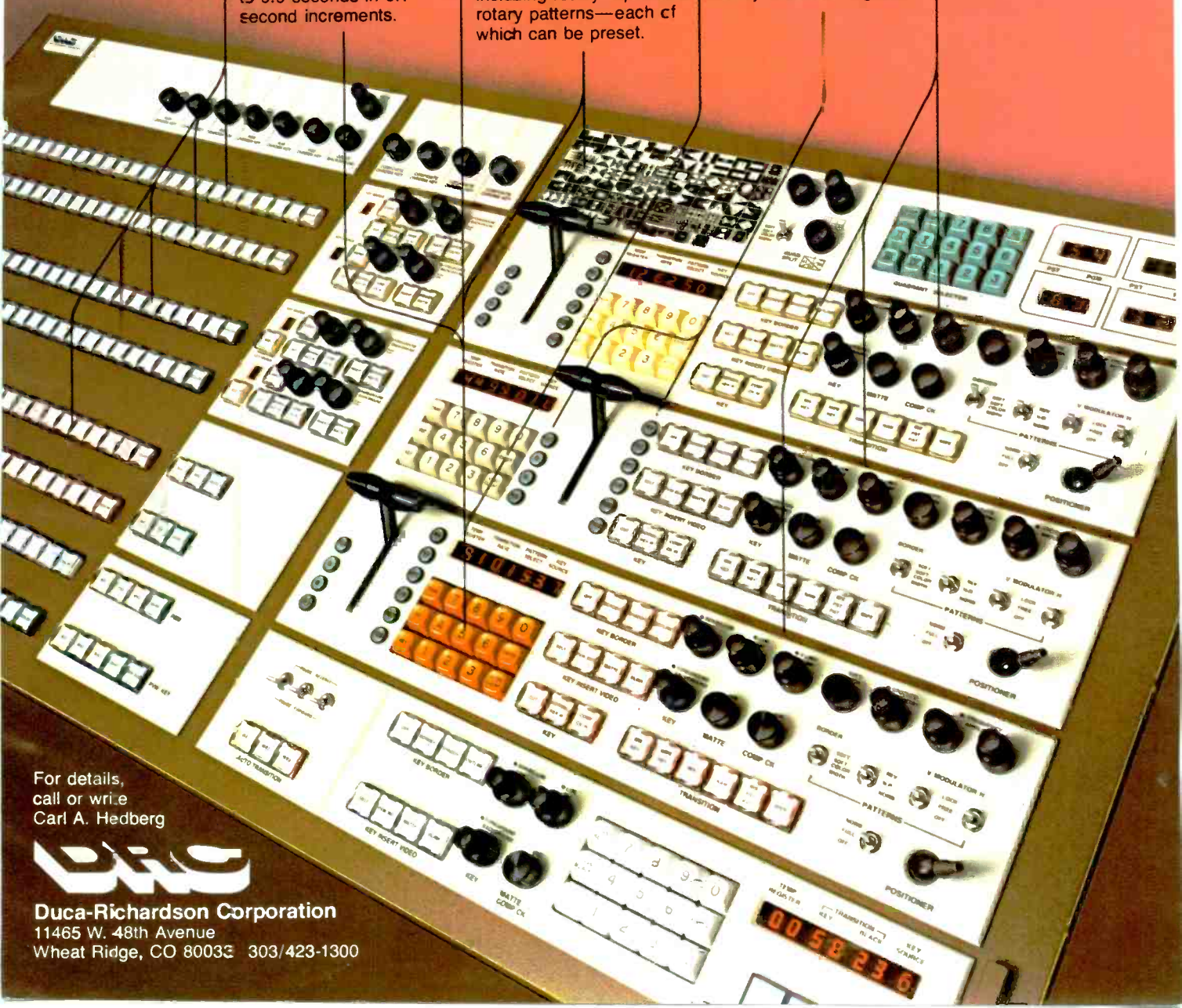

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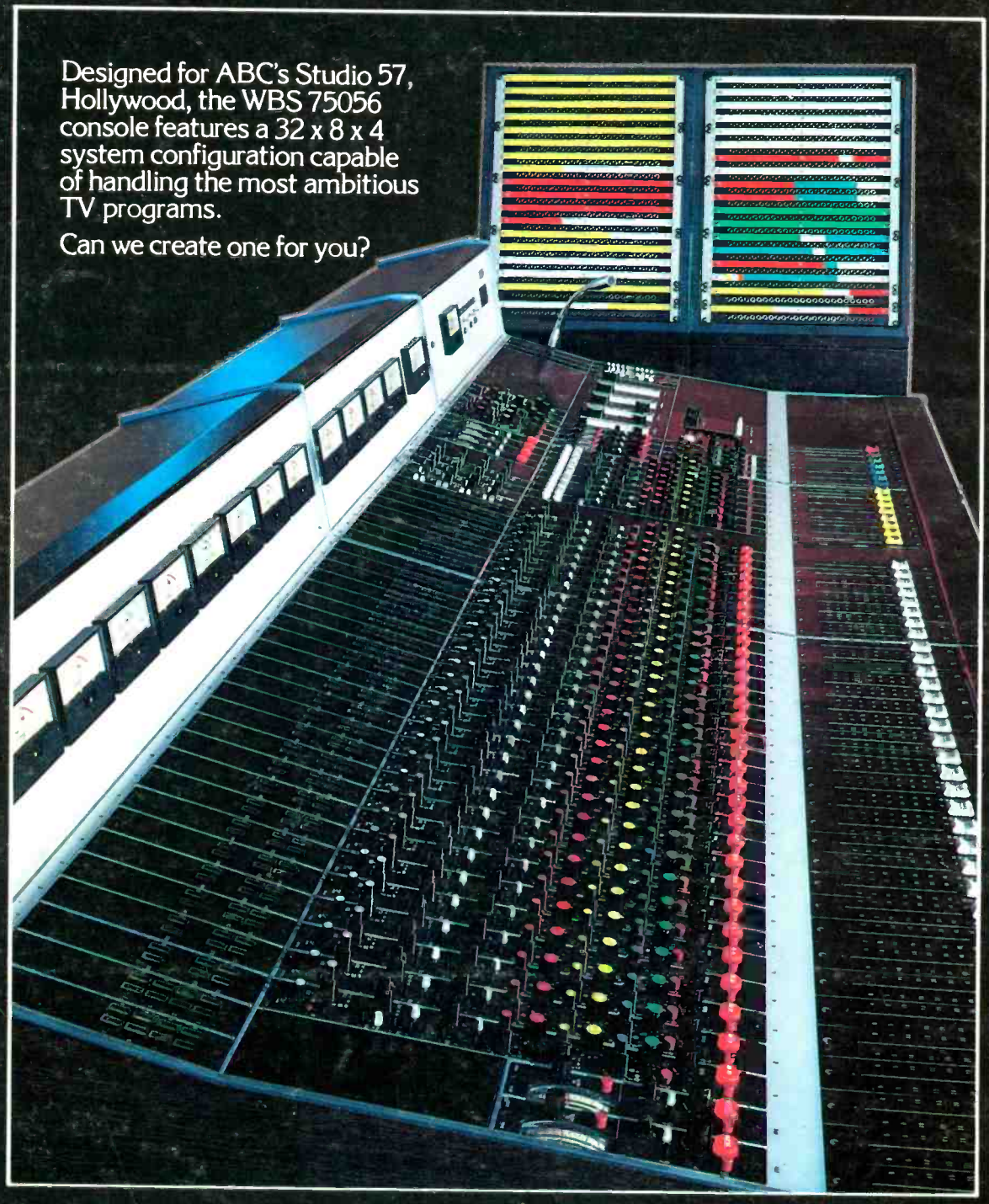

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