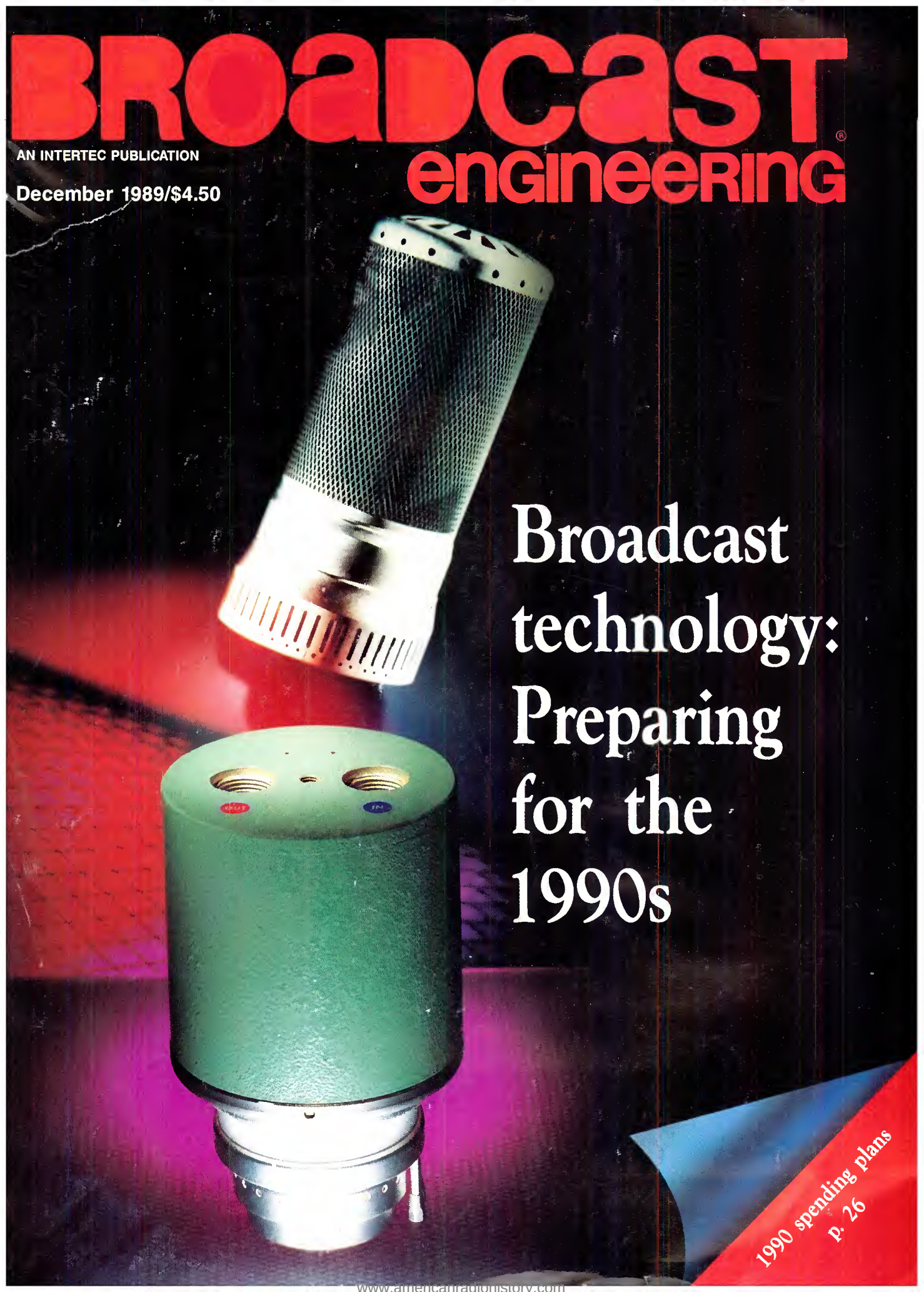
BROADCAST ENGINEERING

AN INTERTEC PUBLICATION

December 1989/$4.50



Broadcast technology: Preparing for the 1990s

1990 spending plans p. 26

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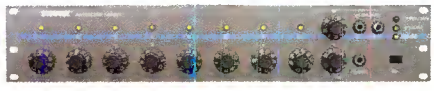

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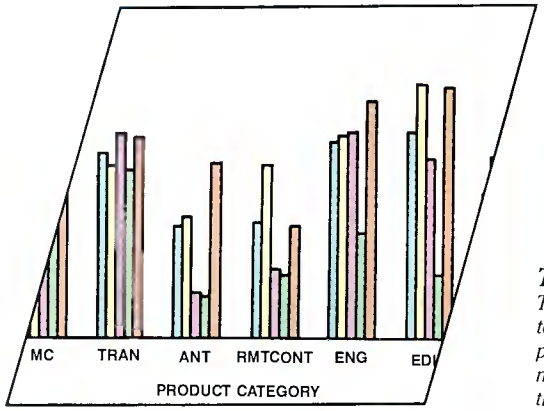

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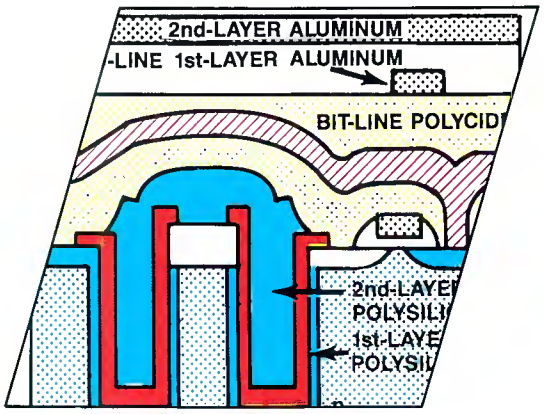

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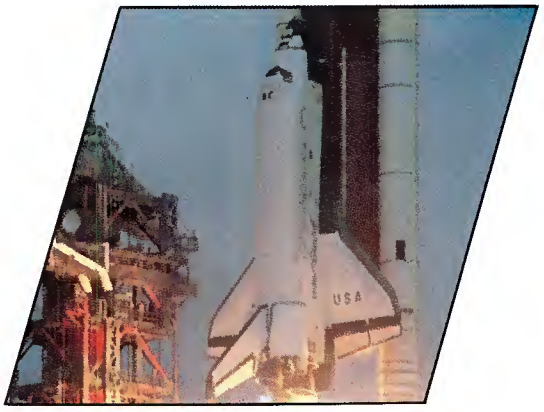

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BROADCAST engineering

TECHNOLOGY FORECAST:
The broadcast industry is moving rapidly as advancements in technology give stations and facilities new ways to solve old problems. The need has never been greater for detailed, measured planning. Our annual Technology Forecast includes the following articles:

OTHER FEATURES:

ON THE COVER

With a new decade about to begin, radio and TV stations face critical business and technical questions. New technology opens new doors for broadcasters and for their competitors. Our cover this month illustrates one area of advanced technology — high-power gridded tubes. (Courtesy of Thomson Tubes.)

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News

By Paula Janicke, staff editor

Second annual LPTV conference is a hit

The Community Broadcasters' Association held its second annual LPTV conference and exposition Nov. 5-8, 1989, at the Riviera Hotel in Las Vegas. The first conference, held last year at Caesar's Palace, was fairly well-attended, with a smattering of exhibitors. This year's event was more successful. The number of attendees more than doubled and the number of exhibitors almost tripled.

The fact that everyone present was directly involved in low-power TV broadcasting set it apart from most other conferences. The attendees were either actively operating LPTV stations, in the process of building one (CP holders) or awaiting a grant of a CP from the Federal Communications Commission. As a result, the interest was highly professional and most exhibitors were pleased with the outcome of the convention.

A measure of the importance given LPTV by the FCC was that commissioner James Quello, dean of the FCC, was the keynote speaker. He was highly encouraging and made listeners feel that the commission really wants LPTV to succeed. One of the most urgent items on the LPTV operator's list is channel protection.

Because of their secondary classification, LPTV stations are subject to channel loss and move to a new channel (if one is available), if a full-power standard TV application is granted. Given the present state of the TV allocation plan, there generally is not much chance of such a move in most major markets. This means the LPTV goes dark and operators lose their investment.

The second concern is cable carriage. This is even more critical for LPTV than for full-service stations.

Keith Larson, head of the low-power branch, presented a tutorial on LPTV and manned an official FCC booth at the conference. There are now more than 700 licensed and almost 1,600 construction permits outstanding.

"Best Local Production" awards were presented to 12 LPTV stations and production houses. Technical papers ran the gamut, from a station manager's round table with new and experienced managers giving the benefits of their experiences, to legal clinics and cable sessions.

The technical side of the medium was taken care of by a panel presentation providing a guide to station construction. Richard Bogner dealt with antennas, John Battison talked about transmitters, and Tom James, Panasonic, provided the necessary data about video equipment.

BTS holds 39th symposium

The Broadcast Technology Society held its 39th Broadcast Symposium Sept. 21-22, 1989, at the Washington Hotel, Washington, DC. The event was well-attended, al-

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BROADCAST ENGINEERING

Editorial and advertising correspondence should be addressed to: P.O. Box 12901, Overland Park, KS 66212-9981 (a suburb of Kansas City, MO); (913) 888-4664. Telex: 42-4156 Intertec OLPK. Circulation correspondence should be sent to the above address, under P.O. Box 12937. RAPIDFAX: (913) 541-6697.

BROADCAST ENGINEERING (ISSN 0007-1794) is published monthly (except in the fall, when two issues are published) and mailed free to qualified persons within the United States and Canada in occupations described here by Intertec Publishing Corporation, 9221 Quivira Road, Overland Park, KS 66215. Second-class postage paid at Shawnee Mission, KS, and additional mailing offices. POSTMASTER: Send address changes to **Broadcast Engineering**, P.O. Box 12960, Overland Park, KS 66212.

SUBSCRIPTIONS: Broadcast Engineering is mailed free to qualified persons in occupations described above. Others may subscribe at the following rates: United States, one year, $50; all other countries (surface mail), one year $60. Rates include postage. Foreign air mail and Canadian first class options are available at the annual subscription rate of $115. Single copy price $4.50, except for the annual Buyers' Guide/Spec Book, which is $20. Back issues, when available, $5; Buyers' Guide/Spec Book back issues $23. Adjustments necessitated by subscription termination at single copy rate. Allow six to eight weeks delivery for change of address or new subscription.

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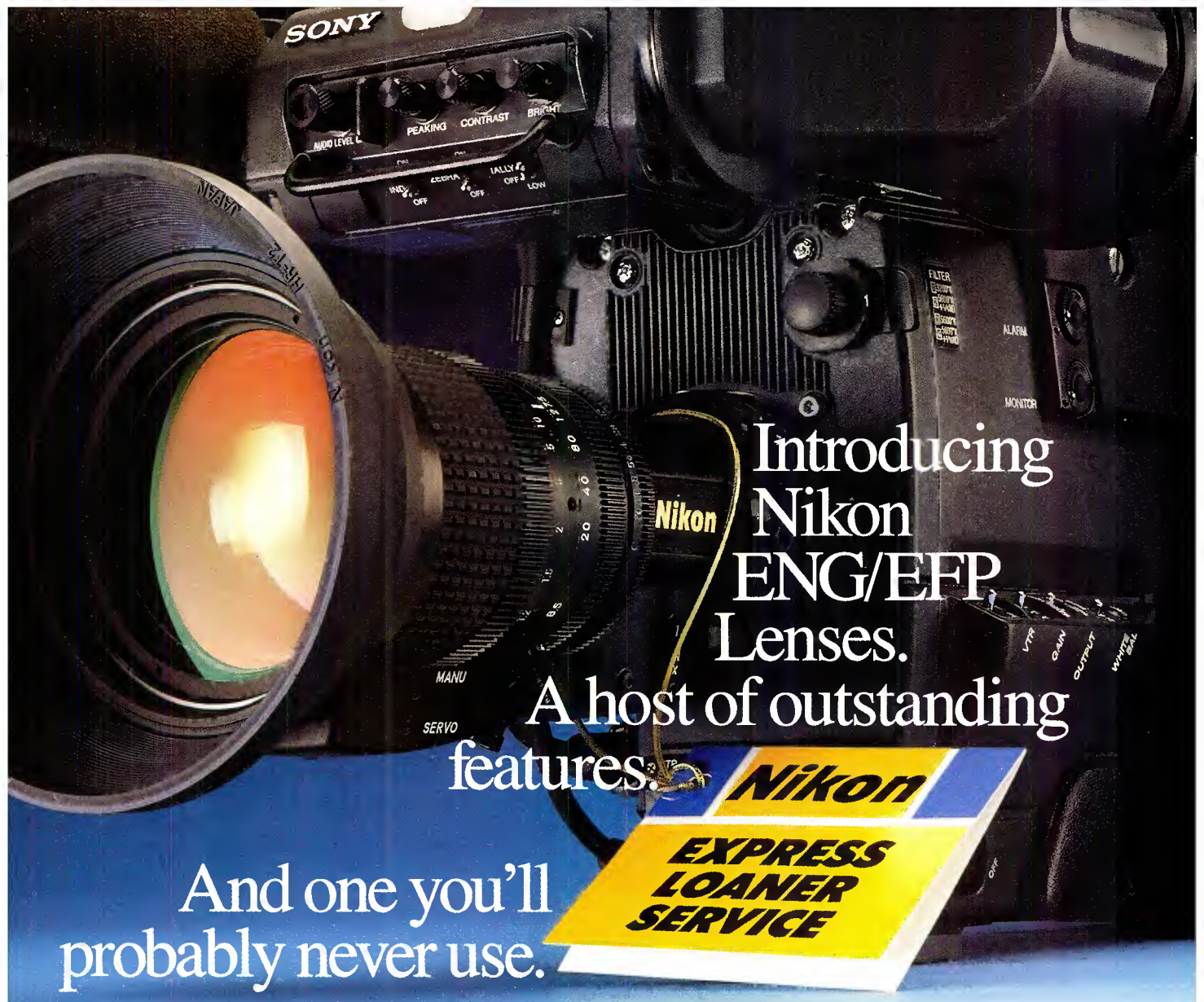

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No rocket scientists

You may have noticed that we have devoted considerable editorial space this year to historical aspects of broadcasting. **BE** editors spent weeks combing the archives, interviewing "old timers" and collecting, collating and writing a truly excellent series of articles on the history of our craft. We published them to celebrate our three decades of success. We thought it was appropriate; after all, you're only 30 once.

How have we remained successful for more than 30 years in the tough publishing industry? Well, it doesn't take a rocket scientist to figure it out.

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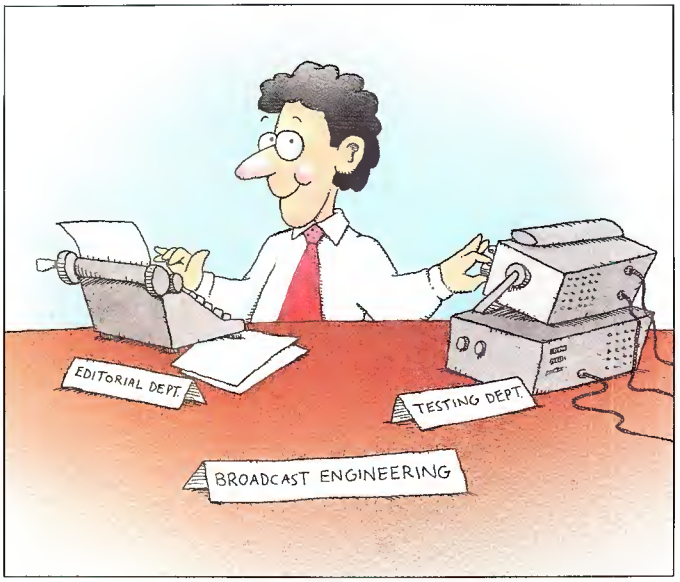

Second, we've been there with you. We've sweated as the clock inched toward dawn and the cameras had to come back to life. We've patched around lightning-ravaged equipment. The news director has breathed down our necks as we've freed stuck cassettes. And we've seen the sunrises you only see on the way down the mountainside after an evening of transmitter service. There is an old song with the line, "Walk a mile in my shoes." We at **BE** take pride in the fact that we've done that.

What does this mean to you?

It means we can be useful. We try to give you what you need to get your job done, with the best technical information we can find.

It means we can be accurate. Because we're from the industry, we can apply the rules of thumb learned on the job when we write an article. And because we don't know everything, we can use our backgrounds to communicate effectively with the esteemed members of our editorial consultants' board, who do.

This means that we can provide you the best magazine possible. And that's the secret to our success.

In the long hours spent poring over old issues of **BE**, we came to appreciate the care and skill of the previous editors and contributors. The magazine wasn't as glossy, the pictures weren't as pretty, but the words were *excellent*. We've made numerous graphic and lithographic improvements over the years that improve the "look" of the magazine, but we still take greatest care with the words. We still seek the best.

Our industry is heading for exciting times, times that may require changes. We're not afraid of that; we've been through a lot these first three decades. Whatever the future brings, we'll cover the distance with you. We'll get there together.

As we conclude our 30th anniversary celebration, it is **BE**'s pledge to continue providing hands-on, authoritative, spoken-from-your-point-of-view news and information.

Rick Lehtinen

Rick Lehtinen,
TV technical editor

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24-hour ban to be studied

By Harry Martin

An inquiry was opened in October by the FCC to develop a record to assist in a judicial determination of the validity of a 24-hour ban on broadcast indecency. The ban was promulgated by the commission in compliance with a congressional directive, but then stayed by the U.S. Court of Appeals in Washington pending judicial review. The court granted the commission a remand for the purpose of conducting an inquiry to determine whether there is sufficient justification for a general ban on indecent broadcasts.

The commission defines indecency as language or material that, in context, "depicts or describes, in terms patently offensive as measured by contemporary community standards for the broadcast medium, sexual or excretory activities or organs." Such broadcasts are actionable when there is a reasonable risk that children may be in the audience.

In 1988, Congress adopted a 24-hour ban on indecent broadcasts to protect the American people, especially children, from exposure to indecent material. Accordingly, the inquiry focuses on the interest of Congress in protecting children. The agency's notice of inquiry tentatively identifies children age 17 and under as appropriate for the purpose of its study.

In the notice, the commission asks for comments on numerous related issues, including:

- The pervasiveness and accessibility of the broadcast media to children.
- The actual viewing and listening habits of children.
- Alternatives to the 24-hour ban, including (1) channeling indecent broadcasts to a time of day when children most likely will not be exposed to it, including reliance on parental supervision to protect children; (2) program rating codes or prebroadcast warning devices; and (3) the existence of broadcast technologies that restrict children's access to indecent broadcasts.
- The availability of indecent material for adults through the broadcast medium.

The commission also announced that its Mass Media Bureau took action on a backlog of 95 complaints of indecency. This action disposed of all documented indecency complaints pending at the agency as of August 1989. The complaints were filed over a period of more than two years.

The bureau instituted enforcement actions against eight stations for broadcasting indecent material. Four of the eight stations subject to enforcement action were issued notices of apparent liability for monetary forfeitures ranging from $2,000 to $10,000. Four other stations were mailed inquiry letters seeking their comments on the complaints. Once the commission has full information, enforcement actions may be initiated against these stations also.

In letters to 51 complainants against 40 stations (34 TV and six radio stations), the bureau explained that it currently lacks enforcement authority against indecent material broadcast after daytime hours because of the District of Columbia Circuit Court's decision in "Action for Children's Television vs. FCC." For this reason, the commission recently concluded that it was forced to vacate a pending action against a station's broadcast of apparently indecent material at 8 p.m.

Fourteen other complaints were dismissed as defective, because they lacked certain elements required to make a *prima facie* case of indecency — identification of the station, the date and time the allegedly indecent material was broadcast, or a tape or transcript of an excerpt of the material. The bureau informed complainants that a resubmitted complaint curing the deficiency would receive prompt re-evaluation.

Most of the remaining complaints were dismissed because they did not meet the requisite legal standards for indecency as formulated by the federal courts.

LPTV filing window opened

The commission opened a national application filing window in early December for construction permits and major changes in existing facilities for low-power television and TV translator stations.

Under the ground rules for the window, the commission would not accept more than five applications per applicant for new stations during the filing window. This restriction was intended to limit speculative applications.

In April 1988 the commission adopted a policy statement providing for limited consideration of terrain shielding in the evaluation of TV translator and low-power TV applications. The policy statement also provided guidance regarding the submission of requests for waiver of LPTV acceptance requirements concerning interference protection standards. The December 1989 window was the third in which these rule relaxations could be used in LPTV application preparation.

The commission's staff reports that the current backlog of processable LPTV and TV translator applications stands at about 2,000, which is considered manageable. This is down from the 34,000-application backlog that existed in the mid-1980s. If its backlog remains manageable, the commission may be able to open several filing windows a year. With a window last March, this was the first year more than one filing window was opened. The next window most likely will be opened in the spring of 1990.

Station totals announced

The commission has announced the total number of broadcast stations licensed as of Sept. 30, 1989:

AM radio	4,965
FM radio	4,240
FM educational	1,407
Total	**10,612**

UHF commercial TV	538
VHF commercial TV	547
UHF educational TV	224
VHF educational TV	122
Total	**1,431**

FM translators and boosters	1,783
UHF translators	2,179
VHF translators	2,719
Total	**6,681**

UHF low-power TV	437
VHF low-power TV	151
Total	**588**

FM translators and boosters

Martin is a partner in the legal firm of Reddy, Begley & Martin, Washington, OC.

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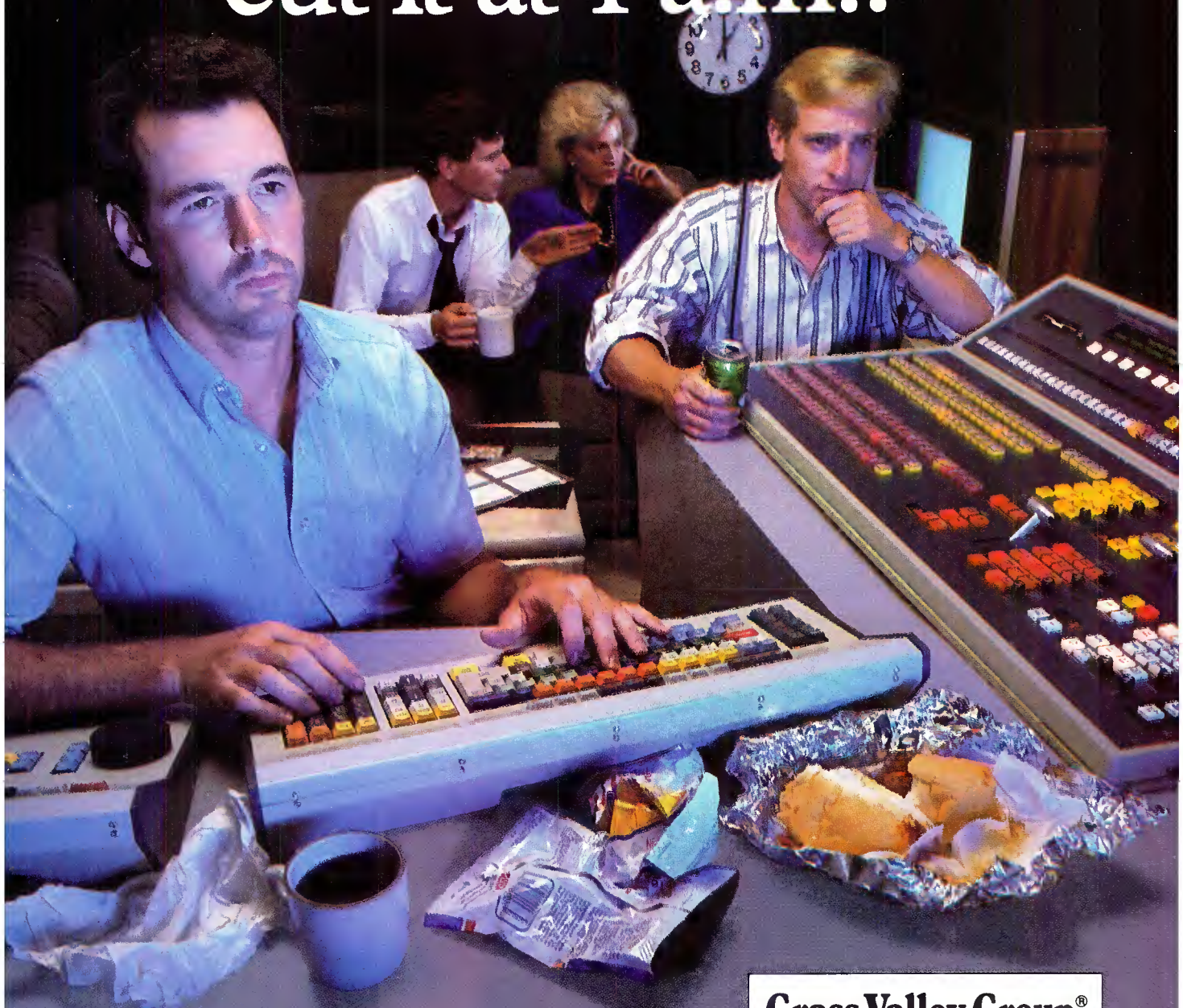

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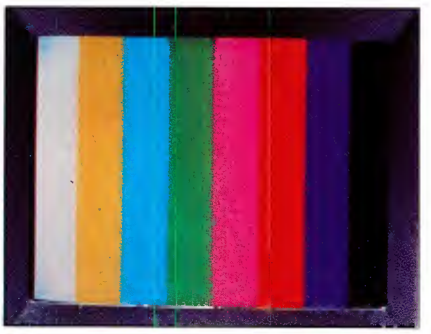


Election network saves the day

By Mark Fenton

For the past several years, KSL-TV, Salt Lake City, has been working to improve the interface between the local election system and the station's character generator. One of the changes is a high-speed data transfer system that uses off-site PCs, which was set up at the local election system. These computers prefilter election data and forward only the changes at 2,400 baud back to the station. This system has an extremely fast update cycle rate.

KSL also installed a local area network (LAN), which allows separate news departments and telephone receptionists to access a common datapool. This LAN also feeds the station's teletext system. It allows anyone to receive virtually real time results for all races for the price of a teletext decoder.

After investing so much work over the years, we looked forward to a relatively easy 1989 election tally. Unfortunately, we were in for a rude awakening. Shortly before election time, we were told that our state and national election services were defunct. After years of working on the display end of the vote-counting system, we suddenly had to develop a system to gather our own vote totals.

Election services

Election services collect data on vote counts and sell the numbers to subscribers. Because of the work involved in tabulating votes from hundreds of cities, the subscriptions are usually well worth their fees. Although an Associated Press feed was available, we found the method of data presentation to be cumbersome and elected not to use it. It required too much human intervention to scan the race tables from the wire and to manually enter updates into our network. We thought that if manual keyboarding was required, we might as well gather our data directly from the source.

Fenton is a senior studio engineer at KSL-TV, Salt Lake City.

Two challenges

The first challenge in developing our data-collection system was deciding whom to call to collect the vote count for each of the desired races. Votes may be counted at county complexes or at the home of the mayor in small towns. We intended to cover hundreds of races and this required hundreds of coordination phone calls all over the state. It took about two weeks of calling to compile the phone numbers.

The second challenge was to develop computer software that allowed efficient entry of race data. We took advantage of our election LAN by structuring the software so several computers could simultaneously access the same database. Each computer was set up with a modem and a headset, and each operator was assigned a group of races on which to call.

The software allowed for finding any given race quickly. Once on the screen, the race could be accessed by a single keystroke, which would tell the computer to automatically dial the number associated with that race. After dialing, the computer also would lock on to all races with the same phone number. This allowed the operator to quickly page between them and to enter all of the other vote totals collected at that phone number.

The system functioned well, but we discovered a few tactical problems. For live election coverage, an efficient system should turn over new numbers every 30 minutes. Our experience indicated that each caller should only handle about 30 races for that kind of turnover. We also found out that small-town mayors may go to bed early and do not appreciate being aroused to ask for vote totals. Even in larger areas, we encountered problems with building switchboards that were shut down when the operators went home. Although votes were being counted into the wee hours, we couldn't call after 9 p.m. This left us with some votes not counted until the next morning.

Commitment

Serious election reporting requires a major expenditure of both technical and human resources. Such a commitment could easily be out of the reach of smaller stations. A definite need exists for election services that can collect data and divide the costs among their subscribers. However, because it requires such a major commitment, the number of subscribers probably would be small, and statewide elections take place only once a year (or less), there is not a large financial incentive to create such services. By creating consortia, which distribute electronically gathered data to their members in some format readily acceptable to automated character generators, broadcasters may make it more cost-effective to deliver live election coverage.

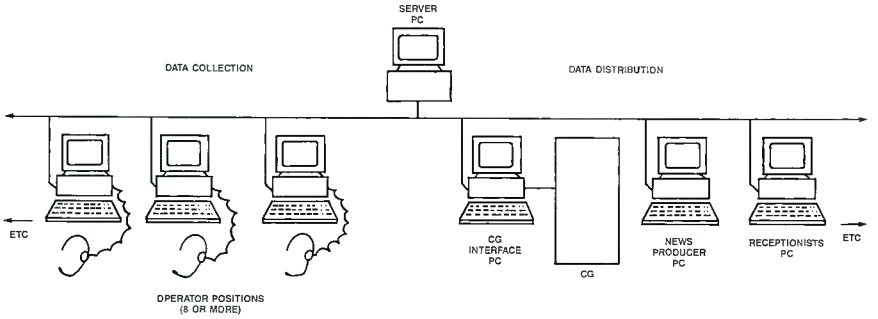
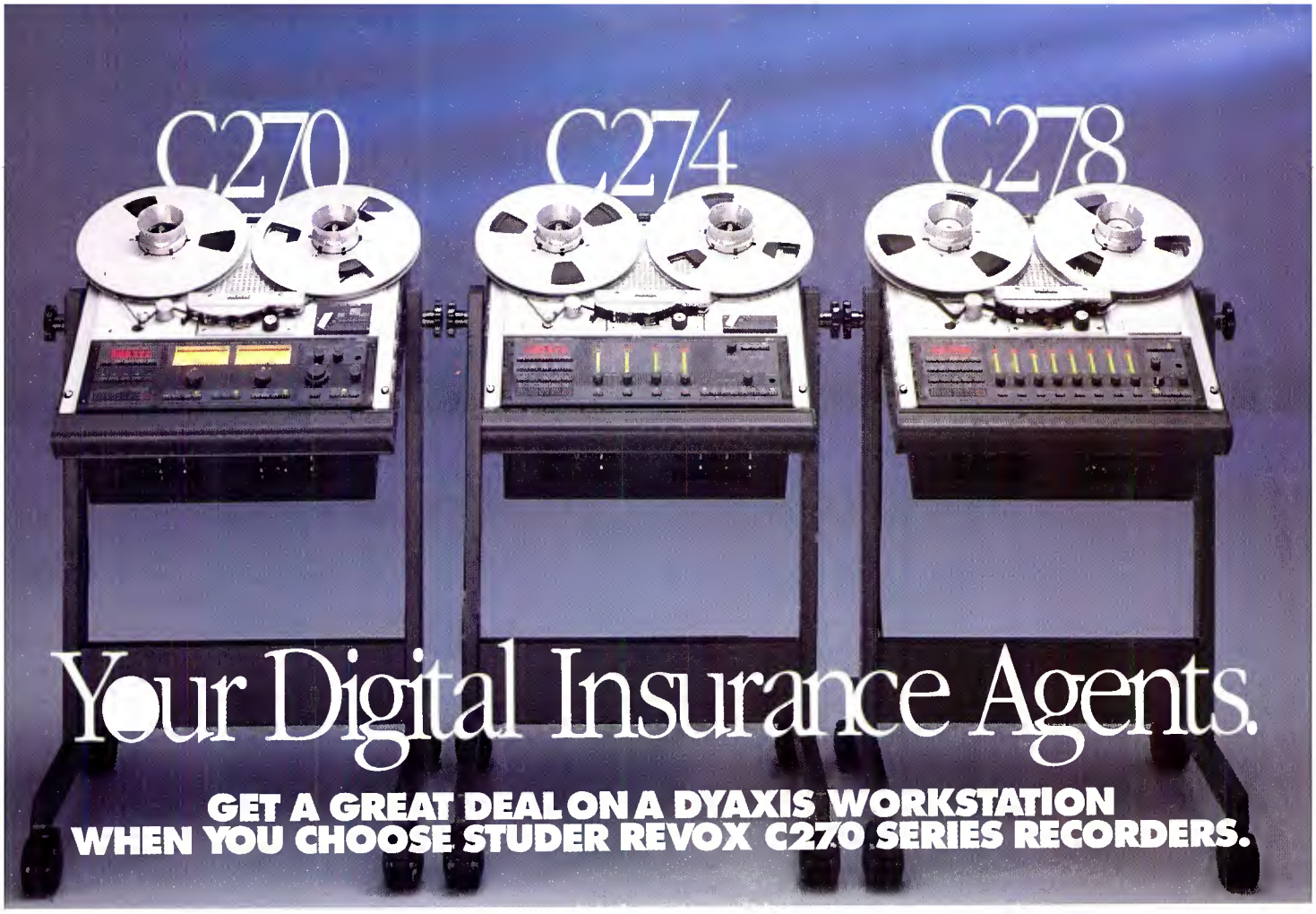


Figure 1. KSL election LAN as configured to accept operator data entry.



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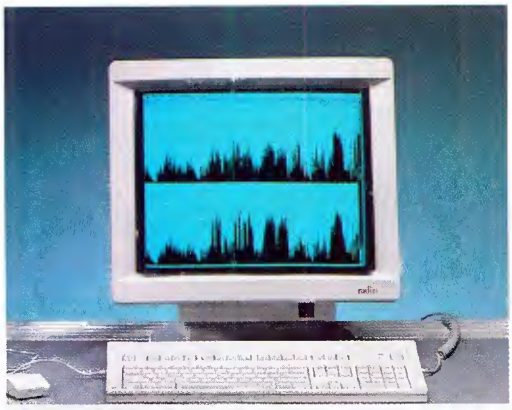

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Nose research used for outer space

By Elmer Smalling III

Orbiting for days in cramped quarters is strain enough for an astronaut, but having to live with foul odors can be unbearable. Common trace odors, barely noticeable on Earth, become major problems in the cramped work areas of a spaceship. Unlike their earthbound friends, astronauts can't just open a window to let in fresh air.

The astronaut's environment is kept fresh partly through the labors of a group of ultrasensitive noses at the Johnson Space Center's White Sands test facility, near Las Cruces, NM. A group of 20 volunteers sniff all the materials that go into the space shuttle's crew compartment.

A bad odor permeating an enclosed cabin for several days can degrade an astronaut's performance seriously, and also could be a catalyst for motion sickness. This could distract the crew from the business at hand, which is too expensive and critical to sneeze at.

The importance of such testing is underscored by a Soviet incident in 1976. During the Salut 5/Soyuz 21 space flight, cosmonauts experienced an unbearable acrid odor coming from their environmental control system. They eventually were forced to abandon the mission and return to Earth.

Smalling, BE's consultant on cable/satellite systems, is president of Jenel Systems and Design, Dallas.

The odor panel prevented serious problems from occurring on some of the later Apollo flights. Because of budgetary constraints, NASA had to cancel missions 18, 19 and 20. Also, Apollo 13 had run into difficulties when an oxygen tank in the service module exploded, freezing the propellant lines used for the main service propulsion engine and disabling the command module cooling system. All efforts surrounding the mission then were shifted to rescuing the astronauts.

These factors forced the recombination of unsatisfied mission objectives into missions 14 through 17. Because each mission plan is the size of a Sears catalog, this led to a frantic rewriting of mission plans. Somehow, the mission plans were prepared using an uncertified ink, and it was only at the last minute that someone thought to pass the new plans to the odor panel. The new ink caused blisters in the noses of all five test sniffers. The plans were reordered quickly and printed with a qualified ink, possibly saving a mission.

Shuttle nose

Today's more refined analytical equipment virtually has eliminated instances such as the Apollo mission plans incident. Materials that will go into the shuttle's crew compartment are checked for toxicity and other negative properties by modern equipment. But the noses have veto power, and items are eliminated if they are found to be objectionable.

The odor panel has existed since 1967. Literally every item that has flown in the crew compartment of every NASA spacecraft since that time has passed the group's examination. The odor panel may have smelled as many as 6,000 materials in its 22-year history. Currently, an average of nine materials are tested each week at the center, three in each of three sessions. A typical assortment may include adhesives, fabrics, potting compounds, plastics, paint, inks, shaving lotion or deodorant.

No brown nosers

The odor panel volunteers all are space center workers with less unusual everyday jobs. Volunteers' noses are given extra care on the day that the tests are conducted; volunteers don't smoke, chew gum or wear heavy perfumes or colognes. They don't eat anything for a half hour before the test. Tests are conducted early in the day so that noses will be fresh from a good night's sleep.

Not just any nose makes the grade. To be selected for the odor panel, members must be gifted in the olfactory department and undergo a nose calibration every four months. They sniff a set of 10 odor samples; seven standard odors and three water samples. Members must be able to isolate the water samples. The tests are conducted in a special room protected from outside smells, and five sniffers grade each sample independently. The samples are sealed in glass jars, and are subject to the same heat and humidity that will be on the space shuttle. Usually, the ratings given by the panel are very close.

The gifted few who have a chance to lend their noses to science make sure that everybody knows it — the group's unofficial insignia is a large-nosed skunk.

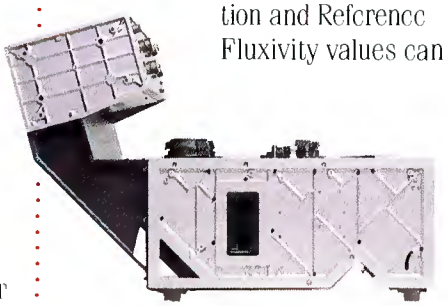
Fortunately for us, most radio engineers look before they leap.

Three cue locations and a zero memory can be accessed via the MX-55NM's built-in locator.

You've always been an analytical bunch, so we're sure you know that our MX-55NM 2-track not only gives you the features you need, but that it's also priced several thousand dollars below its nearest competitor.

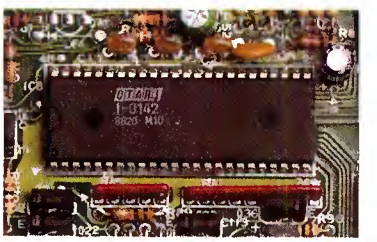
We know you're not about to overlook *major* features, like HX-Pro™ bias optimization, or gapless seamless punch-in punch-out, or that famous Otari sound. However, here's some fine points to examine as you do your "apples-to-apples" with our competitors.

For example, the MX-55NM incorporates a printed-circuit capstan motor (like that used on our MX-80 multitrack machine). This not only gives you low wow and flutter right out of the chute, but very fast start times. It's also worth noting that EQ selection and Reference Fluxivity values can be changed with a flip of a switch. And as you put the deck through its paces, notice that the varispeed control provides 0.01% step resolution. This means you can make precise changes, and perhaps more importantly, you can repeat a change *exactly* when necessary.



A 1.5" cast alloy deckplate, plus cast side frames give the MX-55NM the rigidity and ruggedness you've come to expect from Otari. (Do our competitors show you the inside of their machines?)

For your convenience, an optional voice editing module maintains normal pitch at twice normal speed. And the meterbridge keeps knobs and switches out of the way while you're editing.



Because we know how hard you use our machines, we use a double-sided glass epoxy transport circuit board, and we silkscreen both sides of our PCBs so you can locate the components easily.

In the Otari tradition, we make the MX-55NM easy to service. Only four screws get you into the transport electronics. And when you get there, all servicing can take place with wiring intact. We also hinge all service panels, and use locking cable interconnects.

The specs? Why not call your nearest Otari dealer, or Otari at (415) 341-5900 and check them out. Like everything else, you'll find them "right on the money."

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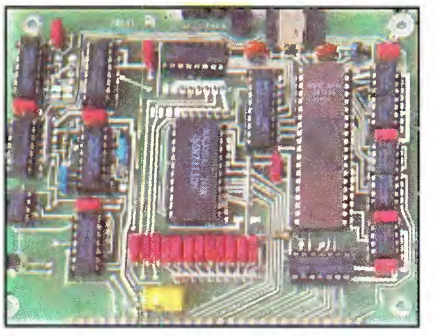

Wait just a second

By Andrew Dart

Almost every radio and TV station has at least one clock in the building that's right on time. The station's master clock usually is kept within a fraction of a second of the correct time, especially at radio and TV network affiliates. The object is to keep the station's clock in sync with the network's clock by referring to a national standard. Many people don't know, however, that even a highly accurate clock that has been carefully set and doesn't drift at all suddenly can appear to have jumped one second away from the correct time. This happens whenever there is a *leap second*.

Why adjust the time?

Since 1967, the official definition of one second has been tied to a resonant frequency characteristic of the cesium-133 atom. The time scale that is locked to this standard frequency is called Coordinated Universal Time (UTC). The cesium standard is far more precise than the rotational velocity of the Earth, so the duration of the day, measured on the UTC scale, isn't exactly 24 hours. Right now, it is 24 hours plus about 1ms.

The excess fraction of a second per day accumulates, and eventually, UTC is more than one-half second out of sync with astronomical time. When that happens, an extra second must be inserted into the UTC time scale, so for one time only, the last minute of the month is 61 seconds long. The leap second isn't required every year, because the duration of the day (that is, the rotational velocity of the Earth) fluctuates for various reasons. The most recent leap second was added to the last UTC minute of 1987.

Dart operates a time and calibration company in Duncanville, TX.

The decision to insert a leap second is made by the International Earth Rotation Service in Paris. The organization notifies timekeeping laboratories all over the world when a leap second needs to be inserted, so the adjustment is made worldwide at the same time.

In reality, the job of an atomic clock is to mark uniform seconds, and a counter or computer numbers those seconds from 00:00:00 to 23:59:59. In the event of a leap second, the counter is allowed to count up to 23:59:60 before carrying over the 00:00:00 the next day. The atomic clocks aren't stopped or slowed down at all; only the numbering of the seconds changes.

When does it really happen?

You might think that leap seconds occur at midnight, local time, all over the world, but they occur only at 23:59:60 UTC, which is long before midnight in the United States. (See Table 1.) Therefore, to make an accurate countdown to the new year at midnight, you should set your clock sometime on the evening of Dec. 31, after the leap second has been inserted.

This raises the question of whether the people at the TV and radio networks will abide strictly by UTC or wait until the early hours of Jan. 1, 1990, to adjust their clocks. In some cases, the network switching is done by computers, and to tamper with the computer's clock during prime time could be disastrous. The network technicians probably will wait until after midnight to adjust the master clocks. In that case, it is more important for the affiliates' clocks to be in sync with the networks' clocks than with WWV.

Observation of the leap second

To really appreciate that such a thing as a 61-second minute exists, it's helpful to tune in to one of the standard time stations on a shortwave radio, on any of several frequencies:

- WWV (Colorado) 2.5, 5, 10, 15 or 20MHz
- WWVH (Hawaii) 2.5, 5, 10 or 15MHz
- CHU (Ontario) 3.33, 7.335 or 14.67MHz

When listening for the leap second on one of these broadcasts, watch a clock or stopwatch, because the difference between a 61-second minute and a 60-second minute is almost impossible to hear.

Almost the same precision can be attained on the phone at one of these numbers:

- WWV: 303-499-7111
- WWVH: 808-335-4363
- CHU: 613-745-1576 (English)
- 613-745-9426 (French)
- U.S. Naval Observatory Master Clock: 900-410-8463 or 202-653-1800

The correct time also is available to your computer at 300 baud or 1,200 baud by having your modem dial 303-494-4774 (NIST) or 202-653-0351 (USNO).

The result is that on the evening of Dec. 31, 1989, the correct and official time of day will be adjusted by exactly one second. If your station's master clock is exactly on time that afternoon and you make no adjustment, it will be one second fast that night because of the leap second inserted into the UTC time scale. Even so, network affiliates may not consider that a problem until the next day.

UTC, also known as Zulu or Greenwich Mean Time	**23:59:60, or about midnight.**
Eastern Standard Time	**18:59:60, or about 7 p.m.**
Central Standard Time	**17:59:60, or about 6 p.m.**
Mountain Standard Time	**16:59:60, or about 5 p.m.**
Pacific Standard Time	**15:59:60, or about 4 p.m.**
Alaska-Hawaii Standard Time	**13:59:60, or about 2 p.m.**

If the leap second occurred at the end of June, most states would be on daylight-saving time, so these times would have to be adjusted accordingly.

Table 1. *The leap second will occur at these times. Because of the different time zones, not everyone will need to adjust their clocks at midnight.*

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Technology forecast for 1990s

New technology is the brass ring of the '90s. Grab it.

Status quo once was described as Latin for *the mess we're in*. Well, broadcasting has endured the status quo for too many years. Lower budgets, smaller profits, higher costs and larger debts all are facts of life for broadcasters. Those who long for less competition and higher profit margins may have to wait awhile.

On one hand, new technology can increase competition. Witness the expansion of LPTV, translators, short-spaced stations and expanded cable and satellite services. On the other hand, the same electronic technology has made it possible for broadcasters to operate more efficiently and reliably than ever before. This means that although technology can make it harder to survive, it also offers new opportunities for growth and higher profits.

One problem with any new technology is that it costs money. GMs often are reluctant to implement the technology unless they can see a likelihood of recovering the investment and improving profits. This is where the engineer comes in.

Today's broadcast engineers are the ones who understand best how to apply these new fascinating technologies within their stations. But are they up to the task? After all, for years, they've been left to their workshops, and there has been little impetus to bring them into the management circle. Technology is forcing a change.

The **BE** surveys for the past five years reflect an increased concern about the profitability of broadcast properties. That's no surprise, but it may be surprising that engineers are showing a keen awareness of the industry as well as the financial picture at their own stations.

Recent surveys show that broadcast engineering professionals understand a lot more about the financial operations of their stations than they're being given credit for. Research indicates that engineers are not only attuned to today's financial marketplace, but also have some concrete ideas on how to improve the bottom line at their stations.

Simply replacing people with equipment is not the answer. However, even engineers recognize the importance of using people more effectively. How well a station balances this dichotomy of people vs. equipment determines, to a great extent, its long-term financial success.

The engineer will play a large part in determining how effectively the new ideas are implemented. Identical systems can be installed in several different ways, and that may mean the difference between profit or loss for the station.

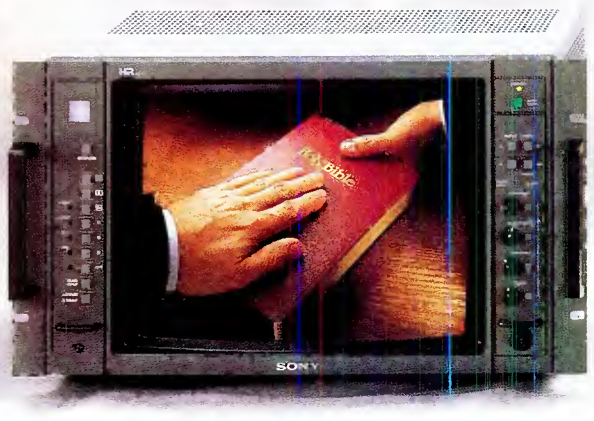
The new broadcast technology places new demands on station operators and engineers. Either both parties will succeed or both will fail. It's not a case of the station winning and the engineer losing. Nor will the reverse happen. Stations cannot operate successfully without adequate engineering talent. Likewise, the engineer wins when the station profits from the proper application of new ideas.

Broadcasting never will return to the days of old, and engineers who long for it to step backward will be disappointed. The old Chinese proverb, "May you live in interesting times," certainly applies to broadcasting.

If you enjoy the challenges of new ideas such as HDTV, digital transmission and storage systems and automation, stay with us. We're in for a fantastic voyage.

Brad Dick

Brad Dick, issue editor



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BROADCAST PRODUCTS

State-of-the-industry report

By Brad Dick, technical editor

It's glum news for television, and radio holds on as equipment budgets dwindle for many markets.

Last year it looked as though the tough times were almost over for TV equipment budgets. In fact, the optimism of the situation was captured by the symbolism of a light at the end of the tunnel. Budgets were up, and better times looked to be ahead. Well, the worm has turned for 1990. When it comes to equipment budgets, TV spending plans are down and radio spending plans are less volatile.

Figure 1 shows the percentage of respondents by market category with plans to upgrade their facilities. Overall, eight of the 11 measured categories show fewer stations planning upgrades.

Not every category looks bleak. However, combined with other factors, they raise the specter of continued softness in the broadcast equipment marketplace.

The survey

The **BE** annual state-of-the-industry survey is the second of a 2-part overview of trends and conditions within broadcasting. The results of the first half of the project, the annual salary survey, were contained in the October issue. That article looked at salaries and benefits paid to radio and TV management, engineering and operations personnel. The state-of-the-industry survey completes the task by providing an overview of purchasing and budgeting plans.

The survey was scientifically conducted by the marketing research department of Intertec Publishing, under the direction of Vicki Kerns-Vall. On Aug. 25, 1,750 questionnaires were mailed to **BE** subscribers on an "nth name" basis. By Sept. 25, 465 completed questionnaires had been received, representing a response rate of 26.6%. The data contained within this report is based on those responses.

TV plans

Last year's survey showed three of four market categories with higher percentages of stations planning to upgrade their facilities. This year, the same comparison shows four of five markets with a decrease. Measured overall, the number of stations planning upgrades fell from 87.6% to 80.5%. Each of the four market categories shows approximately a 10% decrease in the number of stations planning upgrades. The TV upgrade plans over the period from 1987 to 1990 are shown in Figure 2.

Only one category, the top 100 markets, shows an increase in the number of stations planning to upgrade facilities. There, the number of stations planning upgrades

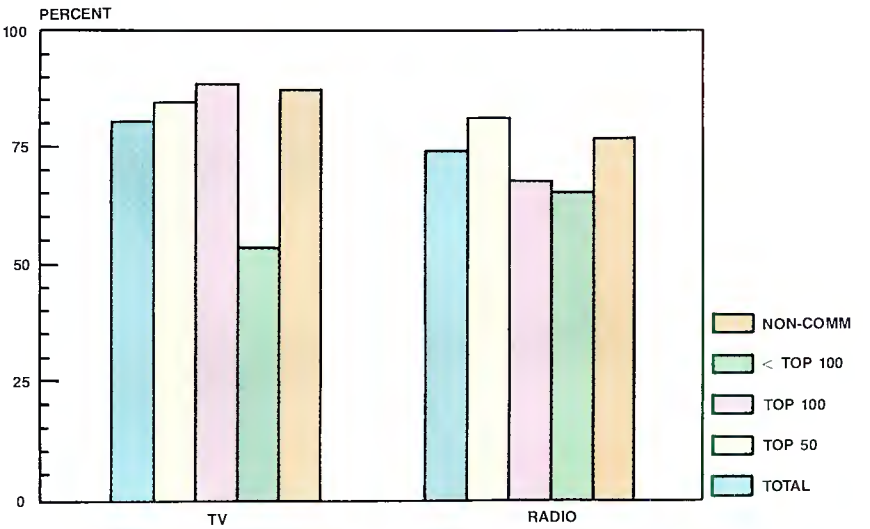


Figure 1. The overall percentage of broadcast stations planning to upgrade facilities in 1990.

Harris Technology in Action

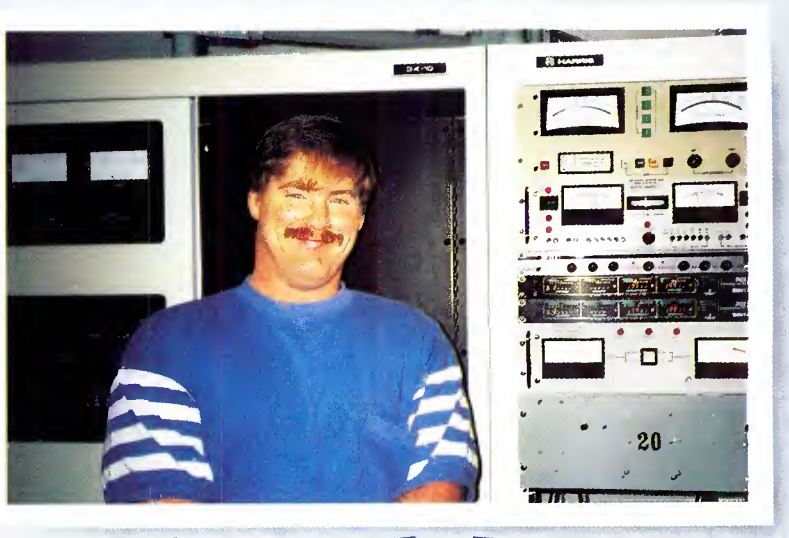
"We're burning up every other AM in the market with our new DX10."

WSEA AM serves the Delmarva region and South Jersey from Georgetown, Delaware. They recently acquired a 10 kW day/1 kW night directional authorization, a Harris DX 10 digitally modulated solid state AM transmitter—and a new Corporate Chief Engineer, Terry Dalton. "By the time WSEA's owner Great Scott Broadcasting hired me," Terry recalls, "they had already decided on the Harris. I could understand that, since the fifteen year old Gates at WSEA still passes its proof of performance tests. But I needed to be sold on the new Harris transmitter. I'd heard about the DX series' all-solid-state design and its digital modulation, but I didn't expect them to make much difference."

Terry ran his DX 10 into a dummy load at full power continuously for six weeks before putting it on the air. "I was ready to jump on the slightest malfunction," he admits, "but I couldn't find anything. That kind of stability and reliability was one thing that turned my head around.

On the road... OR AT HOME, DX PERFORMANCE IS AUDIBLY SUPERIOR.

The other was performance—in A/B comparisons we ran with the old Gates, the two signals were like day and night. We had NRSC-2 pre-emphasis on both and an Optimod® 9000 with the high end cranked all the way up on the Gates—but the Harris DX was still cleaner and brighter. The low end from the DX 10 was tight and punchy, with none of the old transmitter's boominess."



Chief Engineer Terry Dalton... AND "THE BLOWTORCH" WSEA'S NEW HARRIS DX 10 DIGITALLY MODULATED AM TRANSMITTER.

When WSEA finally put their new DX 10 on the air, they did it with no announcements at all. "That very first day," Terry reports, "we got calls from people picking us up in places where they never could before. Others commented on how much better we were sounding, even on car radios. We were still running 1 kW under our old non-directional authorization. But we were burning up every other AM in the market, including some that put out an audibly overmodulated signal. Our sales department immediately named this new DX 10 'The Blowtorch'."

Terry verified the DX 10's increased coverage personally on a drive to New Jersey. "I used to lose WSEA around Cape May," he says. "This last time, the signal stayed clear all the way to Atlantic City—a 35 mile increase in range without any more power.

Measurements showed me why we're getting out so much further now. The asymmetrics are incredible: I'm running 98/9% negative peaks and 119% positive, with absolutely no distortion or splatter. In tests, I've taken the positive peaks even higher, and it stays clean. Digital modulation and solid state circuitry make a real difference."

"I was ready to find things wrong with the DX 10," Terry admits, "But its performance and reliability have me 100% sold. As far as I'm concerned, any new Great Scott Broadcasting AM stations will have Harris DX transmitters."

We're glad the DX 10 won Terry Dalton over. It shows that DX transmitters are doing everything we expected of them. After all, real innovations should make a difference in the real world.

If you'd like more information on DX series AM transmitters from 10 to 50 kW*, call (217) 222-8200, Ext. 3408. If outside the continental US, fax your request to (217) 224-2764. And for studio equipment to take full advantage of DX transmitter performance, call Allied Broadcast Equipment at (800) 622-0022.

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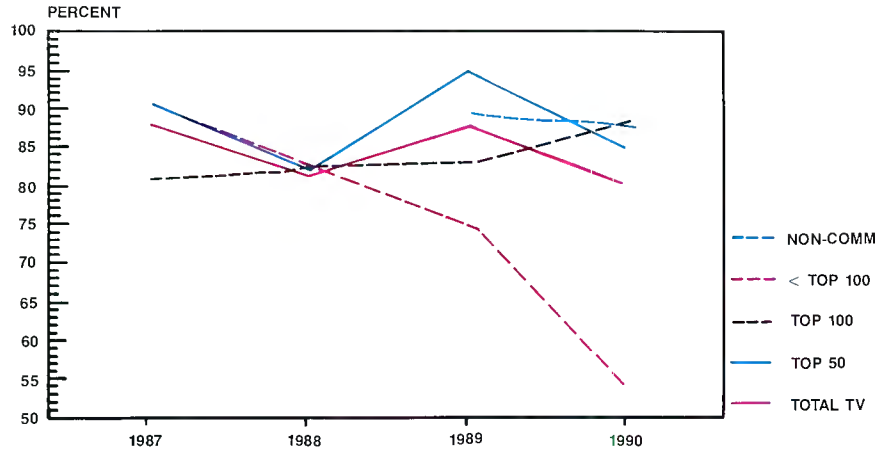

Figure 2. *The percentage of TV stations planning upgrades in 1990 is down in four of five market categories. In some cases, the number of stations planning modernization is lower than any period since 1987.*

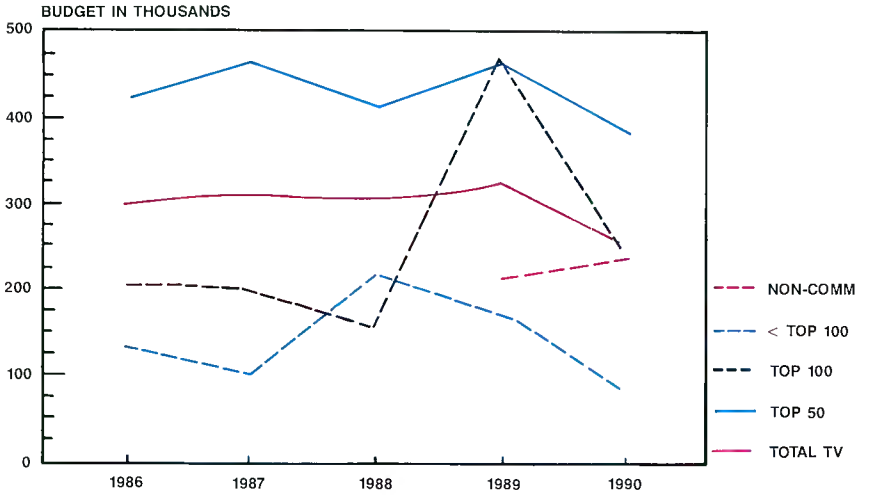

Figure 3. *Four of five market categories show reduced equipment budgets for 1990. The non-commercial stations' median estimated budgets grew by 10%.*

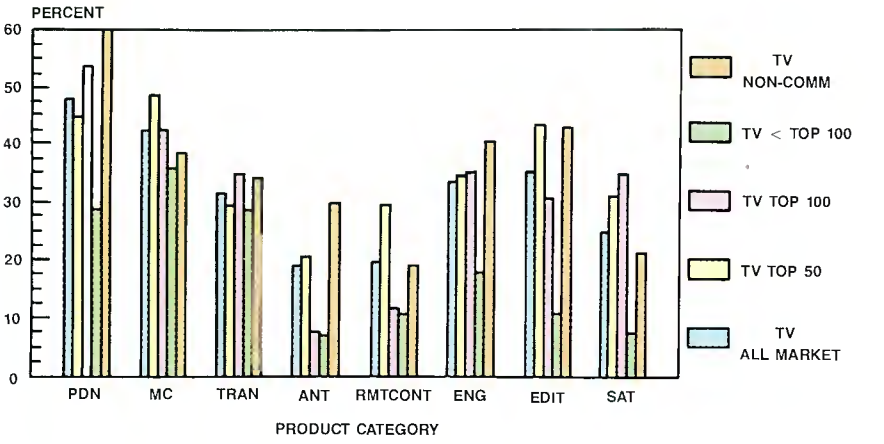

Figure 4. *Planned spending by TV stations, broken down by market size and equipment category. The graph is based on the overall survey data.*

increased from 82.5% to 88.5%. That category also shows the highest percentage of stations (either radio or television) planning upgrades.

TV budgets

Paralleling these results, four of the five TV market categories show a decrease in planned equipment budgets. Only the non-commercial TV station budgets are larger than they were last year. All results are based on estimated medians, which were developed from survey responses. Equipment budgets for 1990 have been cut by as much as 22% from 1989 levels. The estimated median equipment budget in the top 50 markets fell from $460,000 to $380,000, a drop of 17.4%.

Perhaps the most significant trend showed up in the "total TV" median budget. Until this year, that category had been relatively constant, as shown in Figure 3. For 1990, however, it fell almost 23%. In that category, the estimated median equipment budget dropped from $320,000 to $247,400.

One bright spot is the budget for non-commercial stations, which shows an increase from $221,000 to $233,000, or 10%.

What to buy?

The equipment spending plans for television are summarized in Figure 4. The graph shows the overall spending plans based on the entire surveyed population. Each market category is shown, along with the eight equipment categories. The graph shows that the type of equipment needed varies greatly among markets. The TV market is much less uniform than radio, as you'll see.

The data also shows the relative importance that engineering personnel place on acquiring the different types of equipment. The graph shows that about as many stations want to purchase production equipment as master-control equipment. Likewise, an equal number of stations plan on purchasing ENG-type equipment and editing equipment.

Radio plans

As almost every **BE** salary survey in the past has shown, the major shifts in purchasing plans and salaries evident in television are not present in radio. Figure 5 tracks the percentage of radio stations planning to purchase equipment over the period from 1987 to 1990.

The graph shows that in three of five categories, fewer stations are planning equipment upgrades in 1990. The drop in the percentage of stations planning upgrades ranges from 1.7% to 10%.

Two categories, top 50 and non-commercial, show an increase in the number of radio stations planning to purchase equipment. The top 50 market increased a mere 0.6%, and the non-commercial category increased by 4.6%. That's good news because the budgets for non-commercial stations also are up.

Radio budgets

An optimistic note for radio is that budgets are up in three of the five categories, and by significant amounts. Radio equipment budgets for the period from 1986 to

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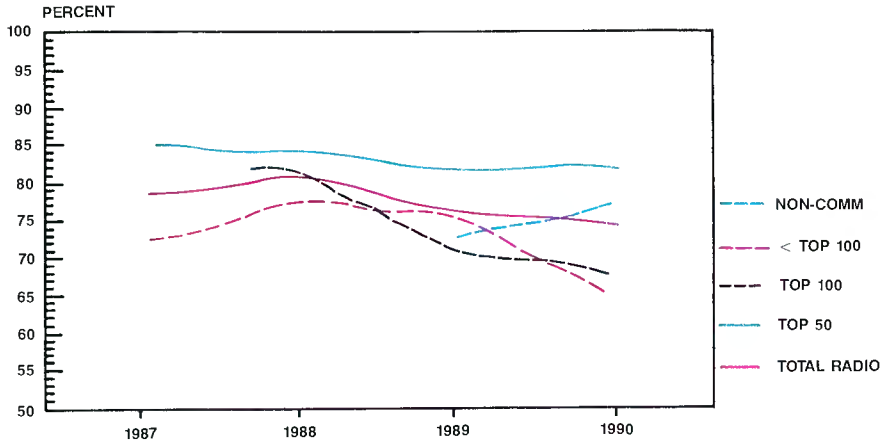

Figure 5. The percentage of radio stations planning equipment upgrades for the period from 1987 to 1990. Three of the five market categories show a reduction from last year in the number of stations planning upgrades.

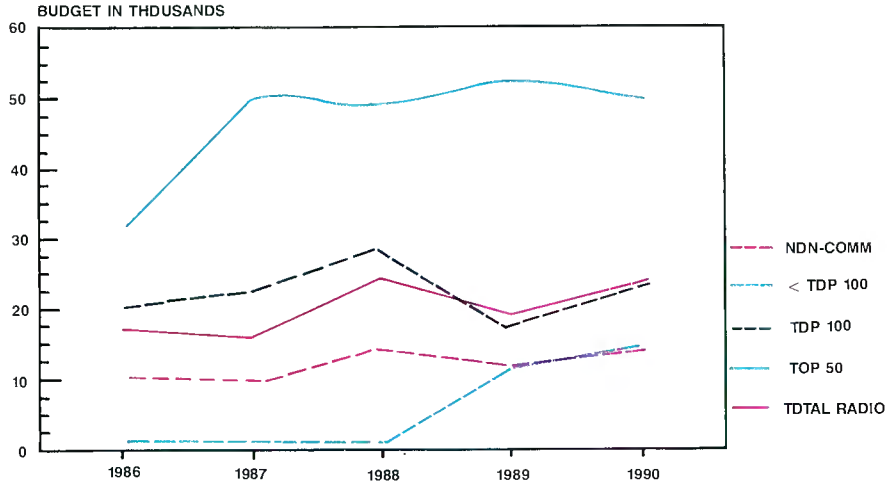

Figure 6. Radio station median estimated budgets are up in three of the five categories. The good news is that in the two categories showing reductions, the decreases are small.

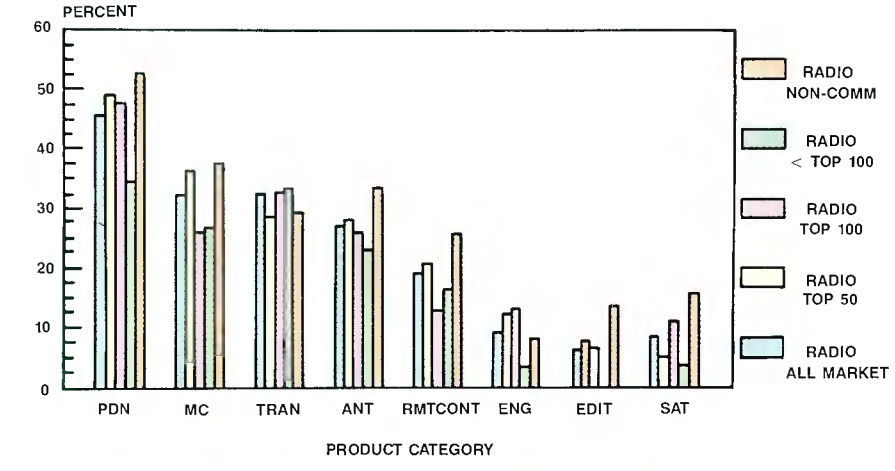

Figure 7. Planned spending by radio stations, broken down by market size and equipment category. The graph is based on overall survey data.

1990 are shown in Figure 6. Measured over all markets, the median estimated radio equipment budget is up 28.5%, from $17,900 to $23,000. This increase offsets the loss in this category last year of −23.8%. These stations' budgets finally have returned to where they were in 1988.

Other good news for spending is that the below top 100 market median estimated budgets are up from $11,200 to $13,300, or 19.3%. The non-commercial stations' budgets are up by a similar amount, from $10,700 to $12,800, or 19.6%.

Although two radio categories show losses, they are small losses. The top 50 market median estimated budget fell from $52,000 to $49,900, a 4% drop. The top 100 market median estimated budget fell from $17,100 to $17,00, or 0.6%. These are minor changes, certainly nothing like what happened in television.

Purchased radio equipment

The planned equipment purchases by radio stations are summarized in Figure 7. The graph shows the type of equipment being planned by each sampled population. Each category of equipment is listed by market category. There is a similarity in the relative importance attached to each equipment category by each market. The similarity between desired types of equipment and market size is much stronger in radio than in television.

Radio stations indicate a stronger need for production equipment than any of the other seven types of equipment. Transmitters and antennas are similarly in demand, as is ENG, editing and satellite equipment.

Staff size

It's no secret that the size of technical staffs has been falling for several years. This year's survey confirms that trend, as shown in Figure 8.

The TV station staffs are, of course, larger than radio station staffs. The unfortunate fact shown by the chart is the dramatic fall in TV staffs over the past three years.

The median-size TV staff was 18.8 persons in 1986. This fell to 14.7 in 1987 and 13.7 in 1988. This year, the median TV station engineering staff is 11 people, representing a 20% reduction in size in only one year.

Radio stations also saw a reduction in staff size. The median radio station engineering staff size was 2.7 in 1986. It fell to 2.4 in 1987 and to 2.3 in 1988. This year, the median radio station engineering staff is 2.0 persons. This is a 26% reduction over a 4-year period. Non-commercial stations show the same median number of engineers.

A large number (67.9%) of the radio stations have two or fewer technical people on staff. About 20% of the radio stations have between three and four. The num-

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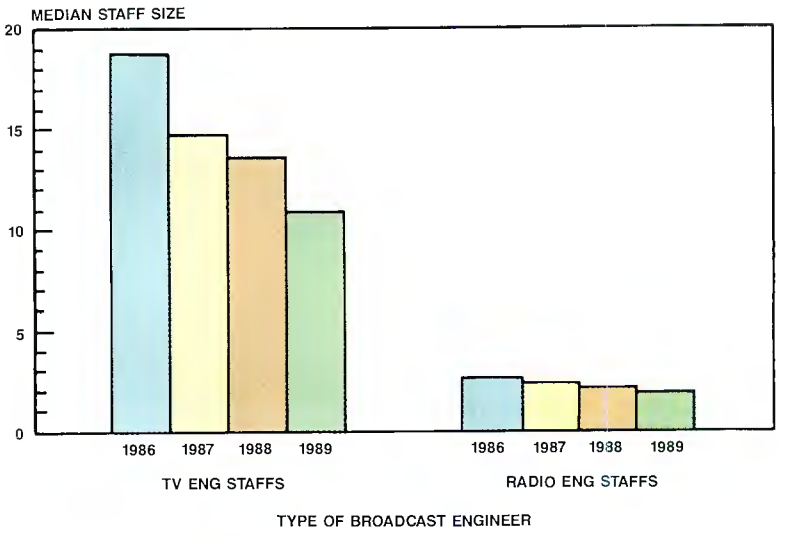

Figure 8. The median number of engineers at both TV and radio stations is decreasing steadily. The TV engineering staffs have suffered large losses, but percentage-wise, radio fared even worse with a 26% reduction over the 4-year period.

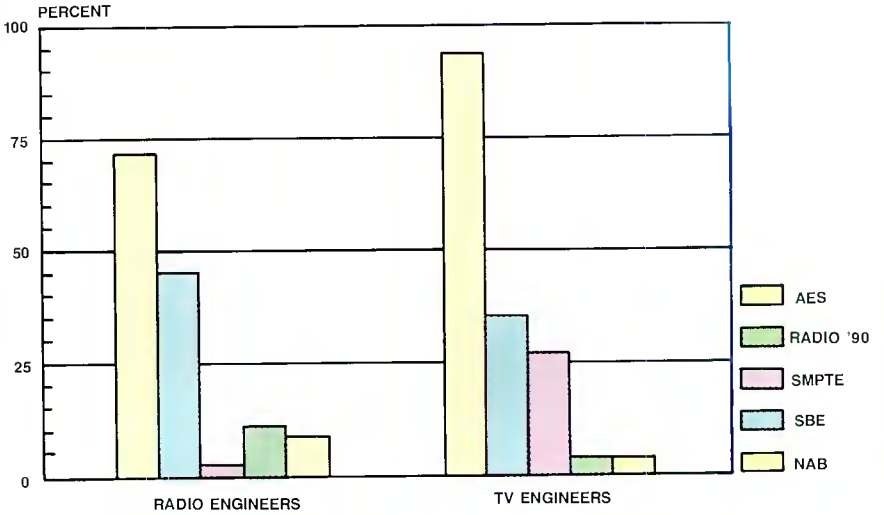

Figure 9. Of those planning convention attendance, 71.9% of the radio engineers and 93.5% of the TV engineers intend to go to the NAB convention. The SBE show is the second most popular convention, with 45.4% of the radio and 35.5% of the TV engineers planning attendance.

ber of stations employing five or more technical people is extremely small.

TV stations require larger staffs. Approximately 23% of the TV stations employ between 10 and 24 technical people. More respondents fell into this category of staff size than any other. Equal percentages (16.5%) of the stations employ between five and nine or between 25 and 50 people.

Non-commercial TV stations operate with even fewer engineers. The median staff size here is only nine. This is down from 11.4 last year. This represents a significant drop (21%) in only a 1-year period.

Convention attendance

Conventions continue to be an important part of an engineer's training. Figure 9 is based on the responses of those who indicated plans to attend one or more conventions. The chart shows the relative popularity of each of the shows with broadcast engineers.

A major show for both radio and TV engineers continues to be the NAB convention. Of those planning to attend, about 72% of the radio and 94% of the TV respondents said they would attend NAB. The SBE convention is the second most popular convention, with 45.4% of the radio respondents and 35.5% of the TV respondents planning to attend. Beginning in 1988, planned attendance of the SBE convention by TV engineers exceeded planned attendance of the SMPTE convention.

Figures 10 and 11 show some interesting trends in planned convention atten-

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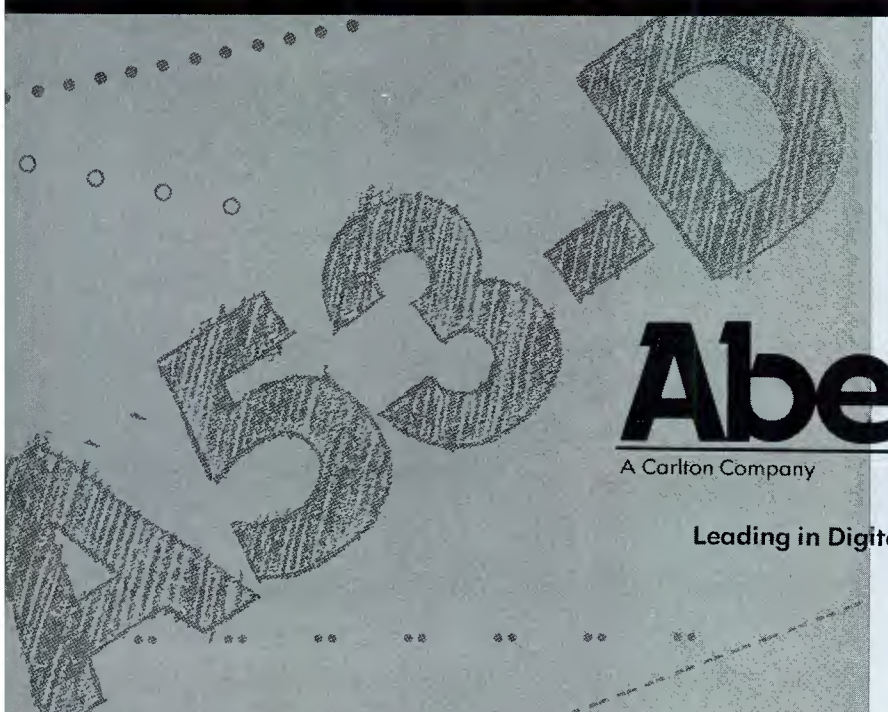

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Continued from page 32

dance. The history of planned attendance for radio engineers is shown in Figure 10. Both the NAB and SBE conventions showed a decrease in planned attendance last year. This parallels the budget reductions and staff cutbacks outlined previously. The data for TV engineers is shown in Figure 11.

The percentage of radio respondents who plan to attend the NAB show has fallen for two of the past three years. Although planned attendance of the convention by radio respondents is up by about 2% for 1990, this is still below the high of 39.2% seen in 1987.

Radio '90, NAB's fall radio show, continues to decrease in popularity with engineers. For 1987, 7.6% of the survey respondents planned to attend the show. That figure fell to 7.2% last year. This year, only 5.9% of the radio and 2.5% of the TV respondents plan to attend Radio '90.

The SBE convention continues to show strong growth. Of those respondents planning to attend any convention, more than 45% of the radio respondents and 35.5% of the TV respondents plan on going to the SBE show. For the second year running, except for NAB, more respondents plan to attend the SBE convention than any other.

Survey comments

Reading the survey comments is always enlightening. Based on some of the comments, you might think that the world was coming to an end. Fortunately, there were interspersed enough positive statements to counter the pessimism.

The survey comments were broken down into 11 categories, according to the common elements they contained. The responses then were tabulated according to the predominant theme. Once the tally was complete, six areas emerged as the most often-mentioned.

The most common complaint was about the poor quality of the AM broadcast signal. Blame was placed on the FCC, receiver manufacturers, the lack of a stereo standard and owners who will not invest in AM radio's future. Approximately 22% of the tallied comments fell into this category.

The next most common complaint was about increased competition. Engineers have increasingly been aware of how competition affects their stations. It was enlightening to see engineers summarize succinctly the problems created for broadcasters by cable, CDs, satellites and alternative delivery systems. About 18% of the comments fell into this category.

For the first time, the FCC had some competition in terms of being classified as the "bad guys." Tied in with the FCC was the often-mentioned "greed factor." A total of 14% of the comments mentioned greed on the part of the station owners as being a major problem for the broadcast industry. The phrase was used so often that it might qualify as a new broadcast term.

The other two most often-mentioned areas were HDTV (11%) and people problems (15%). TV engineers are quite concerned about how HDTV will affect their stations. Many are afraid that terrestrial broadcasting will be dealt a back-seat position by regulators. The problems with implementing HDTV technology also were mentioned often.

Most of those who cited people problems also discussed the difficulty in staying current with technology. Engineers want to do a good job, and it becomes even more difficult when stations don't provide travel and training budgets. Engineers wrote of having to repair equipment without adequate training. They also complained about being forced to perform more tasks with fewer people. Continued staff reductions were a common complaint.

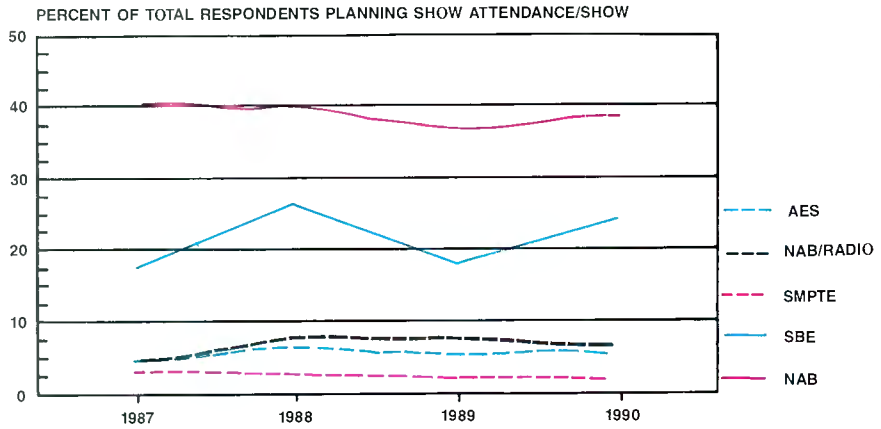

Figure 10. The 4-year trend of convention attendance for radio engineers. The SBE convention showed the largest percentage gain in planned attendance, a 50% increase.

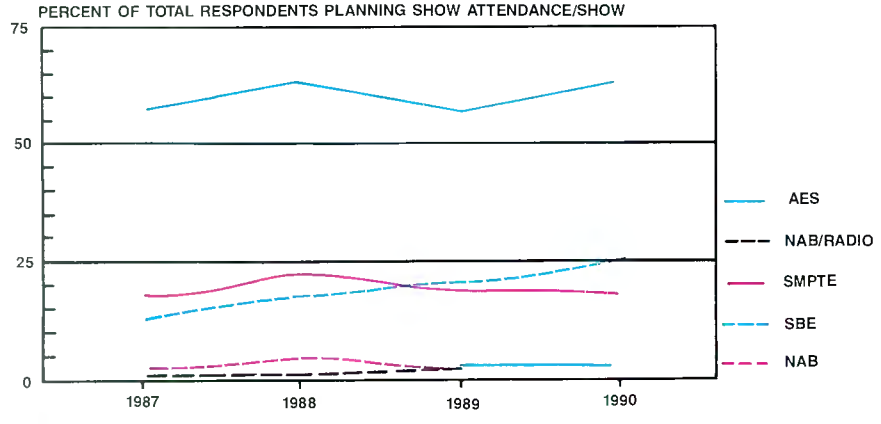

Figure 11. A high percentage of TV engineers continue to attend the NAB show. SBE convention attendance by TV engineers has grown steadily from 1987. Planned attendance by TV engineers at the SBE convention in 1990 is up by 87%, compared with 1987 levels.

Future opportunities

Surveys often elicit complaints from those who want to return to the "good old days." Well, it's true, broadcast engineering isn't what it used to be. But so what?

Maybe it's just that broadcasting finally has matured to the point at which it's more like other businesses, and that's not necessarily bad. Sure, there have been shakeouts, and some of the changes have been painful. Many would agree that the pendulum of deregulation has swung too far away from center. However, there are signs that a change is in the offing. Even so, broadcasting never will be the straight-laced, microregulated industry it once was. If you're waiting around for federal regulators to tell you how to do your job, you're wasting your time.

The challenges faced by broadcasters today are perhaps greater than ever before. The reason is that our problems are no longer strictly technology-based. The issues are economic, social and political. After all, if the problems with this industry were only technical, we'd already have them fixed.

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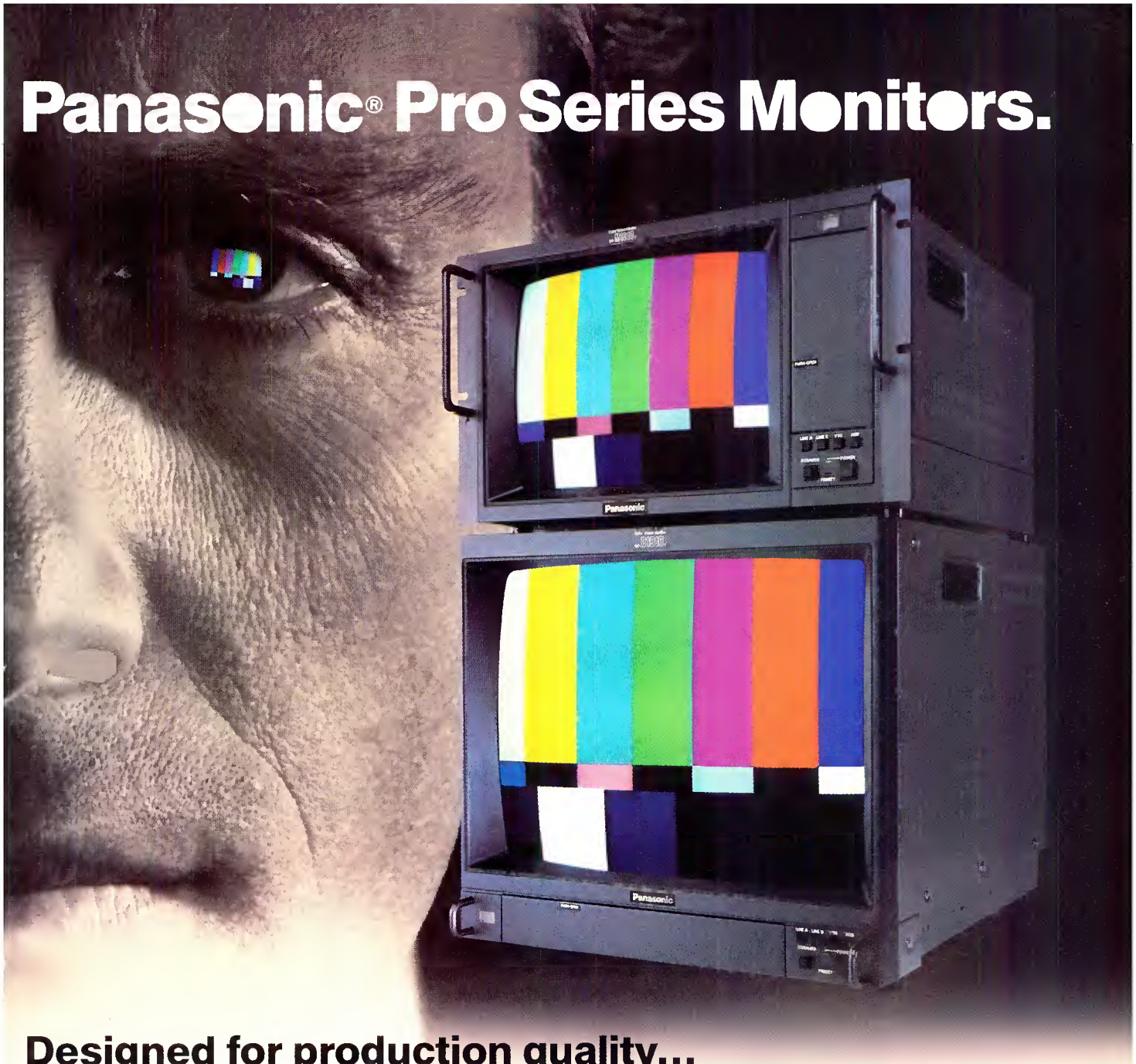

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View from the top

By Brad Dick and Rick Lehtinen,
technical editors

What does the United States want out of HDTV, and what are the telcos after?

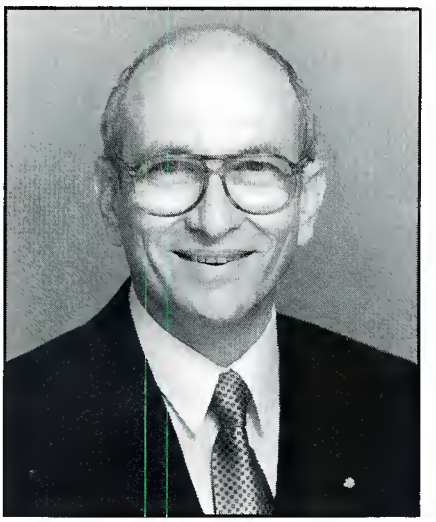
If you want to know what you can see from the top of a tower, climb one. The view from the top can be exhilarating. From up high, you get a clearer look at what is happening in the surrounding countryside.

Each year, to help you understand trends in the industry, **BE** staffers interview leaders in the field of broadcasting, obtaining their views on the issues that are shaping the future of our industry. An issue very much on the minds of today's broadcasters is the implementation of HDTV, and what role the telephone and cable companies will play in getting the signals to the home. Accordingly, Rick Lehtinen, TV technical editor, was dispatched to the Advanced Television Systems Committee (ATSC) offices in Washington, DC, where he visited James McKinney, chairman of the ATSC. Brad Dick, radio technical editor, also went to Washington. He met with Raymond Smith, chairman of Bell Atlantic Corporation.

James C. McKinney

McKinney, ATSC chairman, began his career as a broadcast engineer by working at a radio station during college. He joined the FCC in 1963, and over the next 26 years served in several positions, including head of the Field Operations Bureau, the Private Radio Bureau and the Mass Media Bureau. McKinney is a Fellow in both the Society of Broadcast Engineers (SBE) and in the Institute of Electrical and Electronics Engineers (IEEE).

Q: *Our country is in the throes of deciding on an HDTV system. There will be some tests and, at some point, the FCC will pound the gavel and announce a system of choice. Is that correct?*



James McKinney, chairman of the Advanced Television Systems Committee (ATSC).

A: Yes, that is correct, and the best guess is that will occur in either 1992 or 1993. You can then assume that it will take about two years to get a good supply of equipment into the hands of both broadcasters and consumers, so my guess is that the earliest we will have to deal with HDTV on an affiliate or local station level is about 1995.

As I see it, it looks like we are headed toward a simulcast HDTV system. I don't see us stopping at simply an "improved NTSC" system, and, augmentation is too complicated. With simulcast, you broadcast a separate HDTV channel, which will be 6MHz wide. Then you have a TV system that is analogous to AM/FM radio. There will be NTSC/ATSC TV sets...etc.

Q: *To help the FCC make its decision, is there a point at which the industry can say, "Here is the decision you ought to make (and) let's think about these things?" Is that the function of ATSC?*

A: ATSC serves a coordinating role. We have about 50 member corporations, including all the major aspects of the television industry — all the networks, all the associations here in Washington, NAB, AMST and so on. We include all of the major equipment manufacturers. We have the Motion Picture Association of America. We have educational institutions like MIT. Our role is to try to bring all of those diverse opinions together into a single position. Sooner or later, when the FCC makes the decision, they'll need to have unanimity or virtual unanimity in order to have a politically acceptable decision.

An example of where the FCC decided not to decide is AM stereo. There were several systems vying, and two leading, at a point late in the decision-making process. Because there was a widely diverse opinion, the FCC simply could not bring itself to make a decision, and they "left it to the marketplace."

But let me give you a reverse situation, where the FCC did have unanimity. With MTS — multichannel television sound — the industry got together, worked itself into a lather over a period of years and,

Continued on page 42

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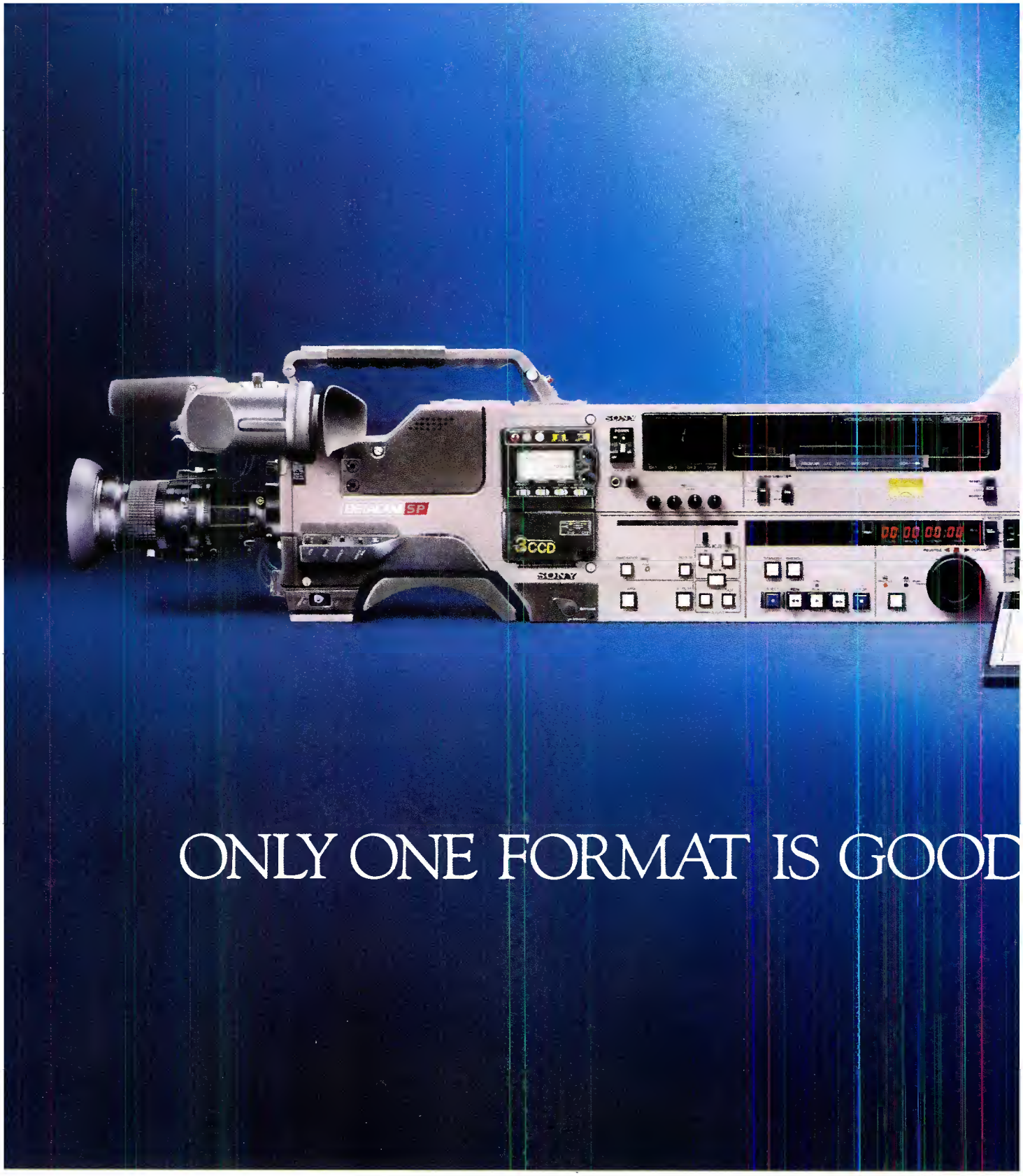

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at the very end, took two votes. The first vote had some division. The second vote was unanimous. They presented that to the FCC, and the FCC said, "Great, let's do a standard!" And it was done.

***Q:** What other voices will be talking to the FCC about the HDTV matter?*

A: The FCC has a group of its own, called the FCC Advisory Committee. I serve on that committee and try to bring in the perspective of the private sector. Also on that committee are members of the U.S. television industry, some other government agencies like the Department of Commerce, the Department of Defense, telephone companies, fiber-optic cable companies, satellite companies and cable operators.

The FCC has many people that it needs to listen to, but I would tell you that HDTV is first and foremost a television business. Television is really the business at hand, and the FCC decision-making process is solely aimed at television.

***Q:** It seems that when committees get busy and propose something, you sometimes end up with camels. What will keep us from walking into a similar bottleneck with HDTV?*

A: There are always pros and cons to standard-setting. The dynamic, positive aspect of setting a standard is that it gives some confirmation to people like broadcasters to go out and invest money in a new technology. It also gives confirmation to equipment manufacturers to put R&D money into the equipment, build their prototypes, put in an assembly line and start cranking out equipment. In many cases, new technology simply will not get off the ground unless a standard is set.

On the other side of the issue, standard-setting, if...not very carefully done, can freeze technology at whatever level it is the day that standard is selected.

I see at the FCC a great understanding that there has got to be headroom in the standard, there has got to be flexibility. Perhaps the new standard will even have sunset provisions. Had we set the standard for multichannel sound for 10 years, we would have been just as successful, and people would have bought the sets anyway.

***Q:** There are some voices who would say that we should not fool with HDTV, but wait for a digital standard.*

A: Yes, I have heard those arguments repeatedly, usually from people who don't understand television. I usually hear them in congressional testimony.

Well, that could be done. The United States government could say to the American public, "You can't have HDTV right now. Europe is going to have it, Japan is going to have it, the rest of the world is going to have it, but we're not going to give it to you, because we choose to leapfrog technology. Therefore, we are going to withhold it from you until the digital technology has been developed."

Now, we have to understand that we don't have a digital standard, we don't have the digital equipment, and we haven't done the research and development necessary to build it yet, so best guess is we're looking 20 years-plus down the road before we have full digital television.

In the interim, there is nothing to prevent a manufacturer in Japan, Europe or elsewhere from shipping to the United States a boatload of wide-aspect-ratio television sets, operating at twice the present resolution with built-in tape recorders, and a supply of motion pictures and other software. People could buy these and put them in their homes, and if they do that, what's going to happen to the market share of the local television station (or) the local cable company, and so on? The answer is that they are all going to lose market share. And once that market share is lost, will it ever be regained?

***Q:** There are now nine proposed systems, advanced by seven proponents. What happens if someone else shows up?*

A: I'll tell you what I think would happen. There have got to be limits to the testing, or else it could go on forever, and so everyone's feet are going to be held to the fire. But if a fantastic new development becomes apparent, we certainly wouldn't close our eyes and walk away. So I'd say the opening is there. I don't see any dramatic new systems on the horizon, but who knows? There might be one out there that has not been made known yet.

I also think you shouldn't overlook the possibility that before this testing process is over, we may see many of those nine proposed systems coming together to give you the ultimate combination system. That would really win the day.

***Q:** Who will spend their money first, the local stations or the consumers that watch them?*

A: We'll have that chicken-and-egg situation that we always have with new technology. Does the broadcaster initiate it? Or does the broadcaster wait until the viewers have sets in the home, and demand it? We've seen this situation before, with color television. Some of the networks were anxious to do color, but the local stations weren't. Stations wanted to wait until there was a reasonable number of people clamoring for it.

***Q:** Are broadcasters looking beyond the mark by talking about an HDTV standard when we still have a great deal we could do to clean up and improve NTSC?*

A: I guess we are trying to do both. We certainly have all of the right forces concentrating at this time on the issue of better television pictures, and since we've got that critical mass established in Washington and laboratories around the country, everybody is trying to get the most out of those experts. For instance, ATSC technology groups are looking at some NTSC improvements like ghost canceling. We've sent letters out to all the companies that we think have systems, and to companies that we don't know whether they do or not, asking them to send us their system's technical specifications.

***Q:** How does the phone company fit into all of this?*

A: The phone company would like to fit into this a lot. But I have yet to see a telephone company want to enter the production side of the business. They are not really interested in having studios and hiring Hollywood to produce films, and so on. They are more interested in getting into the distribution side of the business and going head to head with cable television. They have lots of problems though, not the least of which is a judge named Harold Green here in Washington, who isn't quite ready to let them do everything they want to do in television distribution.

The issue centers around the cost of wiring the country with optical fiber and the huge capacity of fiber. Should telephone users pay the costs of building a fiber-optic system that can also be used to carry video? Or should the phone company be allowed into the video distribution industry, and use the proceeds to subsidize the phone business? A lot of the regulatory issues thought to be solved by the breakup of AT&T are now coming back around again.

***Q:** What about Eureka? If the United States is third to the table behind Europe and Japan, why aren't they beating our door down?*

A: I think they are beating our door down. I think both Europe and Japan know that the United States is their market. And without the U.S., they can't hit the critical number of TV sales to bring costs down.

Both Europe and Japan want us a lot, and we see that going on in the international forum constantly. Europe is trying desperately to convince the United States that its system is preferable. The biggest drawback to the European system, however, is the frame rate, so it's almost im-

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they would gain by such a trial, and what the conditions of such cooperation would be. So we've had feelers, but we haven't sat down at the table to write the specifications for such a trial.

Q: Has NAB president Eddie Fritts been cooperative in looking for common ground on which to talk?

A: He's not been uncooperative. This has not been an active attempt to find common ground to share information.

Q: Do you have any timetable for these talks?

A: We'd like to start something next year. First of all, it provides both of us with a great deal of information without specific commitment, and we begin to understand the needs of the other medium. If a future compromise is required, we'll then be able to speak the same language.

The primary purpose of the trial is to understand each other better, so we can avoid unnecessary confrontations, and so we'll be dealing with facts, not illusions or opinions. I think that's positive. I do believe that a number of members of the broadcast industry are convinced that that's what we're doing, that we are not trying to lure them into a disadvantageous agreement, but find common ground.

Raymond Smith, chairman of Bell Atlantic Corporation.

Q. Is there a fear of the BOCs entering this area?

A: Yes, there is concern that the BOCs are strong, entrenched companies that could provide unwelcome competition. There is also concern that such activity would diminish the value of the broadcaster's properties. Our position is that common ground can be found so that the total market can expand. It's not a zero sum game. It can be a win-win situation, if it's structured properly. As a common carrier, we're obligated to provide carriage to each and every individual service that wants in, and we will continue to be obligated to do that.

Q: How can the market expand simply because you enter the area?

A: The market will expand enormously when we bring fiber into the home. The content that broadcasters have today can be used more and more, and they can get into new fields and provide new products that they can't provide today.

In other words, through the opening of the broadband switched network either to the home or the curb, the broadcasters will be provided with additional market opportunities, yet to be completely defined. When that occurs, it will open new markets. It will provide competition to existing products and present opportunities

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for new kinds of joint ventures.

Q: When you mention joint ventures, who are you thinking about?

A: Between and among various members of the industry, cable, broadcasters, transport industries and producers. If you make the assumption that the broadband network will be installed at some point, and I believe that is a given, then it is to the advantage of all members of the industry to understand how they can capitalize on it. Let's learn about each other, and then, if this broadband network is deployed, we will know how it can be deployed so it's advantageous to all sides.

Q: Are you looking at ways you might supply programming?

A: We might have a joint venture with programmers. We're not going to get into content or the field of production, but we'd like to be able to joint venture. To have some equity, that's all we're asking for.

One of the things that will occur when the broadband network is deployed is that our core business will suddenly become much more competitive. Our secondary markets — "The Yellow Pages," publishing and special construction — are already completely competitive. Once the broadband network is in place, the basic residential network will become competitive, because over one fiber link you can have more than one local telephone service. If we're going to face competition in this area, then obviously the local telcos want the capability to get into other fields. We would be tremendously disadvantaged if we're prohibited from entering joint ventures with other people.

Q: What are the chances of Congress or Judge Greene lifting the current restrictions?

A: I believe the best chance for the restrictions (on the BOCs) being lifted is in the appeals court. The information restrictions placed on the BOCs were not based on evidence in the anti-trust trial and were applied after the fact. So we submit that we have the right to publish our own content under our First Amendment rights. There is not a great deal of optimism that Judge Greene will lift the restrictions on his own.

Q: If that's so, what other avenues are open to changing the regulations under which you must operate?

A: I think that Congress is concluding, slowly but surely, that the U.S. is being retarded substantially by the current policy. We now have the most important policy industry in the U.S. being dictated by one judge and one law clerk. Congress has not stepped up to its responsibility, and it recognizes that.

We used to go abroad and experience foreign telephone systems, and come home and bless Ma Bell. Today, people go to France and return to ask, "Why don't we have those services? Why is the French system better than ours?" It has come about because we're not permitted to improve our own telecommunications system.

The problem is that the U.S. telecommunications industry is restricted from entering into information services. It's not just frustrating — it's a bizarre and damaging situation. This is not a bread-and-butter issue, so mounting sufficient political momentum to bring about change will take time. The pressure will not come from the grass roots, but from the odious comparison with the technological advancements from abroad.

Q: How critical is HDTV to the implementation of fiber to the home network?

A: HDTV or some sort of advanced television will prove a tremendous draw to get broadband into the home. These very smart, computer-based TVs, with better displays, capable of accepting digital signals, will be in American homes underutilized until fiber is deployed.

The only way you can really capitalize on the computer-based TV set is to have fiber optics wired into the home. Some broadcasters feel we should accept a lesser solution, but I don't think that's going to be satisfactory to the American consumer or to American industry. A second-rate information or HDTV system for this country will not fly. The rest of the world will have HDTV that is delivered by fiber optics.

Q: Under that scenario, the terrestrial broadcasters would still be limited to some intermediate HDTV system. Would there be two kinds of HDTV signals coming from a station, one for off-air and one high quality to the cable input?

A: Yes, especially in remote areas where the deployment of fiber will take much longer. Certainly in large cities...it doesn't make any sense to have anything other than the best quality through fiber optics. There will be a combination of types of services for the next 25 years, but we'll have a very high percentage of the population wired long before that.

Q: The telephone company is used to charging for connect time, do you see that in the future with the broadband network?

A: I really can't predict what the terms would be; that's too specific. There are any number of terms that can be worked out and I don't preclude any plan in that regard. However, I'm not putting forth any plan either. Obviously, the transport system ultimately has to be paid for, but the costs of the actual carriage are very low.

Q: Which is the larger market for HDTV, home or industry?

A: The home consumer market will be the larger. The technology will allow a blurring of the two markets in the 21st century. A lot of people will be able to do their work at home using an HDTV terminal. The enabling factor will be the better picture. The use of HDTV will be to change the way we think and work.

Q: Why won't your industry deploy a broadband network today?

A: We can't put up the $500 billion or so required and open ourselves to competition for local telephone service, unless we're permitted into the other fields. Competitors would be able to sell electronic Yellow Pages with full-motion ads and specialized marketing that would diminish our own classified yellow pages. We would be opening up ourselves to severe competition, without being able to expand our lives or defend ourselves. The last-mile fiber-optic delivery system will be delayed years and years if BOCs are not permitted to participate in the full market.

Q: Why won't someone else, perhaps cable, up front the cost to implement the technology?

A: There are brand new monopoly cable systems being built today, and I'm not aware of a single one that is using fiber. It's a brand new technology, it's harder to install, with many levels of complexity. It's a massive investment. Besides, there is no desire by the cable companies to install fiber so another cable company could compete with them. They want to be able to deal with the broadcasters in any way they want.

Q: Do you have any parting shots?

A: I understand the concern, by the broadcasters, surrounding the entry of telephone companies into the program distribution business. They see our entry into the business as changing the industry, but the industry is going to change anyway. I'd like to reiterate our offer to work together to conduct trials to better understand where each of us stands. We may agree to disagree after a few years, but at least we owe it to each other and to our country to try to work out our differences and clear the way for the Information Age in America.

3/4

THE PROFESSIONAL VIDEO MAGAZINE FROM SONY

Dancers inspired by the soaring Rocky Mountains are recorded by a Sony VO-8800 Portable Recorder.

AT REDFORD'S MOUNTAIN RETREAT

VIDEOTAPE IS A PEAK EXPERIENCE

In film and the performing arts, Sony U-Matic SP™ video equipment has become a powerful ally in the search for new creative directions.

High in the Rocky Mountains, in the magnificent Provo Canyon of Utah, Robert Redford's Sundance Institute helps established professionals solve the creative problems that go with breaking out of the mold of "mainstream" work.

In the practical world of commercial production, it is difficult or impossible to find the time, money, and resources to explore a fresh approach. So Sundance has set itself the task of insulating established professionals from the harsh disciplines of budgets, production schedules, and pressures to succeed.

Each year, the Institute offers laboratories for filmmakers and playwrights, and for professionals in music and dance for film. What they find is a creative workshop, a protected environment for trial and error. When an artist brings a project to Sundance, the Institute

(continued on page four)

INSIDE

WHEN WOODS HOLE GOES TO SEA, U-MATICS ARE ALWAYS ON DECK

At Chicago's Museum of Science and Industry, a school group is watching a cluster of screens. Suddenly, a bank of Sony U-Matic SP™ videotape players comes to life.

The screens light up in a sequence encoded on the control track of the master cassette. Soon the audience is deep under the surface of the North Atlantic Ocean, watching video previously recorded by JASON JR., an unmanned undersea vehicle developed at Woods Hole Oceanographic Institution, Woods Hole, Mass.

They are approaching the sunken passenger liner *R.M.S. Titanic,* where she sank 74 years ago. As JASON JR. moves under remote control, the stark and empty decks of the giant ship emerge from the gloom. Image follows image, as a voice explains how scientists use JASON's camera eye to explore the universe beneath the sea.

Now the large center screen comes alive, and the audience sees a dramatic new seascape. In a little pool of light at the depth of 2600 feet is a pile of ancient *amphorae*—giant pottery jars, lost at sea 2,000 years ago.

We are looking through the camera eye of JASON, a bigger, more sophisticated version of the vehicle that explored the *Titanic.* While the youthful audience watches, a robotic arm delicately recovers one of the fragile jars.

And something else is special: the video is live. In the museum, encoded control signals are integrating it tightly with the recorded output.

This was the JASON project, an educational program sponsored jointly last May by 12 North American museums and Woods Hole. The recorded segments, produced by the Turner Broadcasting System, Inc., were pre-recorded on Sony U-Matic SP equipment.

To produce the live portion, JASON cruised the bottom of the Mediterranean, while on-board Sony cameras relayed the scene to the surface. This video was then sent by satellite to the museum, with the help of Electronic Data Systems Corporation.

But these cameras do more than educate. Video is the heart of JASON's primary scientific work, along with the samples retrieved by the robotic arm, explains Bill Lange of Woods Hole. "The video *is* the research," he says. "We bring back hundreds of tape cassettes from a two-month cruise. And that's our work product."

Lange is the Institution's video engineer. He explains that video from JASON's cameras is taped at the surface by Sony VO-9600 recorders—along with a time code signal that correlates each frame with navigational data. "That's why U-Matic SP equipment is so important to us," he continues. "At sea, we record 24 hours a day."

The corrosive sea air eats away at video equipment, even in an air-conditioned control room. "Before we had our Sony gear, some cruises came back with no usable videotapes at all," Lange adds. "But the U-Matic SP recorders are beautiful—they run and run. If a unit does go down, we can have it working again an hour later."

For oceanographers, a video recording system must provide resolution and fidelity for scientific analysis. But an expedition accumulates a huge volume of tape, by recording 24 hours a day for weeks. "With the 3/4-inch format of U-Matic SP equipment," Lange notes, "we get the picture quality we need. The cassettes are physically manageable. *And* affordable in cost.

"Sony U-Matic SP equipment rises beautifully to the demand."

This control room is in a contain which was lifted by crane to the dec of Woods Hole's ocean-going r search ship. Video engineer B Lange uses Sony U-Matic SP equip ment to record video sent up b JASON, an unmanned underse vehicle.

Photo courtesy of Quest Group LT

REDFORD

(continued from page one)

makes a suggestion: "Spend your time here working on your five or six most problematic sequences. That will test your material, and let you see where you're headed."

For a decade at Sundance, videotape has proven to be ideal for experimentation.

Since tape can be edited much faster, the artist sees results immediately. If something just does not work, that becomes obvious sooner and a new direction can be taken.

The head of production operations at Sundance, Ian Calderon, is discussing the use of video by participants. "We tell every visiting artist to 'think film' ", he says. "Our production staff can take direction in film terms and execute it in video."

At first, some professionals resisted this emphasis on video. But when they saw U-Matic SP, how it cuts, and how fast it is to work with, they got excited and involved.

"Of course," Calderon says, "with the U-Matic SP format, they also see a picture quality that impresses them. It's really much better than they expect.

"With the technology that Sony has incorporated into the Type IX equipment, we can get results with 3/4-inch that were possible only with more expensive formats just three or four years ago.

"Now we have the higher resolution of SP (Superior Performance)

technology. Digital noise reduction. And dial menus superimposed on-screen, with on-screen display of time code. The Type IX system helps to expedite the process. It fosters creativity.

"In this environment, if people weren't happy with the equipment, I would hear about it. Because that's not happening, I know that U-Matic™ Type IX works. And works well." ■

U-MATIC AND YOU

Want to learn more about EFP? About operating editing equipment? Directing? Lighting? Camera technique?

The Sony Institute of Applied Video Technology may have just what you need. For 18 years, this educational division of Sony Communications Products Co. has helped videographers at every level of experience.

SVI offers workshops, consulting services, and educational materials on video topics. And now it offers its full program in two locations: Hollywood, California, on the campus of the American Film Institute, and on the campus of the Savannah (Georgia) College of Art and Design.

The SVI program includes 30 workshops of two, three or five days' duration—at beginning, intermediate and advanced levels. Workshops range from basic EFP to lighting, script-writing, camera technique, audio, and editing, among other topics.

And there are special-interest workshops, on such subjects as interactive video, computer graphics and animation, digital effects, and management of the corporate video center.

For details and a complete list of workshops and educational materials, write to: The Sony Institute of Applied Video Technology, P.O. Box 29906, Hollywood, CA 90029. Or call Peggy Bado at 213-462-1987. ■

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PROFESSIONAL VIDEO

New dimensions in integrated circuits

By Jerry Whitaker, editorial director

New IC technology promises to revolutionize the electronics industry in general and broadcasting in particular.

Three digital waves have washed over broadcasting since the early 1970s. The first, *digital-able*, was characterized by the inclusion of chips labeled 74LS-whatever. This wave crested in the early 1980s, when it became impossible to trace signals inside equipment because they disappeared onto a bus. The second wave, *digital-adapted*, is reaching its crest now. Designers tackled analog tasks with digital tools; the digital tape formats (D-1 and D-2) are prime examples. Although certainly enhanced by digital electronics, the processes themselves are analog functions. Now the third wave, *digital-utilized*, is swelling. As it hits, broadcasters will find themselves awash in concepts quite foreign to them, borrowed in large part from the computer and data communications industries.

All three technology waves have a powerful common element: the integrated circuit (IC). The crush of new devices and whole new ways of doing things shows no sign of letting up. In fact, over the years, the trickle-down effect into broadcasting has resulted in a rushing river. Current development work seeks to provide devices that are faster, more reliable and able to offer increased functions. This is the IC's claim to fame.

New frontiers

Wafer-scale integration (WSI) is a technology that holds incredible opportunities for the semiconductor industry. The technology is plagued, however, with several stubborn problems. WSI "superchips" are the next step beyond VLSI (very large-scale integration) development. Instead of using a single wafer to produce hundreds or thousands of individual ICs, the WSI concept calls for the entire wafer to be used for a specific application. This allows the integration of *millions* of logic gates into a single package the size of your hand.

The *superchip* concept is not new. Texas Instruments tried using an entire wafer to implement the first large-scale ICs in the mid-1960s. The process, however, required higher technology than was available at the time. Marketplace demands also did not support the sophistication that WSI could provide.

Chip-fabrication technology today has progressed to the point that it is possible to produce WSI devices. However, several significant problems still linger. The primary difficulty for a WSI designer is removing heat produced by the device. Because the package density of the active circuits of a WSI chip is so much greater than in a VLSI chip, the amount of heat produced over the wafer surface is a serious problem. In fact, it would not be uncommon for a large WSI chip to produce 1kW of heat.

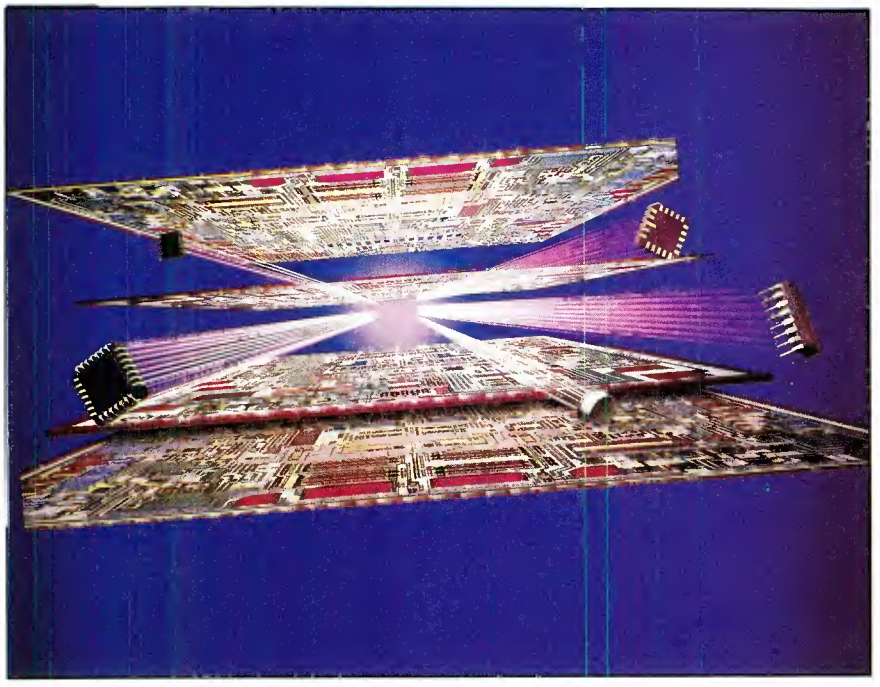
Several innovative removal systems have been devised to conduct large quantities of heat away from the wafer surface. Special wafer-mounting forms have been designed to conduct heat from the wafer to a large heat sink area, where it would be removed by helium gas or water circulating through a fin structure.

The second major problem with WSI technology is that of wafer yield. In conventional IC fabrication, a number of defective dies within a single wafer can be tolerated; they are simply discarded. Semiconductor manufacturers expect a certain number of fabrication flaws because of contaminants that affect the crystal structure of the wafer and contaminants that may be introduced during processing. With a WSI device, however, there can be no flaws if the finished chip is to function as designed. This requirement places extreme demands on device fabrication procedures and quality controls.

In a practical application of WSI technology, manufacturers would use redundant circuitry to overcome the problems of wafer yield. Such "backup" circuits, however, would place added limits on the complexity of chip designs, because space would have to be provided on the IC for the redundant function blocks.

The promises of WSI technology, however, are attractive. Imagine being able to use a single IC to replace an entire card rack of printed circuit boards. It is conceivable that a single 8-inch wafer could hold the equivalent of 100 microprocessors, each the size of an Intel 8086.

The circuit complexity provided by a WSI chip also requires innovation in the design of interconnecting pins to the "outside world." Semiconductor engineers have talked about chip pin-outs in the



New devices and packaging techniques are reshaping the electronics industry. More hardware can be packed into smaller spaces than ever before, resulting in equipment that offers more features and is smaller, more reliable and less expensive than traditional designs. (Courtesy of Precision Monolithics.)

hundreds, or even thousands. A practical approach may involve one or more fiber-optic ports for I/O communication.

Although the technological requirements of WSI devices stretch present fabrication processes to their extremes, the search continues for a practical way of making superchips, which could affect the electronic industry like nothing in recent history.

Superconductor ICs?

Since the beginning of this century, scientists have known that some materials completely lose electrical resistance when cooled to a temperature approaching absolute zero (−273°C). During the past two years, researchers have made major advances in superconductor technology by creating new materials that become superconductive at temperatures far higher than had been thought possible. These materials become superconductive when cooled by liquid nitrogen, which is much cheaper and easier to handle than liquid helium, the coolant previously used. These "high-temperature" superconductors make practical applications more feasible.

One of the most challenging targets of this technology is the use of superconduc-

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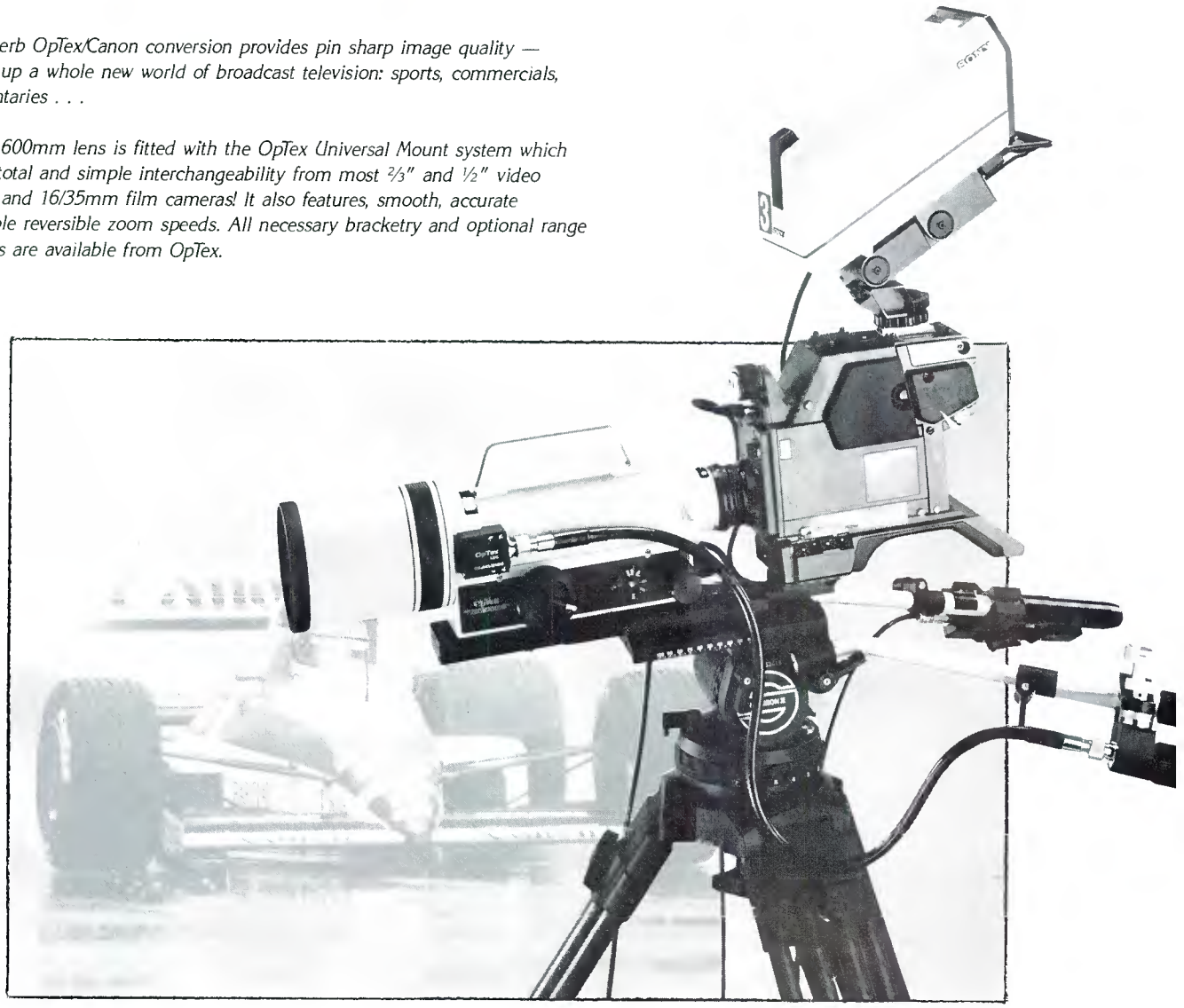

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The 150-600mm lens is available for sale and rental from:

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tive materials for new electronic devices that would surpass present semiconductors in speed, while consuming much less power. Progress has been reported recently toward solving the many problems facing designers. One of those developments is the *superconductor tunnel effect*.

When two superconductors in the form of thin films are joined with an insulator between them (a tunnel junction), there is a flow of electric current through the layers in spite of the insulator. This superconducting tunnel effect is a phenomenon peculiar to superconductors. The most prominent characteristic of the effect is that, when electric current flows beyond a certain level, a large resistance suddenly appears, generating electric voltage. If the electric current decreases, the resistance gradually diminishes to zero, losing voltage. This characteristic can be used as a switch, digitally counting the appearance and disappearance of voltage as 1s and 0s. Because electrons can move much faster in superconductors, unhindered by resistance, the switching function is expected to work 10 to 100 times faster than present silicon or gallium arsenide semiconductors.

Vacuum ICs

The familiar vacuum tube may make a return, of sorts, if researchers have their way. Scientists are studying the possibility of marrying IC technology with vacuum tubes to create a new class of fast, powerful devices that will bear no resemblance whatsoever to the 6AU6s and 12AX7s of yesteryear. Because electrons travel much faster in a vacuum than through solids, engineers theorize that *vacuum microelectronic* devices could open the door to new display systems and faster computers. Researchers report that shrinking the vacuum tube to microscopic proportions results in a device that behaves much differently than its ancestors.

Flat-screen video display is a potential near-term application for the technology. Vacuum microelectronic chips do not use a heater to generate a beam of electrons. Instead, they emit electrons when exposed to an electronic field. Such *field emitter* devices can be made of high-temperature superconducting ceramics, as well as more conventional materials (such as silicon). Commercial flat-screen display products may emerge from the laboratory as early as the mid-1990s.

The microelectronic "CRT" would employ millions of microscopic cathodes, each firing straight ahead toward a flat phosphor-coated screen face, rather than a single cathode scanning the faceplate (as in conventional designs). Such a display would be thin and light and would consume little power.

The possible computer applications are staggering. Aside from providing a method to greatly increase computer speed, vacuum microelectronics also may make it possible to construct computer devices that switch on and off in response to light, rather than electrons. That could make possible the direct processing of data delivered by fiber-optic cables. Such devices could serve as the basis for electro-optic computers at some point in the future.

Much research work remains to be done before any practical products emerge, but initial efforts are promising. The greatest challenge facing engineers is fabricating the devices, which require dimensions well into the submicron region.

16Mb DRAM

Recent advances in memory chip design have resulted in vast improvements in memory capacity. At the beginning of this decade, mainstream memory capacity was 64kb. Today, 1Mb capacity — 16 times the capacity of the 64kb device — is dominant in the market, and 4Mb capacity should become available in the near future.

Even higher-capacity chips will be available in coming years. In fact, an experimental 16Mb dynamic random-access memory (DRAM) chip already has been developed by Toshiba. The experimental IC integrates about 34 million elements (transistors and capacitors) on a single chip. Access time is typically 70ns. The 16Mb DRAM uses a new structure for memory called a *stacked trench capacitor cell*. This structure eliminates electric field leakage between capacitors, which can cause errors in DRAM devices. The basic structure of the 16Mb DRAM is shown in Figure 1.

In addition to random-access capabilities, the newly developed chip has a high-speed serial-access mode that makes possible quick writing and reading of serial data. With conventional random-access operation, a microprocessor assigns an address to every bit of information stored in the chip, and each address must be designated again when that information is read. This process takes time.

The new serial-access mode of the 16Mb DRAM divides the memory area into two sections and automatically stores serial information (up to 2,048 bits) by every four bits on each section alternately. Only the first bit of information requires an address. Consequently, the device requires only 10ns to write and read serial information.

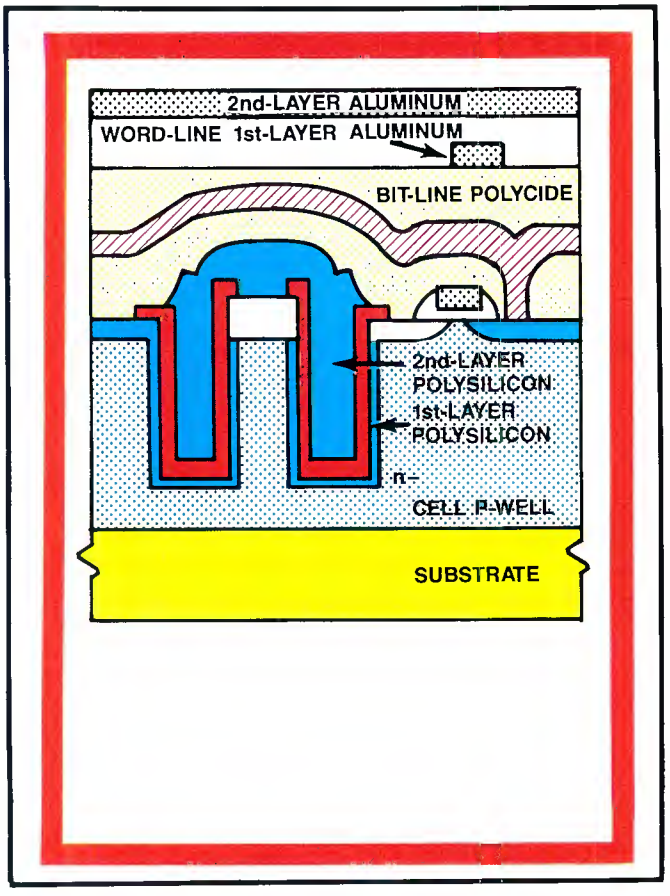


Figure 1. *The 16Mb DRAM uses a* stacked trench capacitor cell *structure to eliminate electrical leakage between capacitors. The polysilicon layer on the side walls of the trench allows impurities to be diffused thinly and evenly.*

Sony's new definition of still video recording: 500 lines of resolution.

Words can hardly describe the image clarity when viewing 500 lines of resolution. Which is precisely what Sony has added to the new MVR-5600 still video recorder/player.

It lets you record, play back and store video signals from just about any video source, in never before seen sharpness. Whether it's still video pictures, frames from video cameras, videotape recorders, copy stand and video scanner images or computer graphics. With the MVR-5600, you have immediate random access to any image on the 2" floppy disc in as little as 30 milliseconds. Which in turn makes it easy to integrate high quality images into broadcasting, video production, computer imaging, business presentations and demonstrations. You can even use it as a low cost video still-store device or for image-archiving applications.

For a demonstration of this revolution in resolution, call Sony at **1-800-833-6302** We'll put you in touch with a Sony Still Image dealer who'll show you our full line of products. And what 500 lines of resolution means for you.

SONY

At present, the most advanced commercially available memory chips — specialized for handling serial information — take a minimum of 30ns to perform the same task.

i860 sets records

The push to produce microprocessor chips with more power and speed has reached a new benchmark with the introduction in February of the Intel i860 microprocessor. The 1,000,000-transistor, 64-bit device combines supercomputer and 3-D graphics workstation capabilities in a single chip. The component contains an architecture specifically designed to handle technical computing. The i860 enables a new class of workstation, one that combines computation rates previously associated with supercomputers with the visualization capabilities of superworkstations. The processor integrates an integer unit, floating-point unit and 3-D graphics hardware, with on-chip caches to sustain high computation rates.

The unique feature of the new device is its on-chip parallelism. The architecture can produce a total of three operations in just one clock cycle. The core of the device is a *reduced-instruction set computing* (RISC) processor that sets new records for execution speed. Designers of the i860 say its most important feature is the lack of on-chip bottlenecks. All sections of the device execute at essentially the same speed, providing for smooth data flow.

In addition to standard scalar operations, the i860 can perform vector operations, similar to a supercomputer. This capability is handled by a software library and on-chip cache that stores data for intermediate calculations. Overall performance of the i860 is rated by experts to be about half the speed of a Cray-1!

IBM has announced plans to make the Intel chip available as an accelerator for its PS/2 series of personal computers. The option would boost the PCs to near supercomputer performance levels.

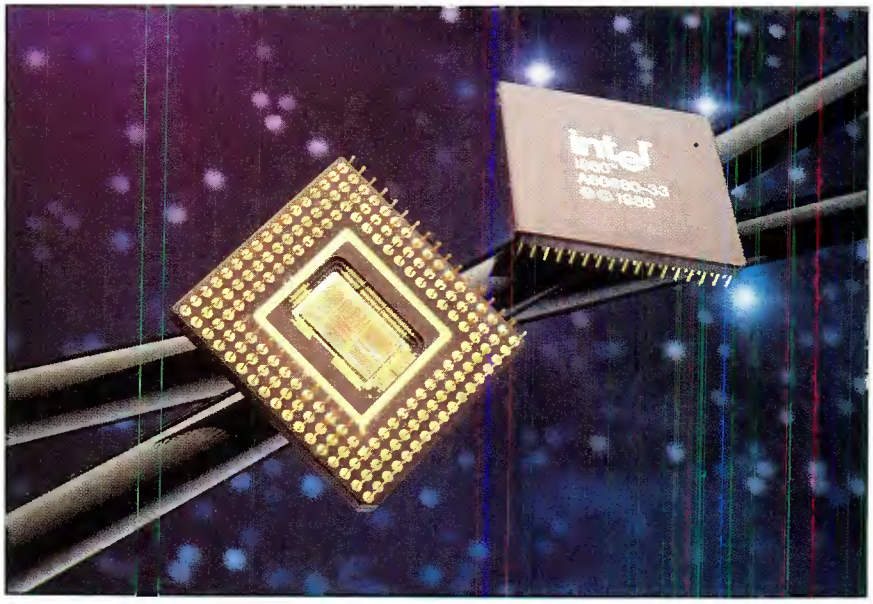
DSP comes into its own

Digital signal processing (DSP) is one of the brightest spots in the semiconductor business today. Like earlier advances in microprocessors and computer memories, DSP is a foundation technology with the power to transform broad areas of the electronics industry. A DSP chip takes an analog signal, such as audio, and converts it into digital data that can be manipulated by a microprocessor at high speed. The impact of DSP is being felt in markets as diverse as stereo systems, automobiles, military hardware and medical instruments. In the next few years, DSP will give rise to thousands of new products and change what people have come to expect from computers.

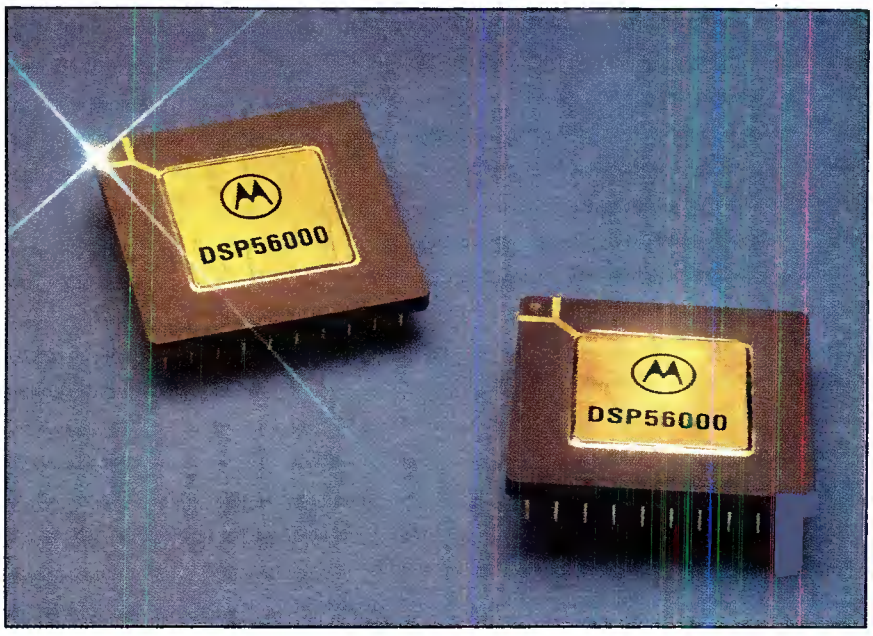
Once confined to academic research labs and futuristic military applications, DSP has made big strides toward becoming a widely accessible commercial technology. In the past few years, a variety of VLSI devices have been making DSP easier to use and more affordable, particularly in low-end applications. New devices have broken previous price-performance barriers. The Motorola 56ADC analog-to-digital converter and the 56001 digital signal processor, for example, provide the two essential elements of a digital signal-processing system. The 56001 delivers two to three times the speed of comparable devices. The 56001 is a key ingredient in the NeXT computer system, unveiled last year by Steve Jobs. The Motorola chip provides the NeXT system with compact-disc-quality sound, speech synthesis, facsimile transmission, mathematical processing and communications facilities.

To keep the processing speed of the 56001 high, the device features three sep-

Continued on page 58

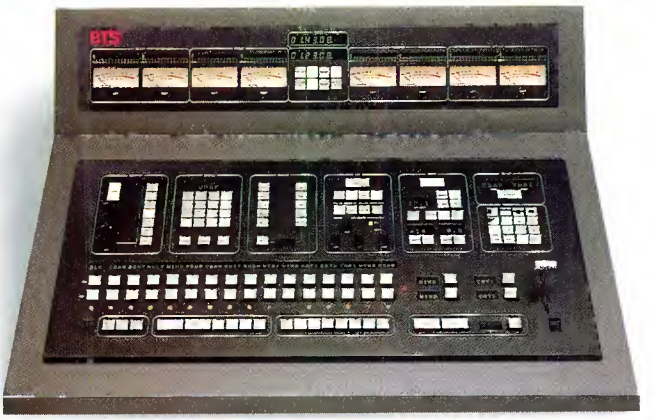


Intel's newest release, the i860 microprocessor, combines supercomputer and 3-D graphics workstation capabilities in a single 64-bit component. (Courtesy of Intel.)



Digital signal processor (DSP) ICs are specialized devices that typically include a microprocessor, memory and logic circuits to perform a limited number of specific tasks. Shown is the Motorola 56000 DSP, which is used in the NeXT computer system to perform a variety of tasks. (Courtesy of Motorola.)

How to take control of a broadcast station



MCS-2000 Master Control Switcher

Go ahead, be ambitious. Controlling a broadcast station is no small potatoes, but these advanced products from BTS make it easy by giving you total control of all on-air programming from two workstations.

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BTA-2300 Automation System

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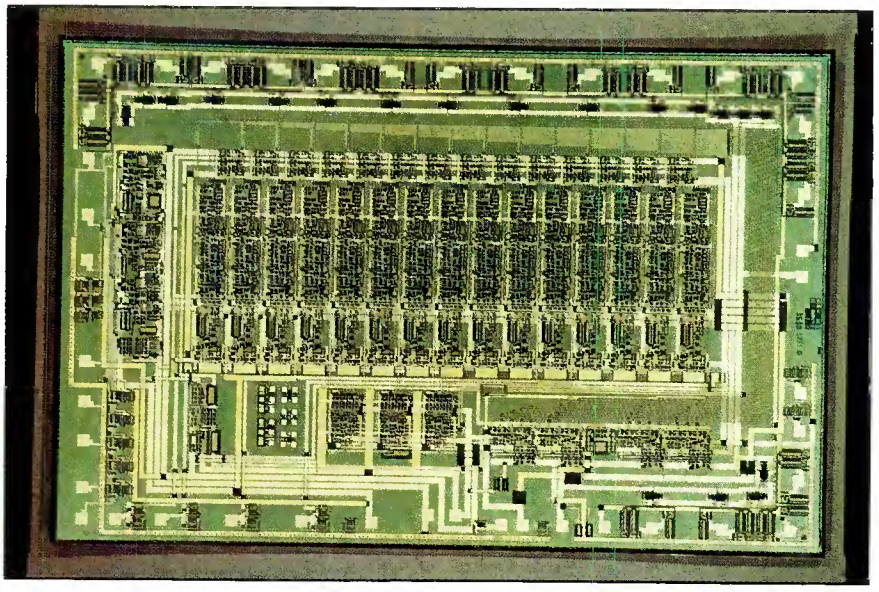
Continued from page 54
arate buses to internal memories. Conventional processors have one memory bus and so must alternate the fetching of data and instructions. More advanced devices, such as some RISC processors, have a 2-bus *Harvard architecture*, giving them access to one data word and one instruction word at the same time. The 56001 breaks new ground in that it is the first DSP to have an extended triple-bus Harvard architecture, which can supply two pieces of data and an instruction simultaneously. A 3-bus design prevents memory bottlenecks.

Future DSP component introductions will provide enhanced power especially suited to the computer graphics, mathematical array processing and speech recognition markets.

Digital signal processors differ from microprocessors in a number of ways. Microprocessors typically are built for a range of general-purpose functions, and they normally run large blocks of software. Microprocessors usually are not called upon for real-time computation. They typically are able to shift workloads around and choose their own course of action — waiting to finish a printing job, for example — before responding to a user command. The DSP, on the other hand, is a single-minded specialist, racing through a smaller range of functions at high speed. DSPs are often thought of as a type of embedded controller, a processor that, accompanied by the necessary software, is built into a piece of equipment and dedicated to a single group of tasks.

DSP programs are usually much smaller than those of microprocessors, and so their memory requirements are lower. In many cases a full complement of software can be stored in a small memory array integrated right on the DSP chip.

Just a decade ago, DSP was more theory than practice. The only systems capable of any digital signal processing were massive mainframes and supercomputers, and even then, much of the processing was not real time. The economics began to change in the early 1980s with the advent of single-chip MOS DSP devices. The computer industry hasn't been the same since.



Digital signal processing chips, such as this high-resolution analog-to-digital converter, are combining both analog and digital technology to answer the data-acquisition needs of the electronics industry. Pictured is the F410-NP front-end IC for the CTI/dbx high-resolution A/D converter chip set. (Courtesy of dbx.)

Integrated circuits are fabricated in an ultraclean environment to keep contaminants that might damage wafer dies to an absolute minimum. The yield of a fabrication facility (or fab, as it is known) is directly related to the number of contaminants in the air. (Courtesy of Precision Monolithics.)

Super High Pi

In the world of integrated circuits, "high frequencies" are measured in the tens of megahertz. In the world of microwave technology, however, high frequency means gigahertz. Research is under way to extend the benefits of integrated circuits to operating ranges well above 1GHz. Present limitations include high parasitic capacitances, large device size, low breakdown voltages and high power consumption. A process has been introduced that shows promise in filling this need: *Super High Pi* (SHPi). The process, developed by Tektronix, offers the potential for as many as 10,000 devices on a single chip with transistor operating speeds of up to 8.5GHz. SHPi is expected to dramatically affect the semiconductor industry by offering analog designers an effective means of producing complex, high-speed circuits on a semi-custom chip at greatly reduced design and production costs.

Reducing both the capacitance and size of an IC is not an easy task. If designed properly, however, such devices operate faster with lower power consumption. This higher level of performance is essential to carry out many of today's analog circuit applications, where devices are required to handle high-speed signals. Typical applications include RF amplifiers and mixers, sample-and-hold circuits, high-speed comparators, frequency synthesizers, fast-recovery amplifiers and high-speed operational amplifiers (op-amps).

SHPi fabrication uses a recessed oxide isolation process in conjunction with shallower doping diffusion throughout the de-

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vice. Reduced device feature size allows higher packing density. For example, in the conventional junction-isolation process, more than 80% of the collector area of a transistor is used to accommodate the lateral diffusion and depletion area of the P+ isolation. Recessed oxide isolation, however, replaces the P+ isolation with a smaller area nearer the active base region, thus eliminating the inactive collector region and reducing the size of the device.

Higher packing density also is achieved by downsizing the transistor emitter. In SHPi, this is accomplished through new photolithographic and processing techniques, which produce finished emitter sizes as small as 1.6μm × 4μm (compared with older 2μm × 8μm sizes. As a result, a typical NPN transistor measures about 448 square micrometers, compared with 1,700 square micrometers for the conventional junction-isolation process.

Smaller device size translates into lower parasitic capacitance, and as a result, higher operating frequencies and lower power consumption. Because of smaller physical dimensions for each element, less expensive ICs are possible. Greater density per chip translates to more chips (dies) that can be obtained per silicon wafer for a given circuit design, and a commensurate reduction in the cost of manufacturing the device.

The availability of faster high-density IC chips opens the door to a number of applications that previously were too difficult or too expensive to fulfill. For example, higher speeds are necessary in satellite communications, where transmitted signals can exceed the ability of many devices to process them. Also, high-speed display drivers are needed to handle the high refresh rates and screen pixel counts of high-resolution CRT displays. Such ICs also will find applications in advanced computers and graphics/imaging systems.

ASICs move in

Application-specific integrated circuits (ASICs) rapidly are finding their way into equipment of all types. ASIC devices are a family of semi-custom VLSI chips that can be configured to the specifications of a customer at relatively low cost. A digital ASIC consists of a given number of logic gates, memory elements and other *digital glue* logic that can be configured to perform a number of different functions. The customer specifies the logic scheme required for the application, and the elements of the chip are interconnected as required to meet the order. This process greatly reduces the cost and time required to develop a VLSI device. Plus, because of the lower capital outlay, small-quantity production runs are practical.

Manufacturers have found it cost-effective to take one or more circuit boards full of logic chips and reduce them down to one or more VLSI devices. ASICs make it possible to produce a product in less time, with fewer components, for less money. ASIC-based systems offer the user equipment that not only consumes less power than conventional circuit implementations, but also is smaller, lighter and more reliable.

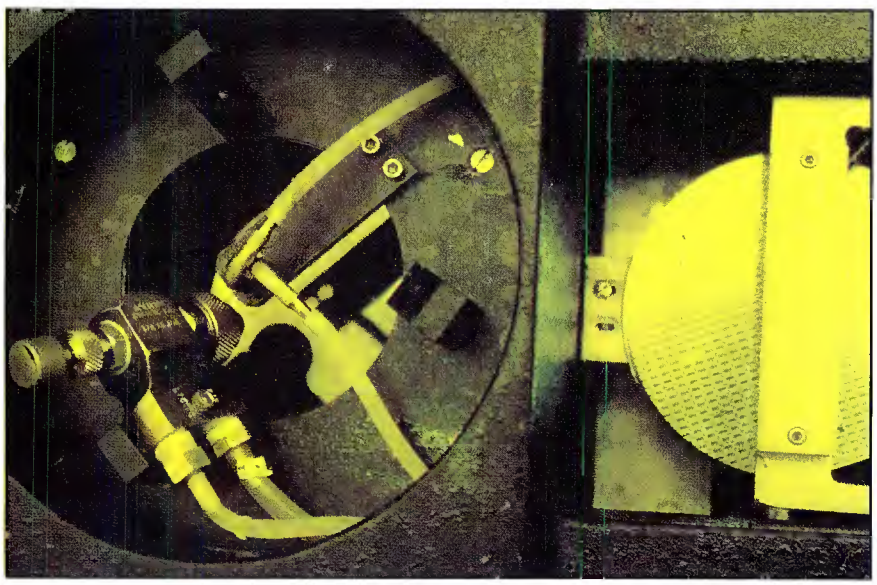
ASICs are available for analog applications as well. Specialized devices include both analog and digital hardware blocks, such as RF amplifiers and mixers, sample-and-hold circuits, high-speed comparators, fast-recovery amplifiers and Schottky TTL buffers. Common applications include telecommunications systems and analog-to-digital and digital-to-analog conversion.

As many as 18 different layers are required to produce the needed circuit pattern on the surface of a typical silicon wafer. Here, an epitaxial reactor grows a single crystal silicon film of the desired dopant concentration upon the silicon substrates. (Courtesy of Precision Monolithics.)

Wafer engineering

Silicon is the foundation of the IC industry, and although it performs many tasks well, it is not perfect for all applications. For this reason, work is being conducted on ways to supplement silicon (Si) with compounds that provide higher speed, such as gallium arsenide (GaAs). The goal is to combine the good points of silicon — mechanical strength, heat dissipation and low cost — with the good points of other compounds. Until recently such *wafer engineering* was difficult, if not impossible. Researchers have now advanced thin-film and surface-processing techniques to the point at which semiconductor wafers can integrate previously incompatible materials, such as *GaAs-on-Si* and *Si-on-insulator* wafers. These techniques even make it possible to grow ultrathin freestanding wafers.

This technology is particularly attractive in the case of optoelectronics. For example, almost all of the electronic and photonic activity in a GaAs LED occurs in just the top few micrometers of the emitting element. The underlying GaAs material (usually about 500μm) is only for mechanical support. If a thin, active single-crystal layer of GaAs were grown on a silicon base, it would enable designers to utilize GaAs but not pay the penalties of poor heat conduction and low manufacturing yield that typically go with that material.



A spinner chamber *is used to apply photo-resist to wafers before the pattern for each layer is exposed. Dry etching equipment removes selected areas later during processing. (Courtesy of Precision Monolithics.)*

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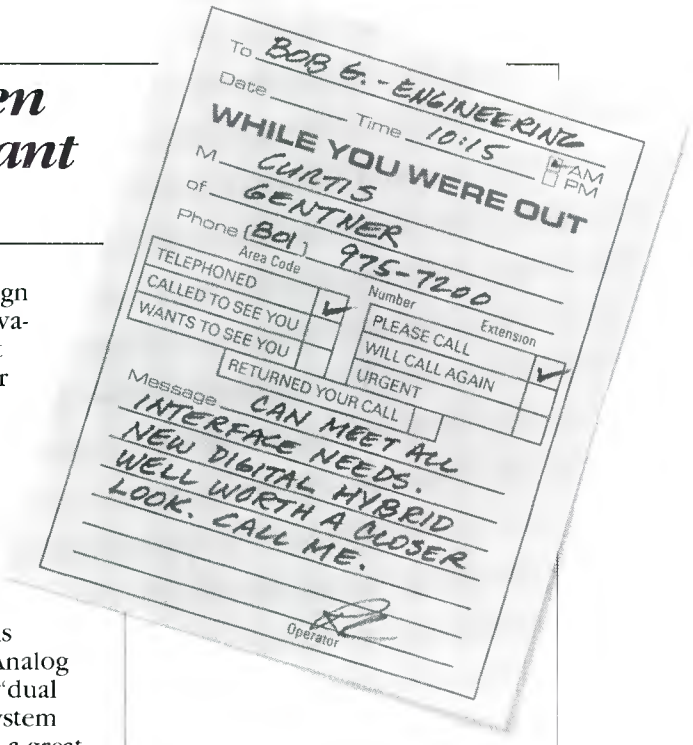

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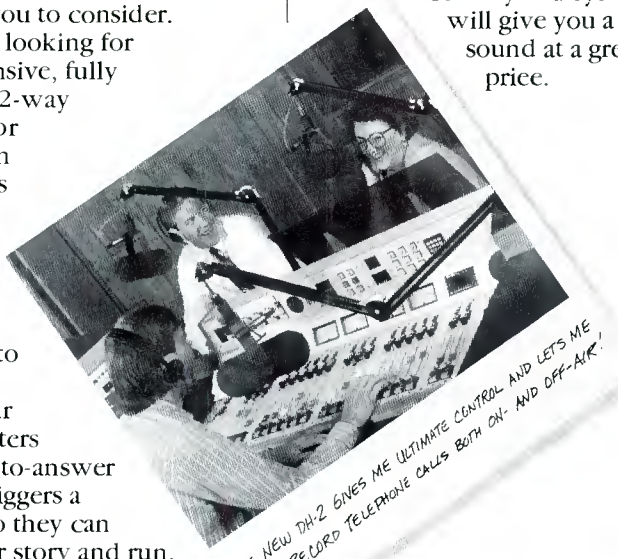

Both the DH-2 and SPH-5 give you a CUE button to toggle send audio between the console and the announcer's mic. This allows your announcer to easily use the hybrid like a speakerphone before putting a caller on-air. And a RECORD button lets you automatically record calls, both on- and off-air, for later playback. Finally, telephone hybrids designed to work the way you work.

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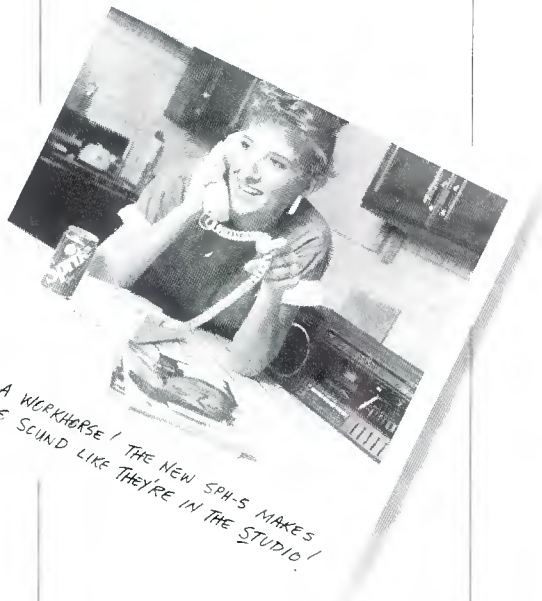

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Researchers believe that GaAs-on-Si eventually could replace GaAs in almost all applications, both analog and digital. Eventually, the Si substrate of such wafers also could support active circuitry to create optoelectronic ICs. Such chips will be in great demand for future high-speed optical/electronic-based computers.

The concept of Si-on-insulator (SOI) also is promising. The idea involves growing a silicon layer over an insulating substrate, probably silicon dioxide. The insulator would completely isolate each device etched in the silicon layer. The benefits include much higher operating voltages (operation at 1kV or more may be practical), higher temperatures (as much as 300°C), more varied types of devices and better production yields.

Although SOS and GaAs-on-Si technologies are promising, much work still remains to be done. During the late 1970s, efforts to produce Si-on-sapphire (SOS) were made, with less than great success. The wafers proved too small, fragile and expensive for commercial use.

Making the chips

It is fascinating to watch the fabrication of integrated circuit chips. ICs are so common and inexpensive today that it is easy to forget they are actually built piece by piece. The fabrication process is long, detailed and requires incredible precision. The effort pays off, though, with millions of chips produced every year, by each of the major semiconductor manufacturers, that have direct application to broadcast equipment.

IC fabrication is done in large, clean room facilities by operators wearing head-to-toe "bunny suits." Anyone entering the clean room first must pass through an air shower. Everything brought into the facility is carefully checked for contamination. Special paper is even used inside the fabrication plant to limit the contamination that would result if standard notebook or computer printout paper were used. These advanced-process *fabs*, as they are called, are 100 times as clean as a hospital surgery room.

Computer-aided engineering (CAE) is used extensively throughout the IC development process. Computer simulation is employed to design the circuit, and once the details have been finalized, the computer plots the physical structure of the IC and generates a database for the wafer masks used in IC fabrication. Depending on the complexity of the particular chip, the computer generates from five to 18 (or more) different glass masks, using the information contained in the circuit database. When completed, each mask will contain hundreds, maybe even thousands, of exact replicas of the various circuit layers.

The raw material used most often in IC fabrication is silicon. After an exhaustive purification process, molten silicon is doped to give it specific electrical characteristics. This material is "grown" as a crystal into a cylindrical ingot. A diamond saw is used to cut the silicon ingot into thin, circular wafers, and the wafers then are polished to a mirror finish.

This silicon-based wafer varies in diameter from two to eight inches, with 5-inch wafers being common today. The processing steps taken to produce a finished IC vary from one device type to another, but the general procedures are similar:

- The wafer first goes through an oxidation stage to give it a thin, protective coating. This is accomplished by placing the wafer into a 1,200°C furnace through which pure oxygen flows, causing an added layer of silicon dioxide to be grown on the surface. Following oxidation, a photo-resist is applied to the wafer. It is then dried to remove residual solvents and passed on to the masking stage.
- The masking step is critical to the success of a wafer, because it establishes the alignment between successive layers of

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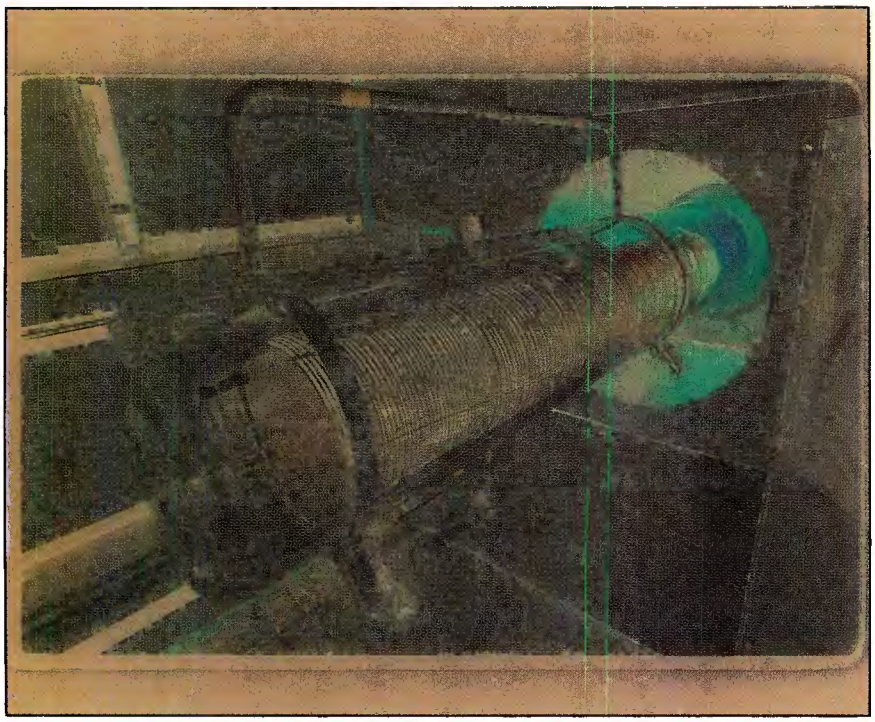

Wafers are loaded automatically into diffusion furnaces, where gaseous compounds are added to give the required impurity doping of the exposed areas of silicon. (Courtesy of Precision Monolithics.)

the individual circuit. A computer-controlled laser alignment system is used to ensure proper positioning of the mask on the wafer. Once alignment has been completed, the wafer is exposed to ultraviolet (UV) light for a predetermined length of time. Masking cuts through the photosensitive resist to expose the oxide underneath. A proximity printing method is sometimes used, rather than contact printing, to reduce the possibility of wafer contamination.

- A solvent rinse removes the soft resist, but the hard resist stays, having been hardened during UV exposure.
- Next, the wafer is etched to remove the unwanted oxide from the silicon surface. This selective etching forms windows for diffusing dopant atoms in the delineated areas of the surface oxide. Dry or wet etching may be used.
- The diffusion of predetermined impurities in the silicon base through the windows created in the etching process takes place in carefully controlled high-temperature ovens. These ovens operate from 800°C to 1,200°C, and must be regulated with great accuracy. This step is computer-controlled, with the IC "recipes" stored in the system memory. When an operator loads a wafer into the oven, cer-

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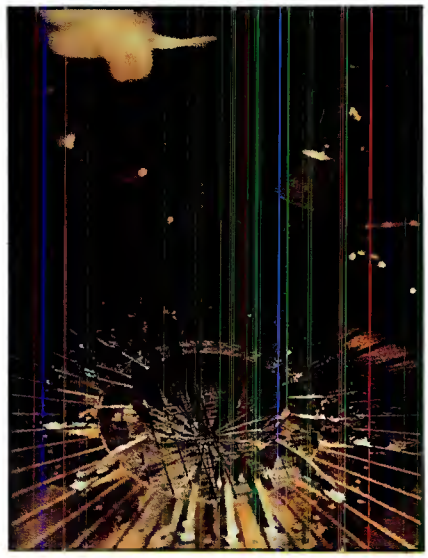
tain details, such as the device type and run number, are entered into the supervisory computer. The computer determines the correct sequence of temperatures, gases and timing of the various steps. Depending on the device and the processing stage, four or more diffusion steps may be performed.

A post-alloy probe of the wafer provides a computerized printout of sample die parameters against specifications. (Courtesy of Precision Monolithics.)

- An etching bath removes the remaining oxide, and a new layer of silicon is deposited onto the wafer. With this step, the first layer of the device has been completed.
- The sequence of oxidation, photo-resist, masking, resist removal, pre-diffusion etching, diffusion and post-diffusion etching is repeated as many times as needed to form the required circuit configuration. Typically, seven masking steps will be performed. A separate mask is used for each step, completing portions of the IC such as isolation diffusion, collector and resistor diffusion, emitter diffusion, contact window metalization and interconnection path metalization.
- During the last diffusion stage, a layer of oxide is again grown over the wafer. Most of it is left in place to serve as an electrical insulator, and only small openings are etched through the oxide to expose circuit contact areas.
- To interconnect these areas, a thin layer of metal, usually aluminum, is deposited over the entire surface of the wafer. The metal dips down into the circuit contact areas, touching the silicon. Most of the surface metal is then etched away, leaving an interconnection pattern between the circuit elements.



Upon completion, each die on the wafer is tested for adherence to specifications. The rejected devices are marked with red ink and later discarded. The yield of a process fab typically ranges from 70% to as much as 96%. (Courtesy of Precision Monolithics.)

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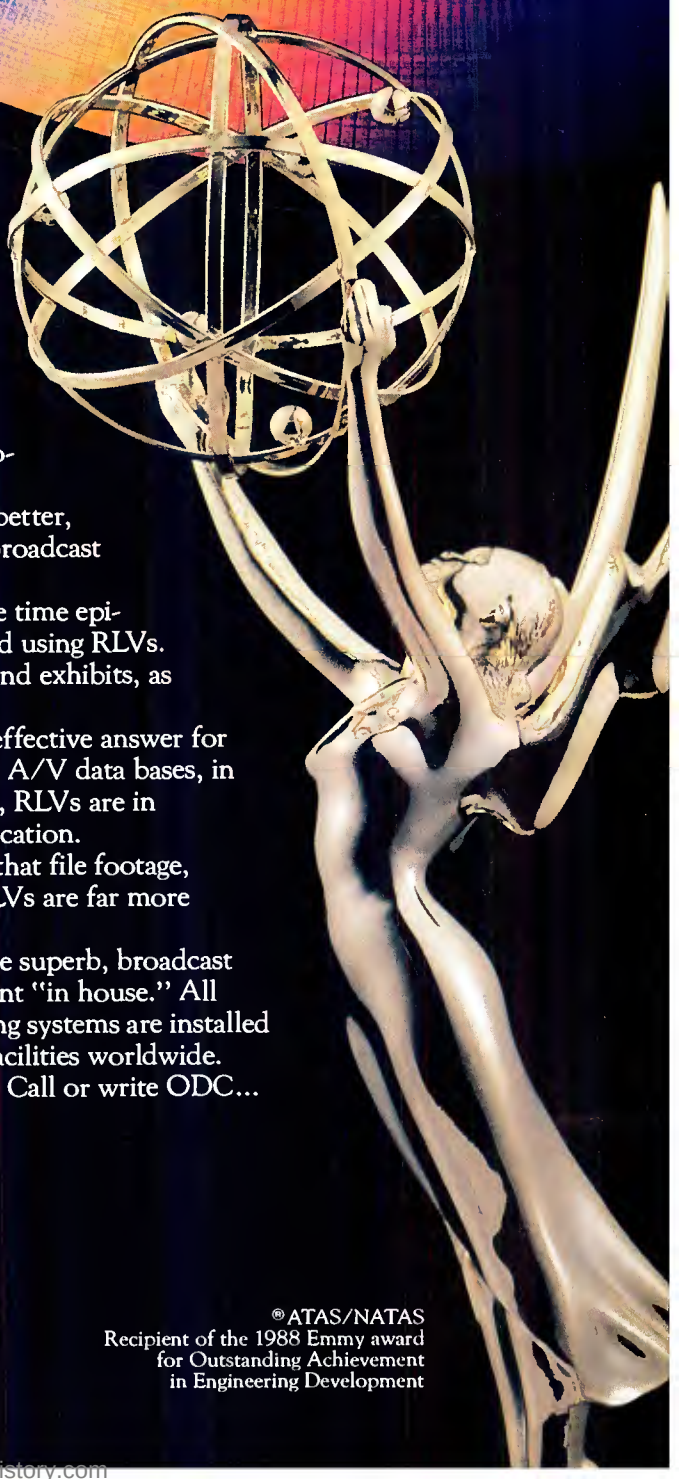

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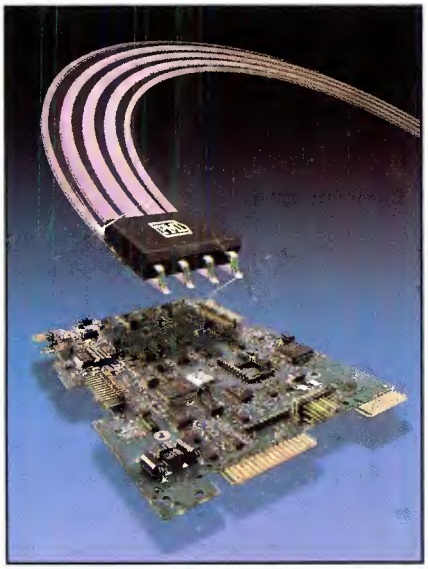
in Engineering Development



Surface-mount packages are making it possible to shrink the size of a printed circuit board. Expect to see more equipment built using this technology. (Courtesy of Precision Monolithics.)

• The final layer applied to the wafer is a glasslike material know as *vapox* (vapor-deposited oxide), which protects the IC from contamination and damage. It is etched away above the bonding pads, which will later be used to connect the device to the "outside world."
• Once the processing has been completed, the wafer is cut into hundreds or thousands of dies, each carrying a complete circuit.
• Last, the leads are attached to the die, and the device is enclosed in a protective package.

The amount of time required to produce an IC depends on the number of wafer-masking steps needed to complete the circuit, but it usually takes from seven to 10 weeks. The wafer processing sequence is arranged so that there will be a minimum of interaction between successive steps. In some circuits, such interaction can be critical. Stages tend to be arranged so that later steps involve lower temperatures, reducing the possibility of interaction from one processing stage to the next.

Spot checks are made at several points along the process to confirm that the development of the wafer has been satisfactory. A computer charts the progress of each wafer in its production, thereby allowing failure modes to be identified and analyzed.

As the feature sizes of ICs continue to shrink, the accuracy of processing and the cleanliness of wafer-fabrication facilities become increasingly important. In fact, the number of airborne contaminants has a direct relationship on the yield of a wafer.

The number of ICs produced from a single wafer varies, depending on the die size, but a common yield from a 5-inch wafer is 4,000 units. The failure rate of individual elements within the wafer is affected by wafer contamination, die size and circuit complexity. Generally, the failure rate is less than 30%. Failure rates as low as 4% have been reported at some fabs.

Most ICs are available to the user in a variety of temperature ranges over which specifications will be held, usually referred to as *commercial* or *military* grades. These device grades are created in a variety of ways. Some chips are given tighter specs in the actual design stage, others in the fabrication processing stage, and still others in the packaging stage.

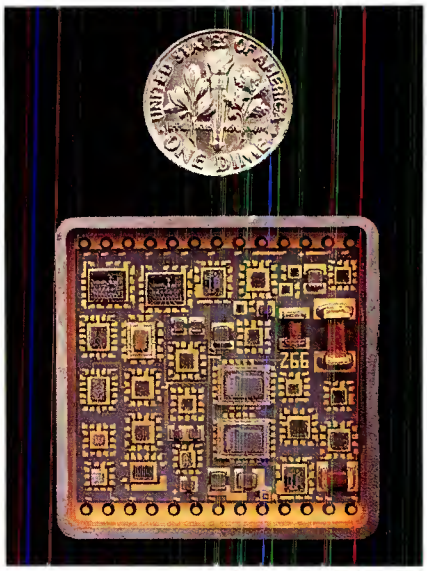
Packaging

The familiar printed circuit board rapidly is changing character, because of the need to cram greater numbers of parts into smaller areas. This requirement is being met with surface-mounted devices, thick-film fabricated components and advanced PC board processing techniques.

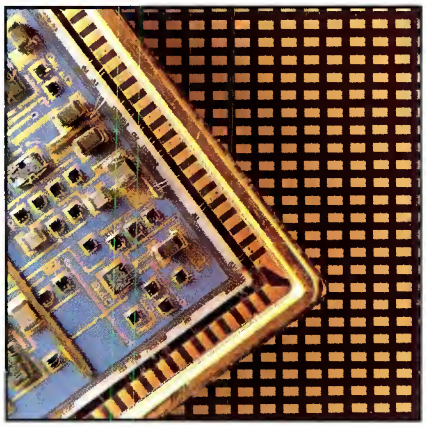
Surface-mounted components, once found only in hybrid circuits, are being used with increasing regularity on standard PC boards. The component selection currently available to manufacturers includes chip resistors, capacitors, potentiometers, RC networks, quartz crystals, ceramic resonators, inductors, discrete transistors and small- to medium-outline ICs. These chip components have tolerance ratings equivalent to devices in standard packages.

Surface-mounted parts make it possible to substantially reduce the space requirements of a PC board. Aside from the savings in circuit board "real estate," performance improvements can be realized because of the shorter lead lengths and printed wiring runs required. Such conductors on standard PC boards are often a source of unwanted inductance and capacitance. Special packaging arrangements also make many surface-mounted components suitable for automatic PC board assembly.

Until now, the PC board industry has adapted methods and machinery from photography, metal finishing and laminating. But, with the added requirements being placed on board designers and manufacturers, the PC board industry is developing a technology all its own to accommodate increasingly sophisticated circuits. It is not at all uncommon today to find 4-, 6- and even 8-layer boards in computer-based equipment. Such construction techniques provide for exceptional device density. They also, however, make the board virtually impossible to service, even by factory technicians.



Researchers expect thin-film hybrid microcircuits to revolutionize the electronics industry because of their ability to pack great amounts of silicon into a small area. (Courtesy of Hughes Aircraft.)



Hybrid microcircuits are perhaps the most exciting development in packaging technology today. Hybrids permit much greater packing density than would be possible with a printed circuit board; plus, they offer better performance and reduced assembly time. (Courtesy of Hughes Aircraft.)

Manufacturers will continue to shift from conventional packaging to more exotic methods because of the complexity of new board designs. Higher-density input/output connections are coming, with surface attachment becoming the norm. New materials also are being used to make PC boards, including Teflon and ceramic substrates, aqueous-based photosensitive materials and merchants (developing and etching chemicals) that can be disposed of economically and in an acceptable manner. An increase also is expected in injection-molding techniques for PC board construction. New imaging and plating processes are being developed to allow the production of PC boards with still-higher density.

3-D PCBs

Everybody knows that printed circuit

No jamming in Inner Mongolia.

Cassette jamming is one of the biggest problems production crews face. Unless they're shooting with Sony Videocassettes. No wonder the producers of a recent documentary shot in Inner Mongolia chose to tape with Sony BCT Series Betacam® cassettes.

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Not that this surprises those of us at Sony Professional Videotape. After all, we've designed all our products around one basic premise: durability. To be frank, the demanding shooting conditions of Mongolia aren't as tough on our tape as we are.

BCT Betacam cassettes, for instance, combine a high-impact ABS anti-static cassette shell with a base film that's been given Sony's ultrafine carbon-black back coating. All of which ensures more uniform tape transport and superior winding characteristics. Among other things, this kind of runability helps keep Mongolians out of a jam.

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boards have to be flat, right? Wrong. A new method for manufacturing 3-dimensional molded circuit boards has been developed by the Allen-Bradley company. (See Figure 2.) The *molded circuit device* (MCD) technique uses a PC artwork "decal" through which the circuitry is transferred onto a 2-D or 3-D injection-molded substrate. There are two distinct processes: *transfer decal*, for single-sided PC boards; and *captured decal*, for multilayer boards.

The process involved is similar to screen printing used in conventional thick-film processing. The inks consist of approximately 75% silver flake (of the proper geometric size and shape) and the necessary chemical *vehicles* to make the silver flow and adhere to the finished surface. Another series of inks has been formulated for resistor applications. The resistive inks range from 10Ω to 1MΩ per square inch. Because the resistive inks are compatible with the trace inks, both may be printed on the same thin plastic decal.

Benefits of this approach include the capability to place components on any non-flat surface, such as a control panel that wraps around various display devices. Resistive ink offers the further advantage

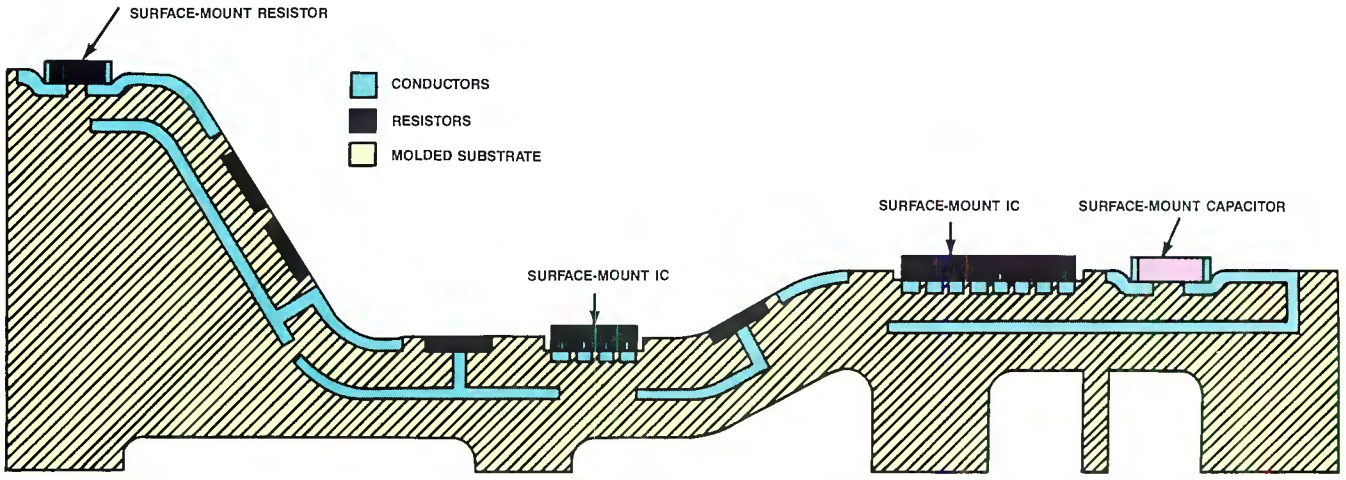
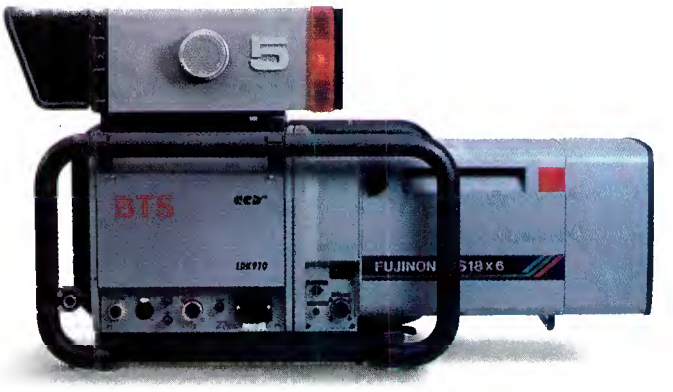


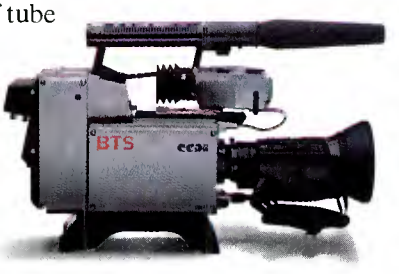
Figure 2. *New printed circuit board construction techniques permit conductor traces and devices to be placed on virtually any 3-dimensional surface. This* molded circuit device *(MCD) technology will make more compact components possible.*

Everything you always wanted in a tube camera. Except tubes.



LDK 910 CCD Studio Camera

What you've always wanted in a tube camera is the best picture possible. But now you get the best picture in a CCD Camera — the new BTS LDK 910. And you'll never miss the tubes. Because the LDK 910 meets or beats the picture quality of tube cameras with a new CCD sensor that employs over 800 pixels per line, and over 406,000 total picture elements.



LDK 91 CCD Portable Camera

In addition to excellent resolution, the LDK 910 has a high signal-to-noise ratio, high sensitivity and accurate colorimetry. Along with a few other things you don't get with tubes. Such as BTS's frame-transfer technology, which eliminates smear. A high dynamic contrast range without blooming or burn-in. And excellent dynamic resolution enhanced by advanced electronic shutter control. It's also ready to shoot when you are — no waiting for warm up.

And here's another reason you won't miss the missing tubes. Not only is the LDK 910 priced competitively with tube cameras, but it costs less than you'd probably spend replacing worn out tubes over the life of a studio camera.

But of course, big ideas also come in small packages. The LDK 91, a lightweight, easy-to-handle ENG/EFP camera, is the LDK 910's portable companion. Singled out by *Broadcast Engineering* magazine as one of the ten "Pick Hits" of NAB '89, it has the same CCD sensor and the same top picture quality as the LDK 910.

Together, these fully compatible CCD cameras will make your old ideas about picture quality go right down the tubes. For complete information and technical specifications on the new LDK 910 and LDK 91, call BTS at **1 800-562-1136, ext. 11.**

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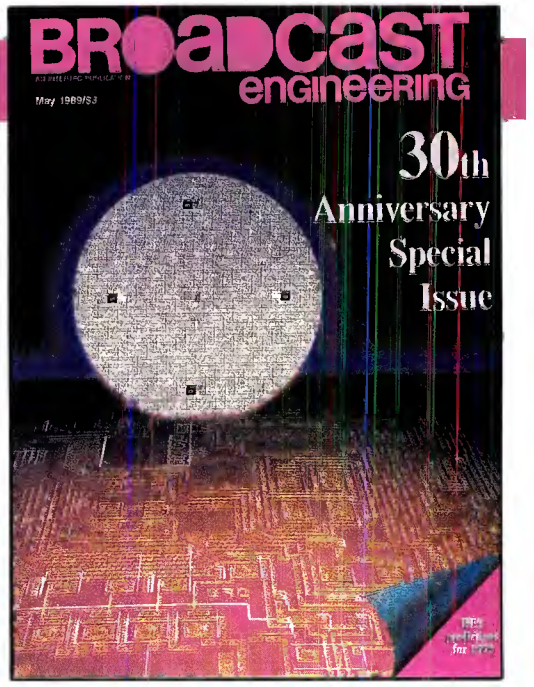

Advanced technologies

By Jerry Whitaker, editorial director

Satellites and computers have brought revolutionary changes to communications in general, and broadcasting in particular.

"An artificial satellite at the correct distance from the Earth would make one revolution every 24 hours; i.e., it would remain stationary above the same spot and would be within optical range of nearly half the Earth's surface. Three repeater stations, 120 degrees apart in the correct orbit, could give television and microwave coverage to the entire planet."

—Arthur C. Clarke, 1945

In December 1947, Dr. William Shockley of Bell Laboratories changed the course of history by demonstrating to his colleagues a newly invented device that exhibited what he called the *transistor effect*. From this demonstration and a later one at the Bell Labs in New York City on June 30, 1948, sprang one of the most important inventions of the 20th century — the working transistor. (The phrase "transistor" was coined as a contraction of "transfer resistor.") For their development efforts, Bell Telephone scientists John Bardeen, Walter H. Brattain and Shockley received the Nobel Prize for physics in 1956.

The first experimental transistor made its debut as a metal cylinder $^{3}/_{16}$-inch in diameter and $^{5}/_{8}$-inch long. Today, transistors are fabricated in dimensions finer than the wavelength of light. The first integrated circuit, made 30 years ago, had two transistors and measured $^{7}/_{16}$-inch long and $^{1}/_{16}$-inch thick. Today, a VHSIC (very high-speed integrated circuit) die with as many as 300,000 transistors literally could be set, like a gemstone, in a ring.

The transistor represented an economic and durable alternative to vacuum tubes. Tubes were big, fragile and had a relatively short operating life. They consumed lots of power and, as a result, got very hot. Transistors offered a way to produce a product that was compact, efficient and reliable.

Eager to exploit the riches of solid-state technology, engineers drew up complicated circuits, cramming boards of discrete devices into tight little islands.

What made transistors distinctive was that they were fabricated from a single solid material that either insulated or conducted, depending on the purity of the base material. A solitary transistor could be scribed on nothing more than a chip of germanium (subsequently supplanted by silicon). Eager to exploit the riches of solid-state technology, engineers drew up complicated circuits, cramming boards of discrete devices into tight little islands.

On paper, the complex linkages worked like a Swiss watch. But on the factory floor, technicians went balmy trying to make all those interconnections. Labor costs for assembly and testing greatly exceeded the total cost of components.

The first completely transistorized computer required connections to 25,000 transistors, 100,000 diodes and more than a million other components. Engineers foresaw the need for 10 million component computers for equipment of the 1960s. It might take 10 times that many hand-soldered connections.

IC to the rescue

With the sheer numbers of connections and components getting out of hand, designers clustered a number of resistors, diodes and transistors into one crystal flake. They linked the components together with metal lines deposited to form a complete circuit out of one block of material, and the *monolithic integrated circuit* was created. The IC threw open the door to a brand-new universe of possibilities; a universe filled with microprocessors, programmable gate arrays, CCD imaging devices, and hundreds of other complex LSI (large-scale integration) and VLSI (very large-scale integration) components.

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Although the first-generation bipolar IC amplifier appeared in 1966, it was not until 1973 that the IC was able to overtake discrete transistor designs in terms of cost and performance. Meanwhile, the miniaturization process for metal oxide silicon (MOS) devices also paved the way for advancements in dynamic random-access memory (DRAM) and microprocessor chips. Between 1970 and the present, DRAM technology grew from 1kb to 4Mb per chip, a 4,000-fold increase in memory capacity. Microprocessors have seen similar density improvements, from 4-bit devices in 1972 to 32-bit devices today.

The *design rule* (minimum trace width) has decreased from 10μm in 1970 to less than 1μm today. At the same time, wafer size has increased from 50mm in 1970 to 150mm today. Figure 1 charts the progress of MOS device technology. The computer industry's insatiable appetite for memory continues to drive semiconductor manufacturers to produce devices with greater density. Figure 2 shows the progress made in DRAM technology in this decade alone.

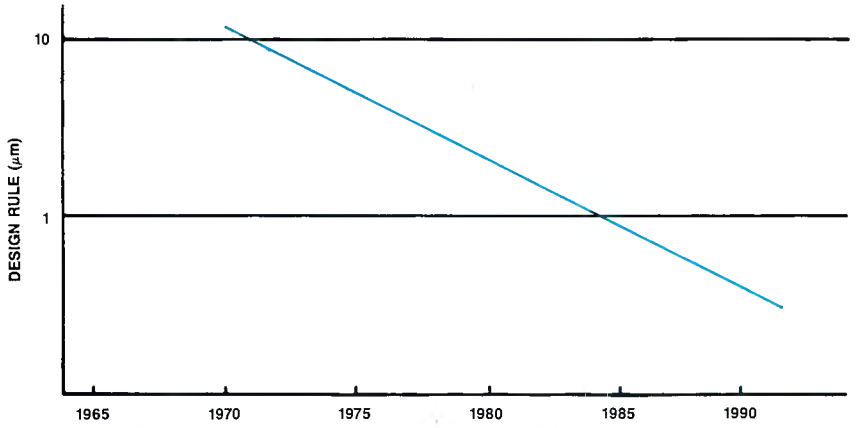

Figure 1. *The evolution of MOS device technology. The* design rule *refers to the minimum trace width on the IC die. (Data from "JEI," June 1988.)*

Broadcasters and broadcast equipment manufacturers have been eager to implement these new devices because of the compactness, reliability, flexibility and efficiency that they afford. Advanced ICs have made possible and practical many technologies that we take for granted, such as satellite communications and a whole range of computer-based systems.

Satellites become a reality

The phrase "live via satellite" is commonplace today. Communications satellites have meant not only live coverage of world events, but also more service to more people at lower cost. "Live via satellite" characterizes the evening news and special events such as the Olympics.

The potential for the use of satellites for broadcasting was first demonstrated in 1960 with the launching by the United States of Echo 1 and Echo II. These passive reflector satellites bounced radio signals across the Atlantic. This type of sat-

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Keith Nealy stages events. Big ones. Imagine 8 or 9 computers (he uses Amigas) creating images that are projected then onto screens (or played on large monitors); imagine superimposing graphics (generated on the Amigas, of course) onto video (also handled by the Amigas); imagine doing these kinds of multi-media events for clients such as:

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ellite, however, left a lot to be desired for communications purposes. Echo was superseded by Telstar 1, an active repeater satellite, launched two years later. Telstar demonstrated that color TV signals could be broadcast reliably across the oceans. Telstar captured the interest and the imagination of the public. It accomplished what had been impossible before.

The first live trans-Atlantic telecast was relayed by Telstar on July 10, 1962. The picture was of the American Flag fluttering in front of the sending station at Andover, ME. More panoramic telecasts, showing life in widely distant places, were exchanged between the United States and Europe 13 days later.

Comsat enters the picture

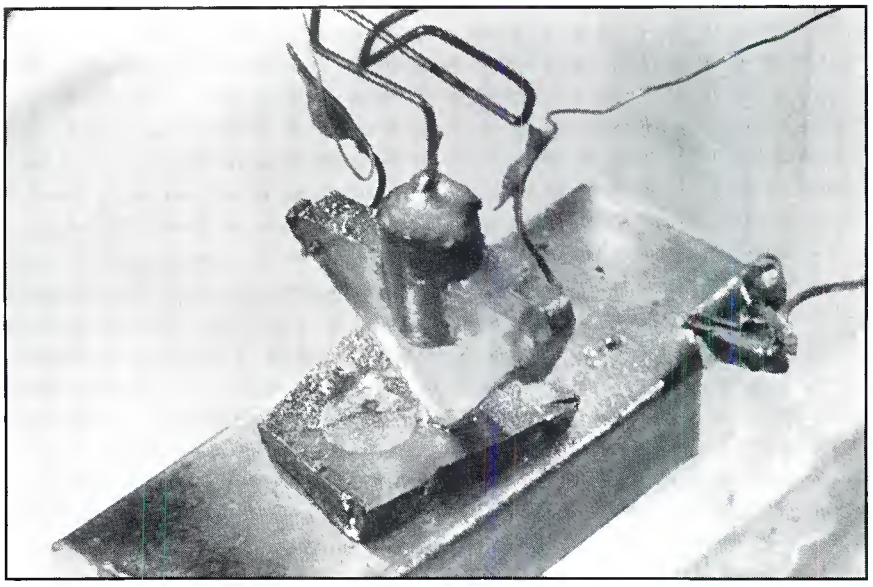
With the potential of international communications becoming increasingly apparent, Congress passed the Communications Satellite Act in 1962, which, among other things, created Comsat. Under the legislation, Comsat was charged with responsibility for establishing, in cooperation with organizations in other countries, a global commercial communications satellite system as quickly as possible.

U.S. initiative under the Communications Satellite Act, combined with growing international interest in the new technology, led to the formation of Intelsat in 1964. Acting as a technical manager of Intelsat during its initial growth period, Comsat developed Intelsat's first geosynchronous commercial communications satellite, Early Bird. The project brought to reality the concept envisaged some 20 years earlier by Arthur C. Clarke, the noted British science fiction writer.

Telstar demonstrated that color TV signals could be broadcast reliably across the oceans.

Early Bird (also known as Intelsat I) was launched from Cape Kennedy on April 2, 1965 and placed into synchronous orbit 22,300 miles above the coast of Brazil. The launch marked the first step toward a worldwide network of satellites linking the peoples of many nations. Early Bird, the only mode of live trans-Atlantic television, provided in July 1965 the first live telecast (via Intelsat satellite) to the United States, a U.S.-vs.-U.S.S.R. track meet.

Although it was a dramatic improvement over the trans-Atlantic telecommunications facilities at the time, Early Bird was nonetheless limited in capacity and capability. For example, in order for the only TV channel to be operative, all 240 voice channels had to be shut down. Furthermore, the cost of Early Bird time was extremely high, compared with today's rates. For example, the 1965 rate for a color TV transmission between New York and Paris was $13,070 for the first 10 minutes and $240 for each additional minute. Prices have, in fact, declined 19-fold, factoring in inflation.



The device that changed the world. The first point-contact transistor, assembled on Dec. 23, 1947, at Bell Laboratories. The device amplified electrical signals by passing them through a solid semiconductor material — the same basic operation performed by present-day junction transistors. (Courtesy of AT&T Archives.)

For example, the 1965 rate for a color TV transmission between New York and Paris was $13,070 for the first 10 minutes and $240 for each additional minute.

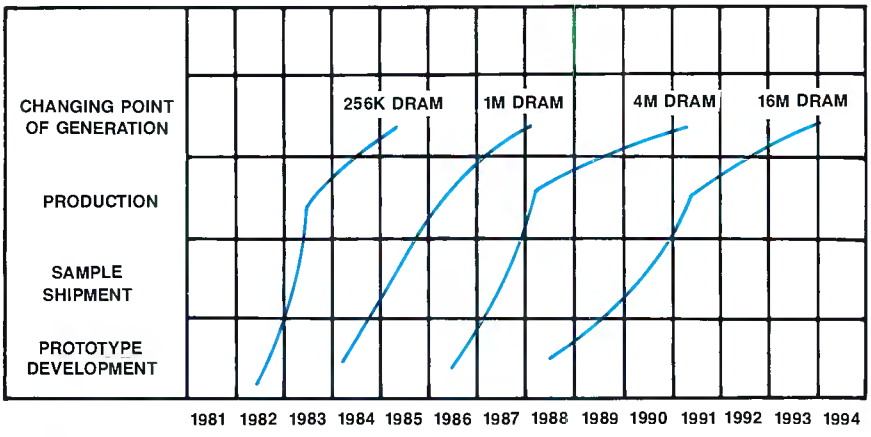


Figure 2. *The progression of dynamic random-access memory (DRAM) technology during this decade. The quest for greater memory capacity continues to drive semiconductor manufacturers to produce chips with greater packing density. (Data from "JEI," June 1988.)*

Following Early Bird's introduction to service in the Atlantic Ocean region, the challenge remained to develop a global network. The next step in that goal was met on July 11, 1967, with the successful launch of Intelsat II, which established satellite communications between the U.S. mainland and Hawaii. Intelsat II made possible live network TV transmissions to Hawaii for the first time. Two years later Intelsat III was launched for Indian Ocean

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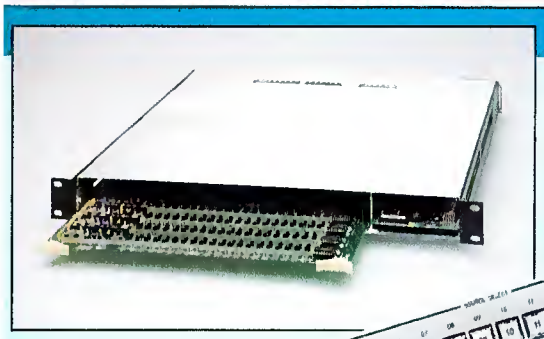
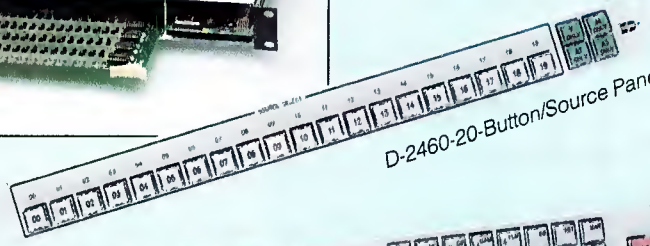
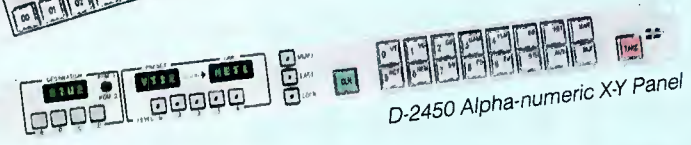
20x10/20x20 ROUTING SWITCHERS




D-2460-20-Button/Source Panel


D-2450 Alpha-numeric X-Y Panel


D-2460-20/10 Pushbutton X-Y Panel

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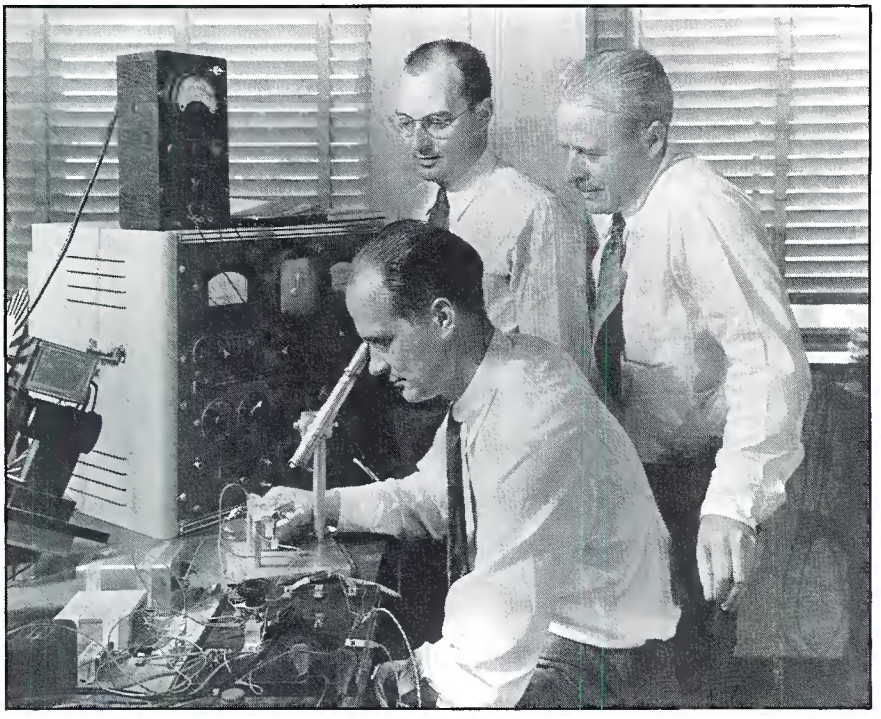
region service, thereby completing the provisions of global coverage.

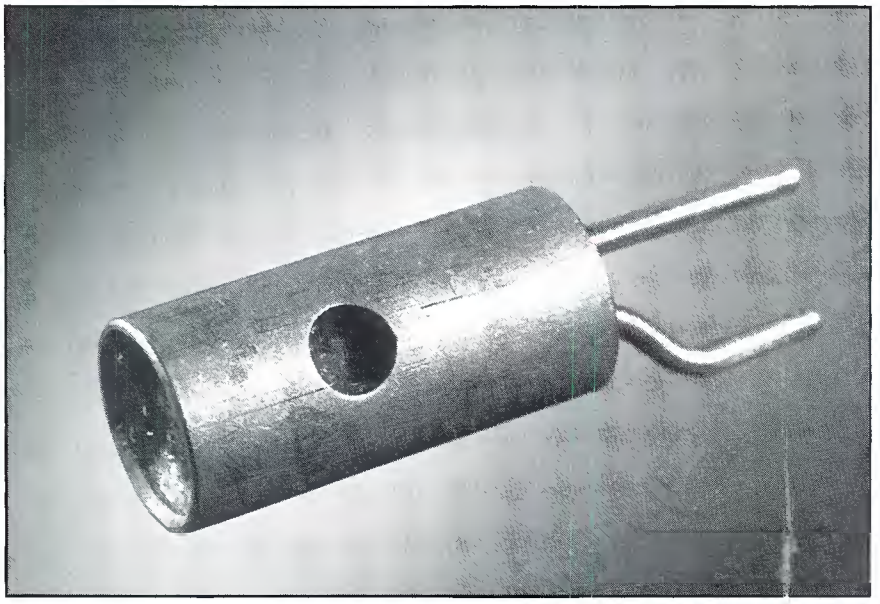
Fortuitously, global coverage capacity was in place just in time for what has been estimated as the largest TV audience in world history, to see man set foot on the moon. What had been a vision by Arthur C. Clark two decades earlier, and a formidable legislative mandate more than a decade earlier, was now a reality.

Establishing an international network was only the beginning, however. Development and maintenance of succeeding generations of satellites — providing expanded services at lower costs, with enviable reliability records — has been a continuing challenge. The sixth generation of international satellites is nearing launch. Each will have capacity for 30,000 simultaneous telephone calls and three TV channels.

Just 24 years have elapsed since the introduction of Early Bird in 1965. Yet, the effects on the world community in general, and broadcasting in particular, have been dramatic.



The team that made it happen. Dr. William Shockley (seated) initiated and directed the Bell Labs transistor research program. Dr. John Bardeen (standing, left) and Dr. Walter H. Brattain were key scientists in bringing the invention to reality. (Courtesy of AT&T Archives.)



The first point-contact transistor to find commercial use in the United States (Bell Labs code No. 1). Although it was announced to the public in 1948, it was 1952 before transistors similar to this one assumed an active role in the Bell System communications network. (Courtesy of AT&T Archives.)

Stations automate

Since its inception, the broadcast industry has been known for its technical advances. But, when it came to the automation of station functions, broadcasting had to be dragged into the computer era. Automatic execution of preprogrammed events dates back to the late 1950s, with electromechanical contraptions built basically around relay logic. The 1960s brought improvements in devices, but the same basic *sequencer* concept remained. It was not until the 1970s that computers were used to control machines at radio and TV stations. This added considerable flexibility and reduced on-air errors, but integrating the "front office" functions with machine control in an effective manner has been a formidable challenge.

...global coverage capacity was in place just in time...to see man set foot on the moon.

The industry was reluctant to automate logging, availing and other business functions in the early days because many of the systems available at the time just didn't work. In the early 1960s, several attempts were made to computerize the business end of station operation, but most turned out to be expensive failures.

Early attempts by computer programmers consisted essentially of modifications to standard inventory programs. The programmers thought that with a few changes, software that could inventory a million pairs of shoes could easily handle a few thousand TV or radio spots.

These efforts failed to account for the difficulty of spot rotations, competitive product protection, time limitations, copy rotations and pre-emptible selling methods. They all seemed to take the approach of working backward from the billing and accounts receivable. This was primarily because inventory and A/R programs were available at the time for other businesses, and scheduling programs were not. It was not until broadcasters began to work with programmers on the front end of the problem (the log), that real progress began to be made.

The UBIQUITOUS STANDARDS CONVERTERS

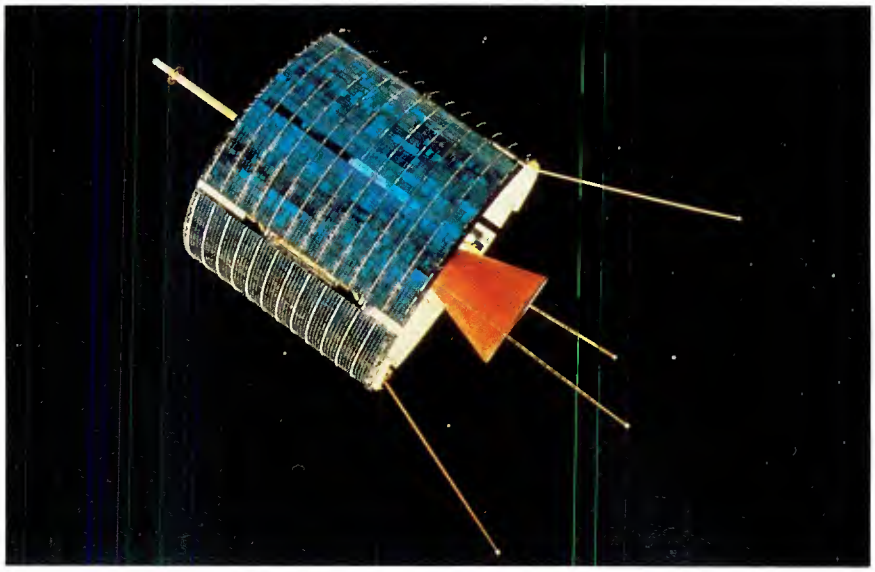
- The world's only complete range of standards converters. More than ten models, including multi-standard, multi-featured, 4-field, 4-line machines with *Advanced Motion Processing* for the most demanding broadcast applications – plus the world's only multi-standard HDTV Down Converter.
- Total upgrade path through the converter families – when your needs grow they grow with you.
- Six machines in one. Besides offering broadcast quality conversion, MSW converters also serve as time base correctors, synchronizers, color correctors, enhancers and powerful noise reducers.
- All fully supported by our range of grade-one multi-standard decoding and monitoring equipment.

Designed, built and used by broadcast professionals

Circle (50) on Reply Card

MERLIN SNELL & WILCOX

In the mid-1960s, there were a few stations working with IBM *unit record* machines such as the 402 and 403 to print logs, invoices and various other reports. These unit record systems used keypunch cards; by punching a card for each spot ordered, they were able to sort and total them in a variety of ways, creating the needed reports. The shortcoming of this approach was that the cards had to be manually placed to create the log, and the system had no capability to actually schedule the spots, rotate them or protect them against competing products. The unit record machine merely used the same card sorted differently for a variety of purposes.

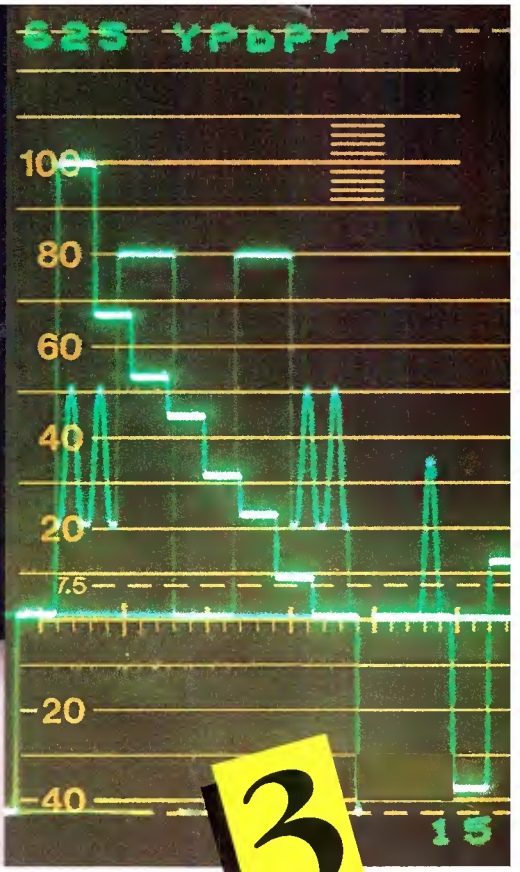


Intelsat I (Early Bird), the world's first commercial communications satellite, was placed in service in April 1965. It established the first satellite pathway between the United States and Europe and made live trans-Atlantic TV possible. (Courtesy of Comsat.)

A practical system emerges

The first truly computerized system to be marketed nationally was developed by BCS (Broadcast Computer Services) at KVOR-AM, Colorado Springs, CO. Members of the station staff had been conferring with Kaman Sciences on an accounting program for payroll, general ledger and balance-sheet functions. During the discussion, they decided to try to do the entire job, from logging through billing to accounting. The system, although rudimentary, worked and was put into service at KVOR in 1968.

The system used an algorithm that was able to log spots based upon contract entry. It started and stopped them according to the contract, protected them against competing products, limited commercial times to comply with FCC and NAB codes, and handled copy assignments. In addition, the system created sales projections,



1

2

3

Figuring out what test signals you need to test all the video formats you use — that's the *easy* part. What's complicated is getting them where you need them to go. Who has room for two or three different signal generators for every rack of equipment?

MAGNI knows that space is as important to you as function. And the new Signal Creator™ brings you the best of both worlds: all the flexibility of a fixed-format/programmable generator in one go-anywhere package.

Inside the unit, precision hardware provides you with full 10-bit digital signal generation. Outside Signal Creator,™ signals are stored on a memory card that fits in your wallet. Testing NTSC equipment? Insert the card, and a full NTSC signal set is automatically downloaded and stored: just make your choice from the display menu. Need to switch to component signals? D1 or D2? PAL? Choose another memory card, and the new format is there at your fingertips — you can even load Signal Creator™ with custom signals tailored to your needs.

No duplicate instruments or complicated programming: just multi-format testing where you need it, when you need it.

An idea that's as easy as…

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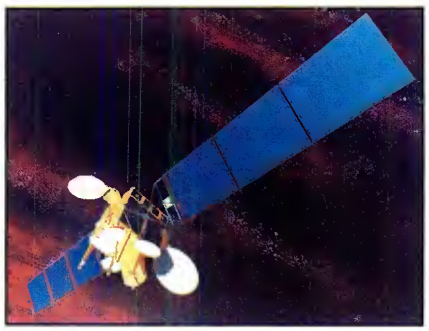


An artist's drawing of the latest-generation communications satellite, Intelsat VIII. (Courtesy of Comsat.)

invoices, accounts receivable reports and income analysis, all through a single contract entry.

Later the same year, BCS developed and installed its first TV automation system at KOOL-TV in Phoenix. It was a batch system, whereby keypunch cards were prepared throughout the day, then transmitted at the end of the day to Kaman's large-scale CDC computer for processing.

The next major breakthrough came in 1970 when Data Communications Corporation (DCC), Memphis, TN, developed and installed its BIAS system at WMC-AM/FM in Memphis. The idea for BIAS came about when Manry Gregner, manager of WMC, and Jim Frommel, business manager, went to the First National Bank of Memphis to see whether their large Burroughs computer could be used to run the BCS system.

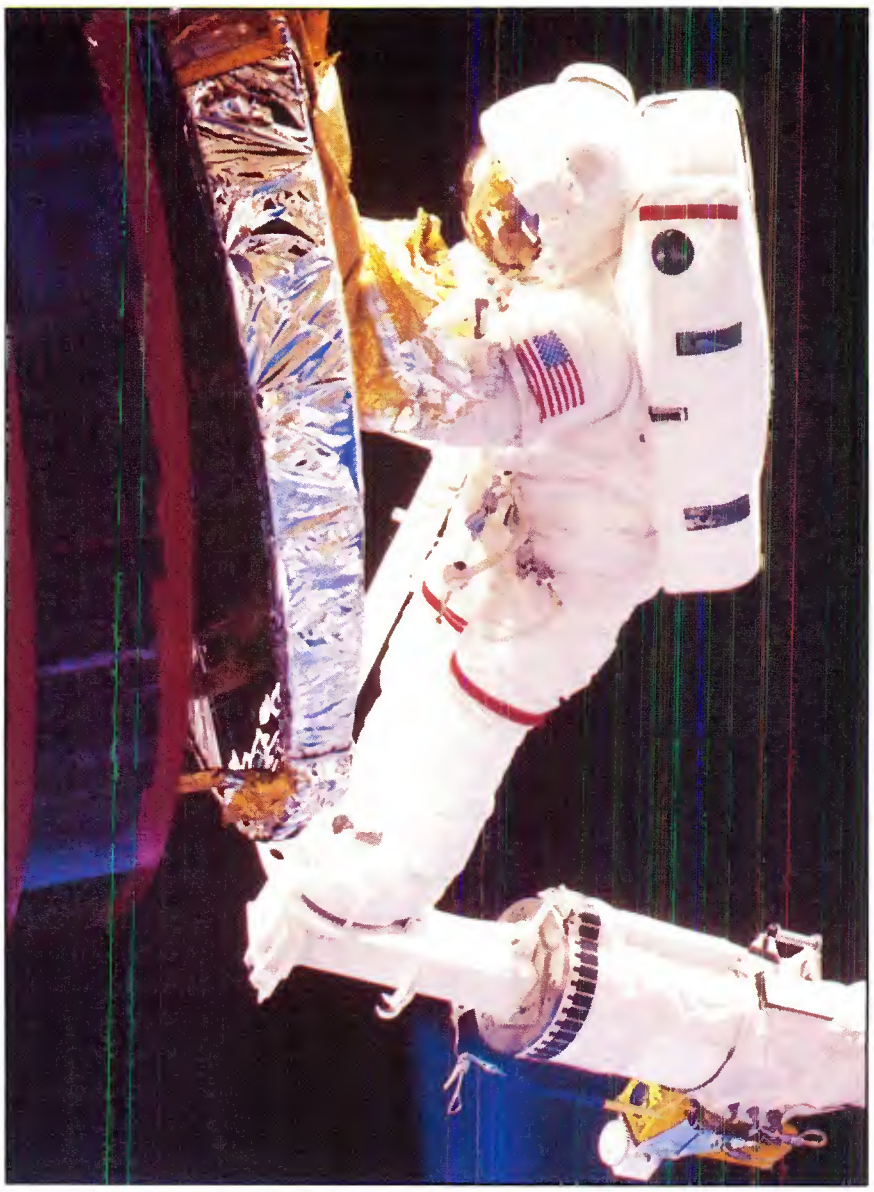
The programmers thought that with a few changes, software that could inventory a million pairs of shoes could easily handle a few thousand TV or radio spots.

Norfleet Turner, an officer of the bank, became interested in the opportunity, and the bank's computer department, in cooperation with Burroughs, began development of the system for WMC. The BIAS system differed from BCS in that it was an on-line arrangement with in-station terminals directly connected to the Borroughs mainframe in Memphis throughout the entire day.

IBM and Metromedia teamed up in 1970 to design the BITS system for KTTV-TV, Los Angeles. The system had been co-developed by Metromedia and IBM back in 1967. BITS used an IBM 360 computer that Metromedia had installed at its corporate headquarters in Los Angeles. The system was not installed at other stations in the company chain because of the size of computer required.

Several other groups, working with IBM, attempted to modify the BITS system to make it workable on smaller hardware, but failed to develop a satisfactory product. At about the same time, Bill Cole and Joe Coons had developed systems that could run on small computers, which could be installed in stations at an affordable price. The systems were designed for radio, then modified for TV applications. Bill Cole's Columbine system was converted from unit record equipment to IBM's System 3 in 1971. The following year, Joe Coons, who had been working for IGM in its computer division, formed what was to become Paperwork Systems. KLEB-AM, Golden Meadow, LA, was the first station to install the system, which used an in-house Data Point 2200 minicomputer.

Development of the Jefferson Data system began in 1969 with an approach that differed from the others in that it used distributive processing. The Jefferson system placed a minicomputer at each station for data entry, editing and other applications. The mini also served as a terminal to transmit data to a large, central-site computer. The company's first radio system



Space Shuttle Mission 51-A made history in November 1984 by retrieving two defective satellites — Westar VI and Palapa B2 — from orbit. Astronaut Joseph Allen is shown securing the Westar satellite while standing on a mobile foot restraint attached to the Shuttle's remote manipulator arm assembly. (Courtesy of NASA.)

PERFECT MATCH

FOR COMPONENT/NTSC SYSTEMS

With the introduction of the new WFM300A Component/Composite Waveform Monitor and TSG-370 Component/NTSC Generator, Tek has the ideal combination, ideally priced, for operation and maintenance requirements of mixed-format television.

X Y mode is useful for stereo audio phase measurements.

You can monitor composite waveforms with the WFM300A and display composite vectors on a companion 1720 Vectorscope.

Tek's 1700F05 Dual Rackmount for matched-system use offers adjustable mounting depths.

Vector center dot clamping makes it easy to detect residual subcarrier on a signal.

The 1720 is precalibrated for 100%/75% color bars.

Precision phase control permits excellent resolution around a full 360 degrees.

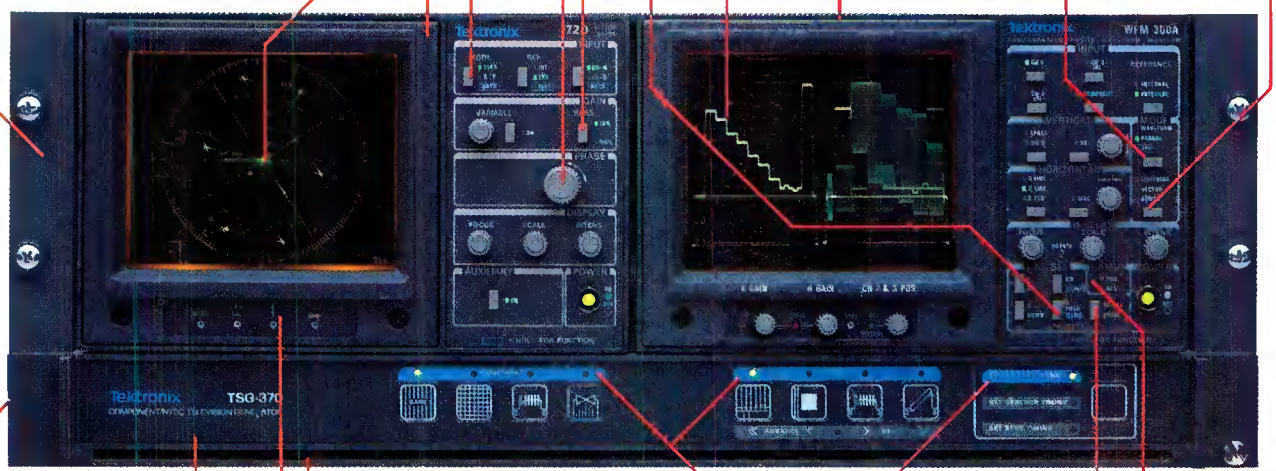
On-screen menus are used to select electronic graticules for different component formats and 525/60 or 625/50 line/field rates.

The new WFM300A provides component and composite parade displays side-by-side for direct comparison.

Tek's innovative Lightning display allows monitoring of important component parameters using conventional color bars.

Bowtie mode uses the TSG-370's Bowtie timing test signal to ensure precise system timing.

The WFM300A offers separate GBR and composite picture monitor outputs.



The TSG-370 provides six component and five composite test signals to satisfy routine equipment setup and maintenance requirements.

R-Y output is included for differential phase measurements.

The new TSG-370 has completely independent component and composite test signal generators. Both use 10-bit signal generation in all channels.

The TSG-370 is available in Betacam®/NTSC and MII/NTSC versions.

Six black burst outputs, a comp sync and comp blanking output are provided for equipment synchronization.

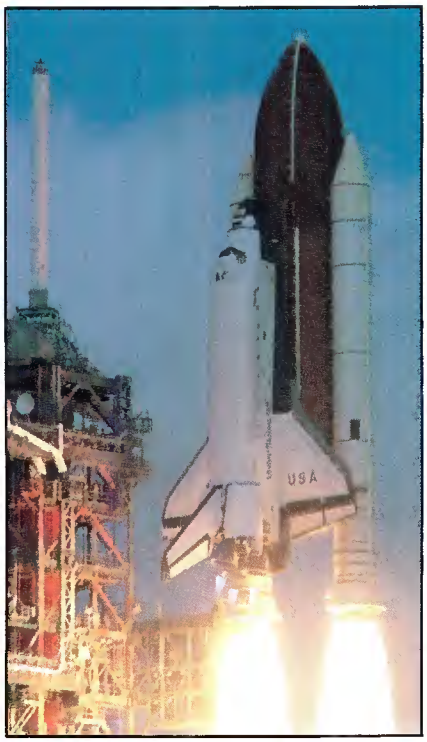
Front panel user recalls promote fast, efficient operation.

Color gamut violation indication is given if limits are exceeded.

Full color genlock simplifies integration of the TSG-370 into an existing system.

Tektronix
COMMITTED TO EXCELLENCE

Circle (89) on Reply Card



The Space Shuttle, first launched in 1981, provided the means to place a variety of commercial and military satellites in earth orbit. The Challenger disaster, on Jan. 28, 1986, delayed the launch of any new satellites using the Shuttle for more than 2½ years. (Courtesy of NASA.)

Automation systems have changed dramatically within the past two decades. Shown is the IGM 500 series automation system, which used electromechanical timers for setting up format breaks. An early version of the Instacart can be seen on the left. (Courtesy of IGM.)

went into service at WBTV-TV, Charlotte, NC (owned by Jefferson Pilot), in 1970. During the following year, TV automation systems were installed at all Jefferson Pilot TV stations.

Cox Broadcasting also formed its own data services operation, Cox Data Services, in 1969 and began development of an on-line system. The original system used a Honeywell 1648 as the host computer. Cox had been a pioneer in various types of broadcast computerization at its flagship station, WSB-AM/FM, Atlanta. The first non-Cox station to go on-line was KSD-FM, St. Louis, in June 1972.

In that same year, Compunet, the first successful national on-line radio system, was marketed. The system used in-station terminals connected to a large Control Data computer. Compunet was developed by Ed Stevens, formerly a manager at KVOR.

In 1974, BCS, Central Dynamics Ltd. and Metromedia's WTCN-AM in Minneapolis developed and installed an interface between the station's traffic system and the CDL automated switcher. The log was sent to the control room switcher, the events scheduled and the *as-aired* log transmitted back to the traffic system. This automatic update of billing information made WTCN the first completely automated TV station.

The more things change...

Beginning with the May issue of **Broadcast Engineering**, we have traced the development of radio and TV technology from the early days to the present. The accomplishments have been remarkable. We owe a great deal to the many pioneers of the art and science of broadcasting. They created and shaped an industry that has a significant impact on the daily lives of citizens in every country on earth.

It is easy to ignore history, and to conclude that the problems faced in years gone by hold no lessons for today. A closer examination, however, will reveal the truth of the old saying, "The more things change, the more they stay the same." The best way we, as an industry, can plan for the future is to look backward at the roads that brought us to the present.

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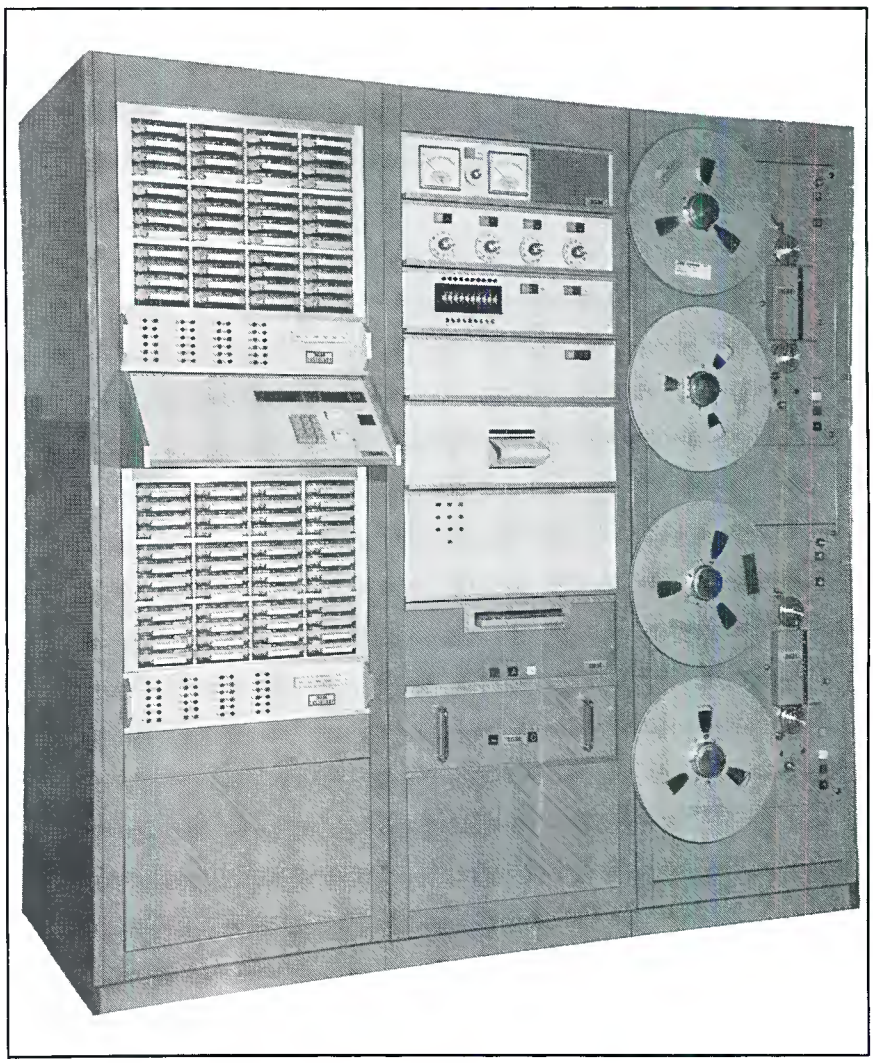


The IGM 600 automation system, which used punch cards as the programming source. Note the card reader at the left, and the full rack-and-a-half of electronics used to drive the system. (Courtesy of IGM.)

This switcher handles standard bandwidth like it's going out of style

TVS/TAS-3000 Distribution Switcher

The new TVS/TAS-3000 video/audio distribution switcher from BTS handles standard bandwidth switching in stride. But the fact is, standard bandwidth may not be the standard much longer. And that's why the TVS/TAS-3000 is not your standard switcher.

With the advent of wide bandwidth video, you'll need a switcher that can handle the new higher bandwidth signals. The 3000 will. It provides a video bandwidth of more than 50 MHz, measured with a full-amplitude sine wave or video signal. Which makes it upwardly compatible with HDTV or computer graphics—no matter what the standard.

The TVS/TAS-3000 also delivers the cleanest signal and expands to accommodate any matrix size to meet your specific needs.

And if high bandwidth capacity isn't a requirement, BTS still has you covered with our best-selling switcher, the TVS/TAS-2000. The 2000 represents the same advanced technology and quality as the 3000 in a standard bandwidth switcher. BTS also offers a full-range of control panels and distribution amplifiers for a complete system designed, tested and guaranteed by one supplier.

All BTS switchers undergo 100% computerized factory testing and are protected with a 5-year warranty. In the unlikely event you do have a problem, simply return the board for a free replacement.

Dependable, performing switchers from BTS. Anything else is substandard. Call for information and technical specifications today: **1-800-562-1136, ext. 21.**

BTS

The name behind what's ahead.

BTS is Broadcast Television Systems, a joint company of Bosch and Philips. P.O. Box 30816, Salt Lake City, UT 84130-0816.

Circle (55) on Reply Card

1989 Annual Editorial Index

The "Annual Editorial Index" is designed to put a year's worth of **BE** articles at your fingertips. Here's how you use it.

The index begins with a month-by-month compilation of all feature articles, regular columns and field reports that appeared in the magazine during the past year. Where applicable, each article review includes a brief list of key words—words and phrases that were defined and used in the story.

Beginning on page 114, you will find a cross-reference listing of articles and columns, arranged alphabetically by general subject area. If you know you saw an article about a particular topic, but can't remember which issue, this listing will guide you in the right direction, and maybe lead you to a related article.

January 1989

Theme: Broadcasting From the Field

Editorial (page 6)
• No guts, no glory
(How do you spell success in broadcasting in the 1990s? Innovative and creative ways to meet challenges in every department and a concerted effort among departments bring greater rewards than copying.)

FCC Update (page 8)
• Rule changes permit short-spaced assignments for FMs with directional antennas.
• City-of-license rules allow change of city without challenges on license assignment.
• Synchronous AM not authorized, based on unresolved technical difficulties.
• One-to-a-market rule refined to allow for multiple ownership of radio, TV stations in selected markets on waiver basis.

Strictly TV (page 10)
• Inside the Visual PA, Part 4
(Picture quality relies on overall linearity and ability of the system to react to transients.)

re:Radio (page 12)
• Time may be ripe for new low-power FM
(A booster or translator increases the power level in the primary service area, while LPFM systems, like regular FM stations, extend coverage area.)

Satellite Technology (page 14)
• A look back at 1988
(A relatively quiet year saw little malicious interference of satellite broadcasts; most satellite channels went scrambled; fiber-to-the-home services advanced quietly; flat TVRO antennas were introduced; and networks and broadcasters lost more ground to alternative program and entertainment sources.)

Circuits (page 16)
• Semi-custom ASICs
(Application-specific integrated circuits, ASICs, offer lower costs to new designs by starting from devices more closely suited to the design objective.)

Troubleshooting (page 18)
• Use a color scheme for wiring
(Color coded wiring and labels facilitates circuit and signal tracing.)

Management for Engineers (page 20)
• Management profiles, personalities, Part 1
(A world of different personalities requires management skills to cater to variations in order to work successfully with all employees.)

• **Planning for Mobile Operations** (page 26)
by Richard Rudman, C.E., KFWB-AM, Los Angeles
Design and construction of a practical news vehicle combines technical needs of relays from remote sites with reasonable working conditions for the staff. A full-sized vehicle with a heavy-duty "police" package is advised. Equipment mounting calls for ingenuity for convenience and efficient operation.
Key words: vehicle accessories, security, mixer, recorder, RPU, cellular phone, mounting, power, noise.

• **Using Cellular Telephones** (page 42)
by Michael Heiss, consulting editor, Los Angeles
Cellular telephones receive broadcasters' approval because of voice, data and fax capability the technology affords. Different styles, from mounted to portable units, allow new freedom to users, as does roaming between cells while keeping in touch with the station.
Key words: cellular, transportables, dual NAM, roaming, data, fax transmission.

• **Computerized Election Reporting** (page 52)
by Mark Fenton, KSL-TV, Salt Lake City
The radio/TV public expects accuracy and speed in election news reporting. To serve the audience, KSL constructed a system with remote PCs, a LAN within the facility for rapid data transfer, methods to improve data integrity and other ways to make election night coverage more valuable.
Key words: LAN, modems, error detection, remote PCs.

• **Ethernet in the Newsroom** (page 58)
by Tyler North, automation consultant, Dynatech, Madison, WI
An ideal automation system handles equipment operation requirements as well as communications with people and information sources beyond the station walls. Networks can be used, including Ethernet LAN, a non-centralized structure that expands in any direction from any point for the most flexibility.
Key words: LAN, linear, star, tree, Ethernet, CSMA/CD, taps, token ring.

• **The Chemistry of Batteries** (page 68)
by Carl Bentz, technical editor
Different battery chemistries offer different advantages, but all involve balanced chemical reactions among the ingredients making up the battery cells. An overview of chemical processes inside lead acid and nickel-cadmium batteries notes new portable power technologies that may be available soon.
Key words: chemical reactions, NiCad, lead-acid, charging.

• **Tracking the State-of-the-Art** (page 78)
by Jerry Whitaker, editorial director

Auditronics' 400 is the best production board for the money,"

Bumper Morgan, Producer WYHY-FM

Cameron Adkins Chief Engineer WYHY-FM A Jacor Communications station

says Cameron Adkins, Chief Engineer of Nashville's outrageous Y107 FM. "In fact, Auditronics' sound has helped make us number one in our market for the last five books, and we expect to capture our sixth one as well."

"After looking at all the production consoles that were out there, we found the Auditronics 400 was the best buy for the money. It had more useful features than any other console in its class, and was less expensive overall. So we decided to buy it not only for WYHY here in Nashville, but for two of our other stations as well."

"We bought the light-bar metering version because the ballistics and characteristics are more meaningful for what the production engineer needs to know. Our producer, Bumper Morgan, likes the light bars better than conventional VU meters because he can see from across the room if he's got one channel a little hot without having to stare at the board all the time. The light bars also give the console a high-tech look that helps our sales people when they bring ad agency and client types in, because the 400 gives us the best looking production room in town."

Bumper Morgan, Producer at WYHY says, "Auditronics has really set a new standard in radio production consoles. Going from our old board to this 400 was like going from night to day. The light-bar display gave me instant gratification. I use the foldback modules a lot. I like the range of the eq and the very clean overall sound of the board. Besides our own work, I do a lot of promos, sweepers and liners for other broadcasters from Honolulu to New York, and I continually get compliments that the sound of our packages helps stations sound better than their competitors."

Adkins says, "The Auditronics 400 was easy to wire in. And nobody's board surpasses this 400 for reliability or stability. We're a heavily produced station with seldom a break that we don't air something that was produced here on this board. Even with this heavy workload, we've had zero failures. Literally nothing has gone wrong since day one," he says.

Call 1-800-638-0977 toll-free today for more information on the 400 production console Cameron Adkins buys.

auditronics inc.

Auditronics, Inc., 3750 Old Getwell Road, Memphis, Tennessee 38118 • 901 362 1350

Circle (76) on Reply Card

The race between broadcast and consumer equipment performance continues, with the gap narrowing. The article describes audio tests measuring various FM receivers to find how well they performed. Results show that the FM station maintains an edge over the receivers, but the distance between the levels of performance is decreasing.
Key words: distortion, signal/noise ratio, frequency response.

Show Replay (page 102)
• Denver (SBE) show, a mile-high triumph
(With 3,300 attendance, 197 vendors and an expansive seminar program, the BE/SBE conference and '88 SBE national convention in Denver served a wide audience.)

Show Replay (page 106)
• Network unveils an HDTV surprise
(The 1988 SMPTE conference and exhibition, Javits Center, New York, hosted an HDTV system introduction by NBC. Products and concepts for improved NTSC transmissions and TV in general were introduced or discussed.)

SBE Update (page 110)
• Express your view on licensing issues. "What is an engineer?" the State of Texas asked and debate resounded from all sides.
• PCB disposition is a subject of concern.
• Frequency coordinator list is available.

News Special Report (page 112)
• Updating the VOA
by James Wood, consulting engineer
(Voice of America modernized after detailed analysis of products before letting contracts for AM and shortwave equipments.)

Applied Technology (page 114)
• Doubly truncated waveguide
(An investigation of suggested benefits of hollow circular waveguide leads to introduction of doubly truncated waveguide, a transmission feedline that does not support cross-polarization and does not require tuning, absorbing loads and other hardware required by circular waveguide material.)

Field Report (page 119)
• Gentner VRC-1000 remote control.

Station-to-Station (page 123)
• Audio step generator makes testing easier
(For construction project aficionados, a suggested circuit forms an audio tone generator to step through the spectrum of interest for response tests.)

February 1989
Theme: Dealing With Digital Technology

Editorial (page 6)
• "We're just here to help"
(The FCC deregulated licensing of broadcast engineers; now state governments propose to be involved in an area not designated for state control. For determining an individual's qualification for engineering positions, the SBE certification program is superior to any state jurisdictional body.)

FCC Update (page 8)
• Protecting your station from PCB problems; review of EPA rules regarding polychlorinated biphenyls in power transformers and other electronic components.
• 24-hour ban of indecent material in place by congressional action.
• Anti-trafficking status quo withholds rules on sale, resale of broadcast properties.

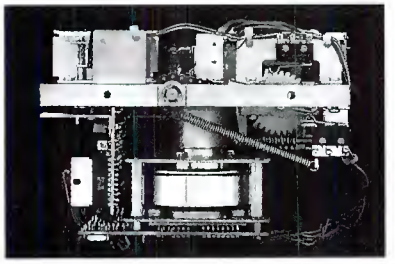
Strictly TV (page 10)
• A new beginning for HDTV?
(A digital encoding plan uses specific positions on a sine wave as part of the data. The Genesys system overlays an auxiliary 3MHz signal on existing 6MHz signals without causing artifacts.)

re: Radio (page 12)
• Some thoughts about the "good old days"
(Bringing older broadcast facilities back to par is basis of reminiscence on how things were in areas of experience and technical knowledge of engineers and technicians.)

Satellite Technology (page 14)
• Spread spectrum technology
(Spread spectrum multiple access, SSMA, works where numerous, widely scattered VSAT terminals share a single transponder. Multiple users of a single channel operate without interference through code domain multiple access. Signals for each user contain address bits in a datastream to enable decoding only by ad-

The cart machine with bells and whistles your audience will never hear.

Finally, a cart that delivers the creature comforts that other Otari audio machines have offered for years! And not only does Otari's CTM-10 make your job easier, it also delivers outstanding audio performance, so your output sounds more like a CD player than a cart.



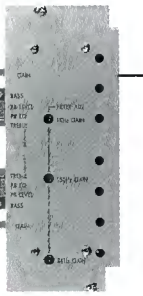
Heavy duty, direct drive capstan provides accuracy and reliability.

You get extensive metering, including dedicated metering for the cue-track. (Now you can verify the cue-tone *before* you go on-air!) And for adjustments to program length, there's a *true* vari-speed control.

You'll also find a record azimuth adjustment system *with phase display* for when you want to make the best recording possible.

But the CTM-10 is not all just bells and whistles. It's the only cart you can buy with HX-Pro.* That means that you can get a really hot signal off the tape, and still keep those high frequencies where they need to be for that crisp, clear sound.

And some things we keep real cool, like we don't use solenoids for our pinchroller because they can generate excess heat. You'll also appreciate the CTM-10's fast start time—it lets you cue up tighter without worrying about wow.



Equalization adjustments are easy to reach and clearly marked, making maintenance and service fast and easy.

And, of course, we give you choice. There are stereo *and* mono record/play decks, *and* a mono/stereo play-only deck.

Call us at (415) 341-5900 for more information about the CTM-10. The cart machine we built for perfectionists.

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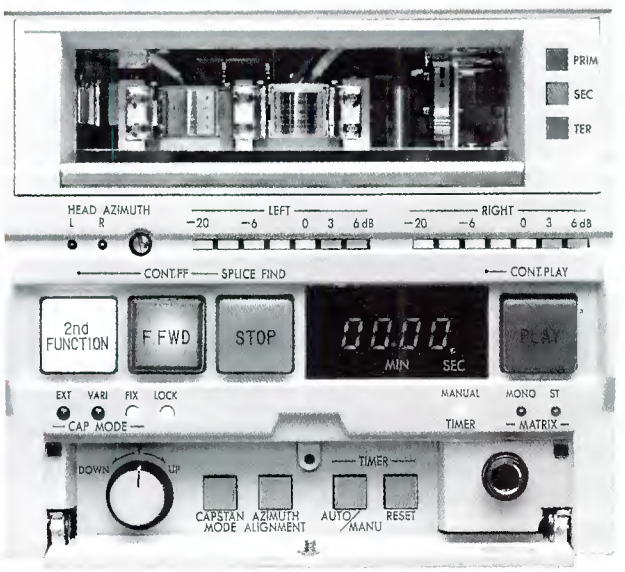

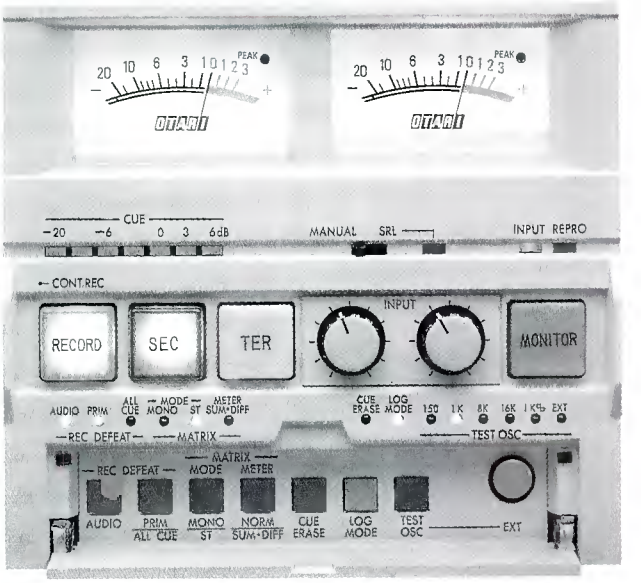

*HX-Pro is a trademark of Dolby Laboratories Licensing Corporation

Circle (58) on Reply Card

dressed receivers.)

Circuits (page 16)

• Technology builds on the basic telephone

(The wired telephone system is important to wireless broadcasting for remote pickups and news or other data services. In connecting equipment to telco lines, maintain the dc line impedance to avoid signal degradation. Telephone lines can carry surges from lightning or ESD sources into the station.)

Troubleshooting (page 18)

• In pursuit of the elusive intermittent

(Intermittent operation of mobile equipment often defies detection and correction. Probable causes include RF noise, thermal variations, vibration, moisture, dirt and corrosion. A detailed, well-kept maintenance log may often help to locate the intermittent.)

Management for Engineers (page 20)

• Management profiles, personalities, Part 2

(Different people and varying personalities and philosophies produce different views of a problem. Perceptions by supervisory personnel may conflict because of the natural individual differences in people.)

• **Inside Mathematics Processors** (page 26)

by Gerry Kaufhold II, SGS-Thomson Microelectronics, Phoenix

Video signal manipulation in digital special effects systems, computer-based graphics and other digital processing equipment depends heavily upon ICs called array processors. With effects programming control, images are stored in source arrays, then remapped according to program parameters to a target array before being displayed.

Key words: real time processes, array processors, matrix algebra, transposition, mega-FLOPS, pipeline, parallel processing, RISC, multiport memory.

• **State of the Digital Studio** (page 42)

by Curtis Chan, Centro Corporation, Salt Lake City

Digital equipment of D-1 component and D-2 composite formats can be interfaced into a common system. Special attention is needed in routing and distribution systems, because of the parallel and serial signals and critical system timing requirements. To some extent, integrated diagnostic software will aid in troubleshooting and system maintenance.

Key words: D-1, D-2, CCIR-601, serial, parallel, A/D, D/A, signal distribution, multiplexing, conversions.

• **Disk Recording and Editing** (page 58)

by Brad Dick, radio technical editor

Recording and editing of audio with digital disk technology provides advantages, including some effects that, although possible in analog systems, would cost far more. Hard disk storage provides faster access to recorded material than linear tape storage, in addition to complete random access. Through non-destructive editing software, original material remains intact while a new edited copy is created.

Key words: Winchester hard disk, signal processing, equalization, mixing, voice coil, blocks, cylinders, effects.

• **MIDI: What's In It For Broadcasters?** (page 82)

by Richard Maddox, Muzak, Seattle

MIDI, the musical intrument digital interface, allows versatile control of musical instruments, digital synthesizers and audio processing equipment. Similar in concept to RS-232, a MIDI current loop sends logic high and low levels between interconnected equipment. A serial datastream carries system messages, channel messages and timing signals to control events affecting all or part of the equipment.

Key words: channel data, system messages, timing signals, SMPTE-MIDI conversions, setup messages.

• **Technical Education for Broadcast Engineers** (page 90)

by F. David Harris, P.E., Purdue University Calumet, Hammond, IN

Most programs in electronics technology at institutions of higher learning, emphasize laboratory work for hands-on experience with electronic components. The requirements for mathematics and science studies differ widely, and little broadcast-specific training is provided because the greatest emphasis is on general electronics. As a result, success in broadcast engineering will depend heavily

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upon individuals, self-study programs and on-the-job training programs.

SBE Update (page 96)
- Annual convention to be in Kansas City.
- Bob Flanders, SBE past president, chairman of admissions committee, VP/director of engineering WRTV-TV, to retire.
- Ennes Foundation program with Armed Forces Radio Network offers graduates of AFRTS entry-level training certification as SBE broadcast technologists.
- Uplink training program set with NAB.

Applied Technology (page 98)
- Batteries for field applications

(How well a battery serves an application is based on selection, care and maintenance.)

Station-to-Station (page 104)
- Installation works in RF environment

(Improved reception for news department receivers needed special designs for operation in a dense RF environment.)

Field Report (page 107)
- Broadcast Electronics Phase Trak 90 audio cartridge system

March 1989

Theme: Managing Automation in Broadcasting

Editorial (page 6)
- On being a technical type

(There is a stigma attached to broadcast engineers and technicians for being technical types, but if you enjoy the work, who cares?)

FCC Update (page 8)
- Lottery proposed in selection of competing applications for AM, FM and TV facilities.
- Settlement policies relaxed; construction permit awarded to a party who buys out all applicants in a new FM station contest.
- LPTV filing window open, March 6-10.
- FM downgrade handled in one-step process by filing an application proposing facilities of a lower class than that specified in Table of Allotments.

Strictly TV (page 10)
- The dollars and sense of automation

(As more facilities look to automation to improve their financial situation, engineers who adapt to the new technologies will be needed to work with the automated systems.)

re:Radio (page 12)
- 1/4-wave isolating sections still work

(For an FM transmitting antenna on an AM transmission tower, a 1/4-wave isolating section feeds the FM antenna without upsetting the AM base operating impedance.)

Satellite Technology (page 14)
- Fiber transmission seems to be the fix

(With over-the-air broadcast and cable reception schemes prone to noise, interference, reflections, distortion and fading, optical fiber presents improvements over coax.)

Circuits (page 16)
- The modem is a great communicator

(The link between the public switched telephone network and standard telephone services is the modem, a device for interfacing computers to telco lines.)

Troubleshooting (page 18)
- Maintaining your computer, Part 1

(Understanding components, peripheral configurations and their possible modes helps in computer system maintenance.)

Management for Engineers (page 20)
- And you thought you sold air time

(The engineering department is an important contributor to the efforts of stations trying to reach a specific audience.)

- **The Bottom Line in Automation** (page 26)

by Brad Dick, radio technical editor, and Karl Renwanz, VP/engineering/operations, WNEV-TV, Boston

An environment driven by finance and profitability forces broadcasters to automation to streamline operations and improve cost-effectiveness. Integrating automated equipment into broadcasting facilities is more successful today, because manufacturers and broadcasters better understand the complex issues that must be considered. Where automation best fits and tasks to be enhanced by machine are points to study.

Key words: intelligent subsystem, distributed intelligence, plant automation, newsroom computer, cost analysis.

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Videotek's new combo monitor gives you more inputs, more output and more memory for less money.

Only Videotek's TVM-620 waveform monitor/vectorscope gives you three selectable inputs for multiple viewing combinations, a roster of other winning features *and* the economy of a two-in-one unit.

Parade or overlay modes let you view any combination of up to three inputs simultaneously with one touch of our new membrane control panel. And ours is the only combo monitor that currently offers user-defined, one-button memory recall.

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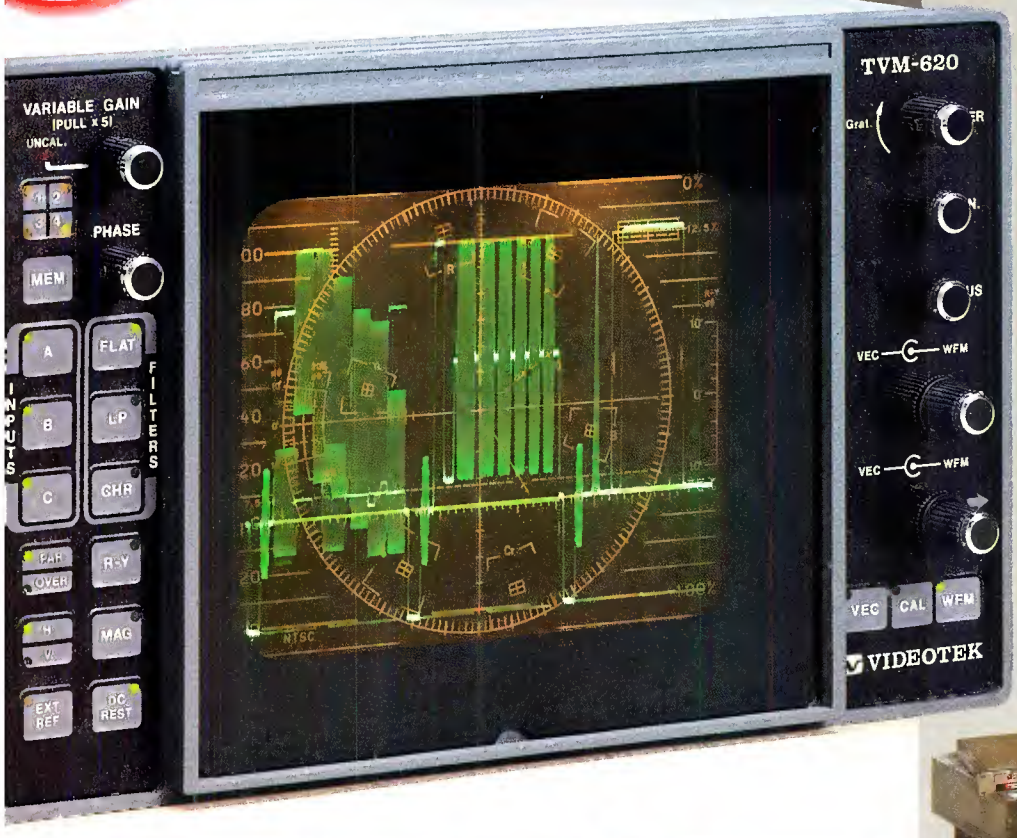

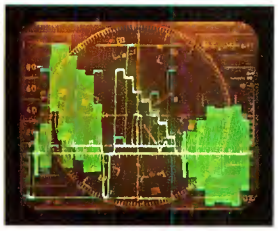

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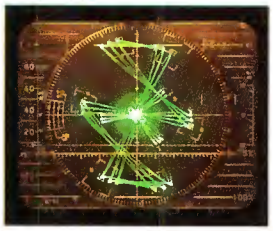
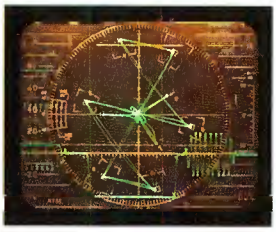


Triple Vector Overlay— SMPTE Bars on A, B and C inputs delayed by 6° and 12° to demonstrate phase error



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Circle (62) on Reply Card

• **Timing Is Everything** (page 36)
by William F. Baker, president, WNET-TV, New York

An industry that bases its income on seconds of air-time sold needs accurate time keeping, horology and intelligent clocks. At the station, a master clock contacts a reference time source through telco lines. Approximately 30 seconds of ASCII data at 300 baud updates the in-house clock from a master source and corrects for loop delays in data transmissions. A sine wave signal from the time source forms the basis of sync, video time code and real time in a cohesive video system.

Key words: time dissemination, loop delay, ASCII, SMPTE time code, RS-232, BCD code.

• **Planning for Standby ac Power** (page 46)
by Morgan Smith, building engineer, Salt Lake City

For increased profitability, standby and backup power is essential for broadcasting. In some applications, a backup power system offers a means to cut the power costs of normal operation. Size, power factor, fuel and noise sources are important considerations in selecting backup power resources.

Key words: critical and non-critical power requirements, UPS systems, noise sources, power factor, fuels, load shedding.

• **AM Power-Reduction Techniques** (page 58)
by Tim Walker, broadcast consultant, Ruffin, NC

Several methods to reduce the AM power transmitted are available, each with its limitations. The methods include shifting of the operating point through changes in plate voltage, quadrature power dividers and inductive sampling. The system for any one station depends upon power levels, the equipment involved and the financial resources available. Caution should be used to maintain safety standards and operational economies.

Key words: plate modulation, distortion, bias currents, power dividers, apparent efficiency, dummy loads, sampling loops.

• **Getting Ready for NAB** (page 68)
by Carl Bentz, technical/special projects editor

A preview of events at the 67th annual National Association of Broadcasters convention and international equipment exhibition.

News Special Report (page 78)
• Winter CES: On the other side of the tube
by Michael Heiss, consulting editor

(The gap in performance quality between consumer and broadcast products is narrowing, bringing new interest to producing the highest possible quality in the broadcast signal. The Consumer Electronics Show offers insight to project near-future consumer buying and effects to broadcast services.)

Applied Technology (page 84)
• Digital modulation using the NCMO

(A number-controlled modulated oscillator, NCMO, provides an interface for compatible analog transmission with digital signal origination and processing.)

Field Report (page 92)
• Sola 3kVA UPS system

Station-to-Station (page 100)
• Living by the rules

(A review of FCC regulations for STL frequency assignments notes improved allocation methods.)

SBE Update (page 106)
• Debate continues on licensing, Part 1

(Do states have control over licensing of broadcast engineers? A panel discussion at Seattle chapter regional convention uncovered conflicting viewpoints.)

• An Executive Committee tentative policy statement on the subject is outlined.)

April 1989

Theme: NAB Preshow Issue

Editorial (page 6)
• Blinded by theory

(New ideas without correct lineage or proper footnotes in traditional texts often meet obstinate criticism, because the ideas do not follow theory. Sadly, such new ideas often advance the technology.)

FCC Update (page 8)
• TV rule changes follow requests; unrelated video, audio transmissions; subcarrier during monochrome programming; calibration of visual power meter each six months.

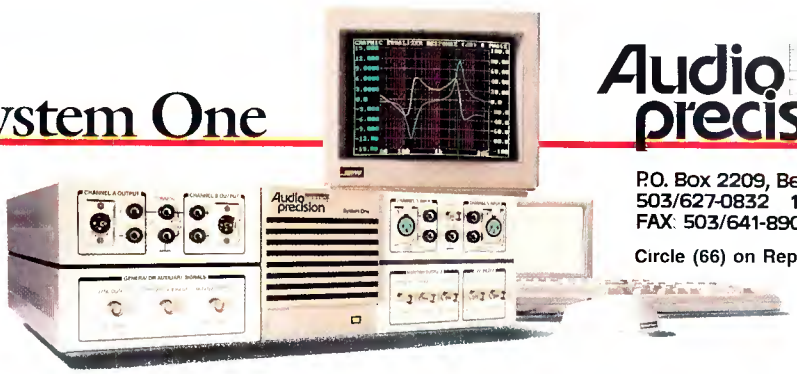
Let's compare automated audio test equipment performance:

KEY PERFORMANCE SPECS	AUDIO PRECISION SYSTEM ONE	H-P 8903B	S-T 3100/3200	TEK AA5001/SG5010
Flatness 20-20kHz, gen/analyzer	0.03/0.03 dB	0.06/0.2 dB[1]	0.1/0.1 dB	0.05/0.1 dB
Amplitude accuracy, gen/analyzer	0.1/0.1 dB	0.2/0.2 dB	0.2 dB/no spec	0.2/0.3 dB
Generator amplitude range	+30 to −90 dBm	+17 to −68 dBm	+30.6 to −90 dBm	+28 to −72 dBm
System THD + N 20-20kHz, 80 k BW	0.0015%	0.01%	0.0018%[2]	0.0032%
Min. amplitude for THD + N function	25 microvolts	50 millivolts	30 millivolts	60 millivolts
Residual noise (80 kHz BW)	3.0 μV	15 μV	4.0 μV	3.0 μV
Analyzer stereo separation @ 20 kHz	140 dB	function not avail.	100 dB	function not avail.
Common mode rejection ratio	70 dB, 50-20kHz	60 dB, 20-1kHz	100 dB @ 60 Hz	50 dB, @ 50/60 Hz
Speed, THD function (autorange)	10 sec 16-pt sweep	1.5 sec to 1st rdng	2.5 sec to 1st rdng	2.5 sec to 1st rdng
Speed, amplitude function (autorange)	10 sec 30-pt sweep (2 chan simultaneous)	1.5 sec to 1st rdng (1 channel)	1.3 sec to 1st rdng (per channel)	2.0 sec to 1st rdng (1 channel)
PRICE (U.S. DOMESTIC)				
Computer-interfaceable instrument	$6950	$5800	$9985	total
Software package	included	none available	$575-$1220	system
Typical controller	$600-$3000[3]	$5750[4]	$1000-$3400[5]	$16490[6]

[1] *Analyzer flatness not specified separately; analyzer accuracy 0.2 dB 20 Hz-20 kHz*
[2] *Total system THD + N not specified; generator THD plus analyzer distortion specs added together equal 0.0018%*
[3] *Personal computer. Interface card included in instrument price.*
[4] *H-P Model 310M IEEE-488 compatible*
[5] *Personal computer plus IEEE-488 interface card*
[6] *Total of instruments, software, Tek 4041/4205 IEEE-488 controller*
Competitive data compiled from H-P 1988 catalog, S-T data sheet 3000A 1987, Tektronix 1988 catalog.

For a much more complete comparison of these and other audio test sytems, call or write Audio Precision.

System One



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Circle (66) on Reply Card

• Clarification of reporting EEO efforts.
• Repeal of fairness doctrine upheld by U.S. Court of Appeals.

Strictly TV (page 10)
• Design may prevent VDT user symptoms
(Room layout, lighting, glare, posture and physical position affect VDT operator fatigue. Radiation from CRT, often indistinguishable from background cosmic radiation, is not a concern in birth defects.)

re:Radio (page 12)
• A pirate network strives for legality
(An English organization, operating radio stations without official government approval, asks for assistance in getting a license.)

Satellite Technology (page 14)
• Space robots are at hand
(Many menial tasks involved in space station construction could be accomplished by robots, reducing the risk to human lives and loss of material, equipment and energy.)

Circuits (page 16)
• More about modems
(AFSK, return-to-zero and non-return-to-zero binary coding are discussed.)

Troubleshooting (page 18)
• Maintaining your computer, Part 2
(Hard disk systems are the most probable source of problems or failure in computers. Be aware of signs and sounds that may predict failure.)

Management for Engineers (page 20)
• On being a leader, Part 1
(Successful leadership results when an individual, promoted to a position of leadership, is able to meet various levels of human needs of employees assigned below that position.)

SBE Update (page 22)
• Debate continues on licensing issue (Part 2); the question: "Is a Broadcast Engineer really an Engineer?"; the answer: . . . ?
• Executive committee's points of policy on licensing continues.
• 25th anniversary gala celebration planned for SBE convention in Kansas City.

Show Preview (page 26)
• NAB Engineering Conference, Las Vegas, April 28-May 2

• **Designing a Post-Production Center** (page 40)
by Phil Kurz, consulting editor
The requirements of studios of the future are not clearly defined, but fundamentals in facilities design and construction can offer flexibility. Allow for expansion and change of the plans to meet needs of the future. The design must consider human and technical parameters yet remain balanced within the allowed budget. Related information describes "USA Today" production center, Infinity Broadcasting, WJLA-TV.
Key words: site survey, power up, HVAC, CAD, timing, cabling, documentation.

• **Building on the "Rock"** (page 66)
by C. Robert Paulson, Artel Communications, Hudson, MA
The decision that NBC would not leave Rockefeller Center brought plans for reconstruction. Technology is important, but many changes will be more people- and service-oriented than technological. The plan is possible through recent investments in equipment and technology, such as M-II and ARPS automation. Flexible planning will enable integration of digital technology into the facility, as well as HDTV routing, when a format decision comes to pass.

• **Acoustical Design and Monitoring Requirements** (page 76)
by Chips Davis, LEDE Designs, Las Vegas & San Rafael, CA
Audio signals from a studio microphone result from the acoustical environment in which the source and microphone are located. Noise, reflection, absorption, cancellation and frequency response must be considered in studio design. Equalization may compensate the presence of unwanted signal components, but cannot replace components lost with faulty acoustical characteristics.
Key words: EQ, cancellation, reflections, comb filter, noise, HVAC, frequency response, Eigenmodes, traps, signal polarity, near-field, far-field, localization, speaker placement.

• **Acoustical Door Design** (page 98)
by Carrol G. Wright, Jamison Door Company, Hagerstown, MA
Any opening into the studio provides an entry for noise, unless methods of sound absorption are used. An acoustical door can allow continued work in the scene shop, while a production is in progress on the opposite side of the door. Parameters to consider are the sound transmission loss (STL) or sound transmission characteristics (STC) of the wall and door material.
Key words: STL, STC, door types.

• **UHF Multichannel Antenna Systems** (page 110)
by Ernest H. Mayberry, LDL Communications, Laurel, MD, and
James T. Stenberg, Micro Communications, Manchester, NH.
Suitable antenna site real estate is becoming difficult to locate. Wideband, multiple-channel antennas for transmissions of more than one station simultaneously are economical solutions to the dilemma. VSWR, an obstacle in wideband antenna and waveguide operation, which can be controlled.
Key words: VSWR, series feed, branch feed, phase perturbation, patterns, channel separation, waveguide components, combiners.

• **NAB '89 Exhibitor Listings** (page 134) and **New at NAB** (page 186)
by Carl Bentz, special projects editor.
A directory of participating manufacturers and equipment suppliers for the NAB equipment exhibit includes descriptions of new products introduced for 1989.

• **Enhancing NTSC** (page 244)
by Rick Lehtinen, TV technical editor
Changes have enhanced NTSC TV imaging, resulting in pictures that some feel challenge the need for HDTV. A review of typical video encoding methods and suggested approaches to improvements are discussed. Of particular importance in improved NTSC is filtering, its type and location in the system.
Key words: luminance, chroma, color-difference, IQ, UV, cross-color, cross-luminance, bandwidth, noise, anti-aliasing, constant luminance, gamma, flicker, dimensional filters.

Field Report (page 260)
• Odetics TCS2000 video cart machine
Field Report (page 266)
• Ampex ACE 25 editing system
Field Report (page 272)
• Sony PCM-2500 R-DAT recorder

Applied Technology (page 280)
• Modulation monitoring for BTSC sound
(A review of the BTSC system shows how different ways of monitoring the complex multiple-channel TV aural signal may indicate the same information in a different way.)

Station-to-Station (page 290)
• Supplemental system handles remote control
(An approach to expansion of a remote machine selection and machine-control system is described.)

May 1989

Theme: Broadcast Engineering's 30th Anniversary

Editorial (page 6)
• Creating tomorrow from today
(The goal of the broadcast industry and **Broadcast Engineering** magazine is a common one: improved communication.)

FCC Update (page 8)
• AM licensees urged to cut interference through reduction of protected contours by reducing power or tower height, changing antenna reconfiguration or tower relocation; licensees will benefit from their efforts.
• Cable syndicated exclusivity rules reinstituted in simplified form; scope of network non-duplication rules extended.

Strictly TV (page 10)
• The seven layers of OSI
(The discussion reviews the layered approach to computer network communication.)

re:Radio (page 12)
• If high-tech fails, use humble basics
(Irish pirate stations granted acceptance. Today's advanced technology is well and good, until problems develop; then, fundamentals may be needed, such as, a grid dip meter instead of a TDR.)

Satellite Technology (page 14)
• It's time for spring cleaning
(Inspect the satellite antenna site for possible winter damage. New satellites are authorized and the 1990-91 NASA budget is released.)

Circuits (page 16)
• Today's modems are fast and versatile
(Modems find many applications around the broadcast facility, moving data at rates from 110b/s to 9,600b/s. Smart modems with V.32 protocol use echo signals to verify transmissions.)

Troubleshooting (page 18)
• Maintaining your computer, Part 3
(A discussion of the hard disk considers the formatting process and mechanical problems,

WHY WTVH-TV'S BRUCE LEVY LOVES HIS EPO ROBOTIC CAMERA CONTROL SYSTEM.

For more than 20 years, WTVH-TV, the CBS affiliate in Syracuse, N.Y., has broadcast its news using EPO remote camera control systems. During that time, the systems have outlasted four sets of cameras—a clear testament to EPO's durability and reliability.

For most of those years, as Bruce Levy, the production chief at WTVH-TV, will tell you, the station was virtually alone among American broadcasters.

Now, of course, all that has changed. Americans are beginning to wake up to what their European brethren have known for some time—that **EPO Camera Control Systems can save them money. Lots of money!**

But even EPO Robotic Camera Systems don't last forever. Recently, when WTVH-TV's 20-year-old unit began to show some wear and tear, Bruce Levy confidently ordered three new ones from A.F. Associates, thereby continuing his and WTVH-TV's long association with the EPO systems.

If you would like to know more about Bruce Levy's favorite way to save money, call A.F. Associates. In the east: (201) 767-1201; in the west: (619) 277-0291.

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such as wear and its effect on servos.)

Management for Engineers (page 20)
• On being a leader, Part 2
(The ability to direct social interaction among employees and to find ways to help employees feel good about themselves and their work are top qualities of leadership.)

• **Milestones in the Evolution of Technology** (page 22)
by Jerry Whitaker, editorial director
An overview of technological developments over the past 30 years tracks introductions in broadcast-related areas from equipment components to signal components, from infant FM stereo broadcasts to HDTV with multiple-channel sound and from competitive transmission methods from cable to satellite. A more cost-effective operation in broadcasting has been the impetus for changes in station and engineer licensing, tape formats, even basic circuit designs. FCC actions have definitely affected the industry, not always positively.
Key words: CATV, superstations, passive/active satellite relay, stereo multiplex, videotape and recording formats, character generators, TV transmission standards, AM stereo, composite/component video, digital video, HDTV, MSDC klystrons, Klystrodes.

• **Five Decades of Magnetic Tape** (page 36)
by Don Rushin, 3M professional audio-video, specialty products division
Sunday, Feb. 25, 1940, was the historic inaugural broadcast of the New British Broadcasting System, much of the broadcast made possible by audio recordings. The 40s found interest with magnetic recording in the United States as well. Since then, magnetic tape has undergone constant change, with data densities increasing significantly, allowing the introduction of video and data recording. Originally a German development by Poulson in 1898, recording technology found Bing Crosby a strong supportive figure in its rapid growth.
Key words: phony war, NBBS, Jack Mullin, paper, metal ribbon, wire, VR-1000, the Kitchen Debate.

• **Perspective on the Industry** (page 54)
by Jerry Whitaker, editorial director
The U.S. Patent Office said that everything was already invented in 1899. Still, the 1980s have enjoyed a constant stream of new developments, and the spring of innovation shows no signs of running dry in the 1990s. Will the future belong to radio and TV broadcast as we know it, or to transmission by fiber optics? No matter how methods of reception develop, digital technology will hold a dominating position in the future. Much of the direction taken by broadcasting will depend upon non-technical financial gurus and their attempts at increased productivity.
Key words: economics, push-button madness, electronic tuning, telco, connectivity, technical certification, smart equipment, data storage, remotes, AM vs. FM, workstations, digital recording, CCDs, advanced television, HDTV, transmitter efficiency.

• **The Future of Fiber** (page 74)
by Phillip Kurz, consulting editor
Glass opens our view to the universe. Similarly, fiber-optic cable vastly expands the world of communications, carrying voice, video and numerous data services directly to the home. The ISDN integrated services digital network, already in place in areas in Europe, advances today's telephone services by many levels. Several advantages of fiber—its broadband characteristics, its immunity to magnetic sources and predicted lower cost over time—indicate a bright future.
Key words: Information Age, ISDN, single-mode/multimode, pulse broadening, HDTV, CATV and fiber, telco and regulation.

• **AM Radio: Regrouping for the 21st Century** (page 96)
by K. Dean Stephens, professor, Amoz Gibson Centre, Arecibo, PR
AM radio pioneered the broadcast industry, becoming complacent FM and TV rapidly encroached upon its space. Now AM fights for survival. AM fidelity, often blamed for amplitude modulation disfavor, can be improved through technical housecleaning in the radio facility and replacement of outmoded equipment. Many proposals are in the works; but they must be implemented if AM is to continue as a viable radio service.
Key words: AM vs. FM, fidelity, receiver bandwidth, hum/noise, signal processing, NRSC, in-

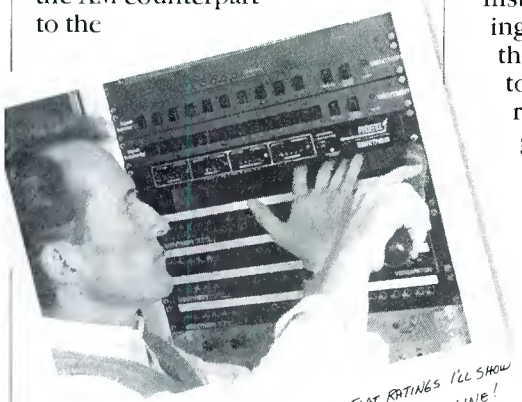
What the Audio Prism is doing for ratings in FM, the Phoenix can do for your AM ratings.

It's no secret. The Audio Prism has been giving FM stations the competitive edge for years. It's a proven commodity in the top 50 markets. And it's rapidly finding its way into middle and small market FM's, providing greater clarity and a stronger, more pleasing presence on the dial.

The Best Kept Secret In AM Broadcast.

With the Audio Prism setting records like it has, we're a bit surprised how little people really know about the Phoenix. It's the AM counterpart to the Audio Prism and does an equally credible job of getting your signal out there, loud and clear, right to the fringe.

The Phoenix delivers a smooth crisp sound that cuts through traffic noise, knocking engines and baby's screaming in the back seat. If listeners are what you're looking for, the ones that tune in and stay with you all day, you owe it to yourself to listen to the Phoenix.



RIGHT TALENT. TIGHT PROGRAMMING, FLAT RATINGS. I'LL SHOW 'EM WHAT ENGINEERING CAN DO FOR THE BOTTOM LINE!

It's Smooth It's Digitally Controlled. It's Easy To Operate.

Don't let the flashing array of LED's throw you. They're there to keep you posted on how the Phoenix is working. And, it does work well.

With the same digital control that has made the Audio Prism almost a household word, the Phoenix makes over-processing a thing of the past. Our motto: *If it ain't broke, don't fix it.*

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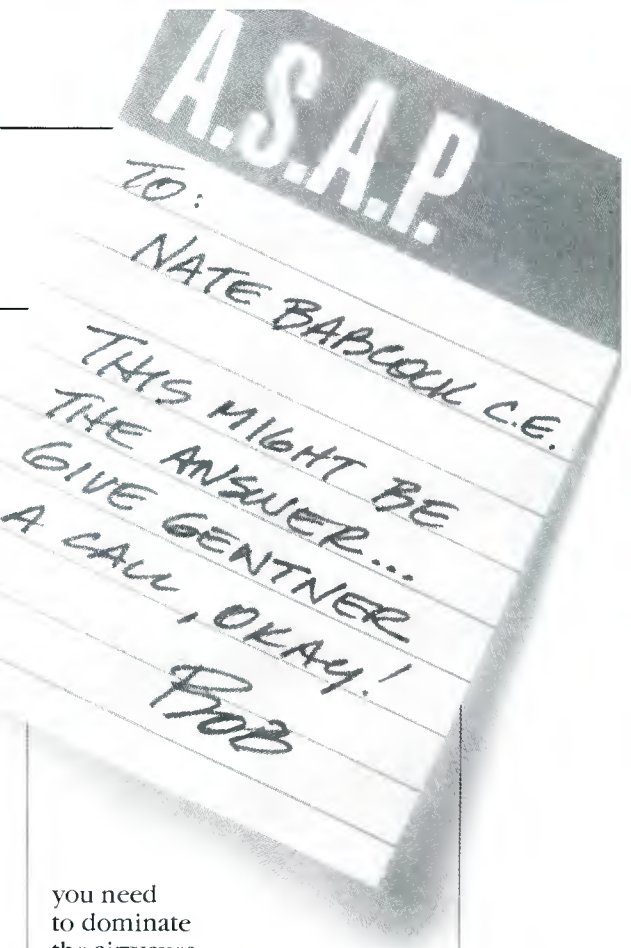
An Added Benefit, Full NRSC-1 Compliance.

Maybe you can afford to wait until next June to meet NRSC-1 standards, maybe not. The Phoenix complies with the new standard today and gives you the punch you need to dominate the airwaves. Why not make your move today, then sit back and celebrate the sweet sound of success. Tell your station manager it sounds a lot like a cash register, only louder.

HERE'S TO THE PHOENIX, NRSC-1 COMPLIANCE AND BETTER RATINGS!

Hearing Is Believing.

Give us a call, we'll put you in touch with your Gentner dealer. They'll give you complete product specs and arrange for you to put the Audio Prism, the Phoenix or both to the test. Hook 'em up, head for the country and listen to the difference.



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terference, AM stereo, narrowcasting.

• **UHF-TV: Breaking New Efficiency Records** (page 104)
by Jerry Whitaker, editorial director
The costs of broadcasting wideband TV signals in the UHF band are high, simply because handling of signals at such frequencies is more difficult. Extensive experimental work with klystron devices and improved efficiency has come to fruition with the multistage depressed collector (MSDC) klystron for higher-power facilities. Improved tetrode-based systems and combinations of tetrode and klystron concepts (Klystrodes) also show enhanced energy transfer from the power input to RF.
Key words: Klystrode, MSDC klystrons, efficiency, figure of merit, pulsing, annular control electrodes.

Field Report (page 126)
• The Arrakis 10,000 series audio mixer

SBE Update (page 138)
• Manufacturers' workshops will highlight 1989 national convention; schedule contains 23 hours of seminars, 12 hours of exclusive exhibit time.
• Professional licensing discussed with National Society of Professional Engineers; most complaints against "engineers" involved contractors practicing telecommunications engineering in non-broadcast areas.
• Call made for National Officer nominations.

Show Preview (page 140)
• ITS (Montreux) to showcase HDTV festival

June 1989

Theme: NAB '89 Replay

Editorial (page 6)
• Vaporware
(A need, as perceived by manufacturers hoping to remain in business against their competition, to introduce new products at trade shows too often leads to performance claims that do not exist when the products debut.)

FCC Update (page 8)
• License renewal procedures reformed to avoid sham competing applications and petitions to deny.
• New FM Class C3 to be midway between Class A and Class C2; applicable in zone II.
• FCC Form 301 revised to request financial, ownership and integration information not currently required.

Strictly TV (page 10)
• Tape defects defined by "RF signature"
(Dropouts caused by tape defects are characterized by observing playback RF envelopes.)

re:Radio (page 12)
• Beyond the coverage map, Part 1
(Comparisons between original coverage map and current signal levels may reflect changes in ground radials and other factors.)

Satellite Technology (page 14)
• The business world turns to VSAT
(Very small aperture terminals gain in popularity for many communications needs with multiple channels per transponder using SCPC operation. New Ku-band satellites to include an L-band system for air traffic control.)

Circuits (page 16)
• Have a taste of telephone soup
(Subscriber line interface circuits form the input connection to the telco central office, providing a variety of functions.)

Troubleshooting (page 18)
• CD troubleshooting, Part 1
(Before you spend hours trying to repair a CD player, check for a faulty CD.)

Management for Engineers (page 20)
• On being a leader, Part 3
(Promotions sometimes cause the tyrant syndrome; a better approach is to form a management team composed of the people in the department being supervised.)

• **Perspective on NAB '89** (page 23)
by Jerry Whitaker, Editorial director
What is the future of HDTV? Can broadcasters and Bell coexist? How will alternative entertainment services affect broadcasting? These questions posed by NAB attendees about the destiny of the industry, found few straightforward answers. A consensus of NAB, FCC and others suggests that major changes are imminent, but the nature of those changes is unclear.

• **The HDTV Scorecard** (page 32)
by Phil Kurz, consulting editor
The future of HDTV as a transmission medium is poorly defined. Two special demonstration areas showed proposed HDTV systems to numerous observers, but the quest for "one" system remained unanswered.
Key words: terrestrial transmission, encrypted B-MAC, NTSC compatible, SuperNTSC, line doubling, Genesys, MUSE, HDB-MAC, SC-HDTV, SMPTE 240M.

• **The Automation Equation** (page 42)
by Rick Lehtinen, TV technical editor
Technology has downsized many broadcast products and introduced communications links, allowing computers to perform many functions in the modern station facility. Industry buzz words often heard at NAB '89 were robotics and LANs.

• **NAB Engineering Conference Report** (page 46)
by Brad Dick, radio technical editor
The engineering conference schedule of concurrent sessions and evening hands-on workshops covered the entire transmission chain with many sessions emphasizing digital techniques for traditional analog functions. Many sessions focused on FM technology, performance improvements and reception problems. AM systems engineering received significant attention, including discussion of new antenna designs. TV topics viewed areas of digital technology in creation and manipulation of images and viewed transmission systems in regard to improved efficiency, including the MSDC klystron.

• **The Pick Hits of NAB '89** (page 72)
by Brad Dick and Rick Lehtinen, technical editors
TV pick hits included: *AF Associates* Roboped robotic camera head positioning system; *Abekas* A-34 Solo digital production system; *Ampex* ADO-100 effects system; *Auditronics* 1900 mix-minus signal routing system; *BTS* LDK-91 CCD camera; *Grass Valley Group* DPM-100 effects system; *Harris Broadcast* Platinum series solid-state TV transmitters; *Lectrosonics* H185 plug-on wireless mic transmitter; *Mobile Data International* data terminals; *Tektronix* 1780R video measurement set; *TSM* SP-200 Autocam robotic camera pedestal with X-Y option; *Videotek* VDP-8400 framestore and synchronizer; *Vinten Broadcast* Automotion robotic camera pedestal.
Radio pick hits included: *Alldesigns* DAMS hard-disk replacement for audio cart machine; *Broadcast Electronics* FX-50 FM exciter; *Delta Electronics* SNG-1 stereo noise generator; *Dorrough* #1200 stereo signal test set; *Harris Broadcast* DX-50 solid-state, digitally modulated AM transmitter; *Moseley* 8-channel multiplexer; *QEI* Cat/Link T1 compatible 2-way wired STL; *TFT* 886/887 EBS system and 8900 synchronous FM exciter; *Tri-Tech* RBS 801 remote broadcast studio.

• **New at NAB** (page 88)
by Carl Bentz, special projects editor
A compilation of new products introduced at NAB includes introductions since NAB '88.

• **HDTV: Politics on a Grand Scale** (page 186)
by Jerry Whitaker, Editorial director
The discussions have moved from technical merits and marketing to the realm of politics, resulting in questions that are far more difficult to resolve than the technical differences in TV systems around the world. HDTV has become a matter of national pride and national security. No agreement on standard scan and frame rates or spectrum bandwidth requirements has been achieved. One major question begs an answer: "How fast will consumers flock to HDTV once it is available in the marketplace?"

• **The SBE Observes a Milestone** (page 192)
by Brad Dick, radio technical editor
The Society of Broadcast Engineers celebrates its 25th anniversary. Organization of the society followed a suggestion of then **Broadcast Engineering** editor John Battison and has grown to a membership greater than 5,500 with more than 80 chapters around the nation.

SBE Update (page 193)
• National Conference on Engineering Specialty Certification meets with associations covering a broad range of engineering disciplines.
• SBE council requests an opinion from Texas State Board of Registration regarding the title of "engineer" and its use in broadcasting.
• Paul Montoya to fill vacancy on national board of directors.
• ITVA to hold technical conference concurrent with SBE national convention in Kansas City.
• Frequency coordinators receive suggestion that commercial answering services would make them more accessible by individuals needing frequency information.

July 1989

Theme: Improving Your Audio Product

Editorial (page 6)
• Managing the future together

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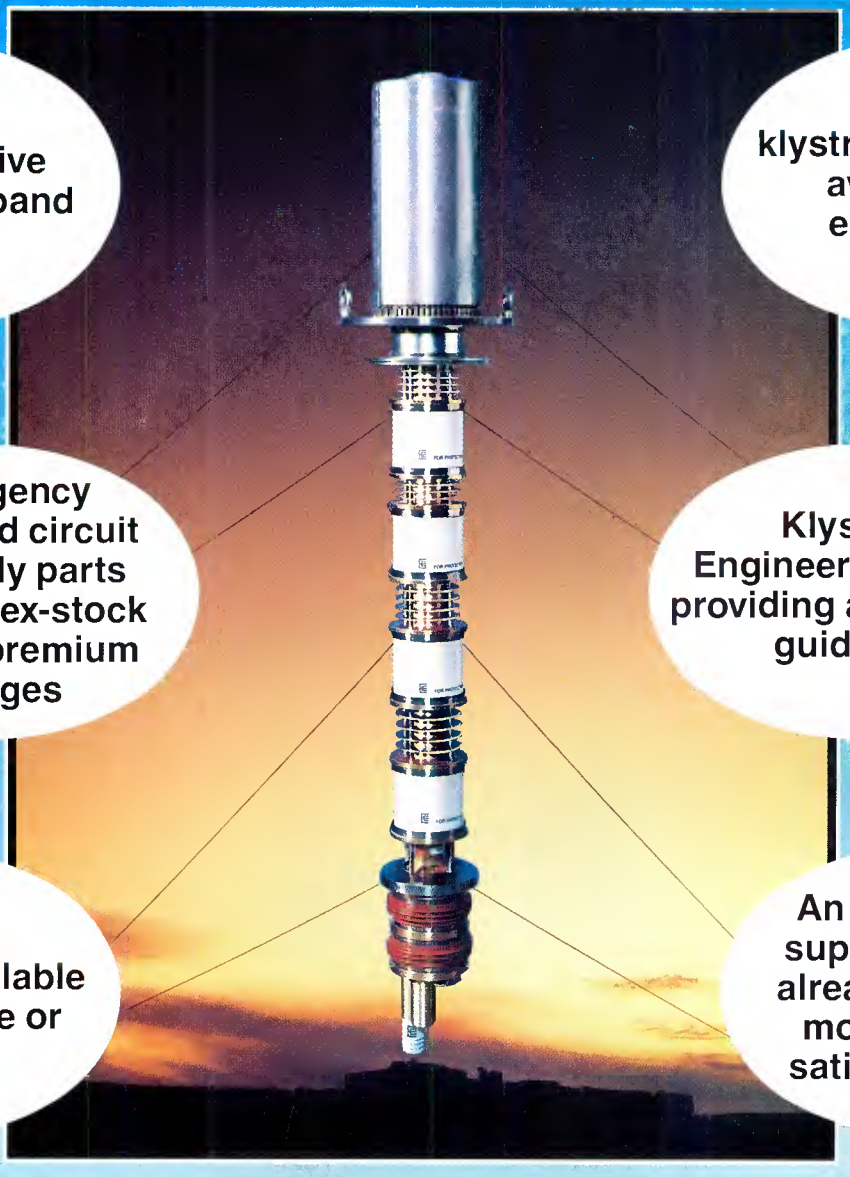

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Circle (73) on Reply Card

(The **BE** conference, held in conjunction with the SBE convention, offers a chance to learn to deal with new equipment.)

FCC Update (page 8)
• A/B cable switch requirement imposed, allowing cable subscribers an easy method to return to off-air viewing during cable malfunctions.
• EEO standards enforced, resulting in short-term renewal and fine for Maryland AM/FM broadcaster.
• Federal Communications Bar Association proposes reforms to FCC comparative hearings process, while FCC ponders use of lottery techniques for competing application situations.

Strictly TV (page 10)
• VBI heats up
(Insertion of data into the relatively vacant vertical blanking interval provides additional video services.)

re:Radio (page 12)
• Beyond the coverage map, Part 2
(Complaints about station coverage may mean a changed radiated pattern, which in turn means a change in antenna current or impedance.)

Satellite Technology (page 14)
• Sunspots affect communications
(Solar activity, sunspots or solar flares, caused by magnetic field variations on the sun, affect the ionization of ionospheric layers and how those layers reflect radio waves.)

Circuits (page 16)
• ISDN to bring better service
(The integrated services digital network will offer improved telephone services with new capabilities, such as HDTV and data.)

Troubleshooting (page 18)
• CD troubleshooting, Part 2
(Before trying to find the problem in the CD player, consider possible problems in the manufacture of the CD medium.)

Management for Engineers (page 20)
• On being a leader, Part 4
(A management team approach has many advantages, among them chances for the individuals to become "more important" in the operation.)

• **Control-room Monitoring Systems** (page 26)
by Brad Dick, radio technical editor
Audio equipment in today's control room exhibits excellent performance, but the ultimate test is: "Do the room and monitoring system sound good?" Various causes produce less than perfect performance: flaws in the acoustics of the room environment, distortion in the system, background noise from various sources. Proper reverberation time, room equalization, a uniform distribution of sound, speaker selection and interaction of surfaces are all part of good sound.
Key words: IM, TIM, THD, HVAC, noise, reflections, reverb, half-space loading, frequency dependence, room EQ.

• **Using Close-field Monitors** (page 42)
by Jeff Blenkinsopp, audio consultant, New York
Close-field monitoring is considered by many as the preferred standard listening reference. A small pair of speakers, often sitting on the mixing console, are positioned to place the audio operator's listening point within the direct sound field. The technique generally removes effects of the room environment on the sound. Objections to the technique include the loss of bass response typical of some small speakers.
Key words: acoustical environment, wiring, power ratings, bass/sub-bass systems, frequency response, multiple cabinets, remote production.

• **Planning for an Audio Routing Switcher** (page 56)
by David L. Bytheway, switching hardware manager, BTS, Salt Lake City
Flexible distribution of sound in the broadcast and production facility depends upon quality and capability of distribution amplifiers and switching equipment. Although patchbays could serve routing purposes, switching provides more flexibility with instantaneous response to changing routing requirements. The complexity of stereo and multiple audio channels demands multilevel control capability.
Key words: single output controllers, take but-

ton, SAP, time code, stereo, matrix switches, reentry, phase inversion, X-Y controller, distortion, linearity, noise, crosstalk, RF sensitivity, transformer coupling, digital audio, balanced/unbalanced, floating, level matching.

• **Managing Satellite Operations** (page 88)
by Richard Maddox, chief engineer, Muzak, Seattle

Signal relays by satellite has become an important part of radio/TV broadcasting. The growing dependency of business and broadcast on satellite relays sometimes makes it difficult to get a channel when it is required. Beyond the normal uplink and downlink locations, satellite transmission and reception may not be arranged as easily as expected. Along with scheduling, budgeting for satellite time charges is critical in managing the satellite operation.
Key words: C-/Ku-band, IFB circuits, time charges, limitations, time brokers, footprints.

• **Setting Standards for the Future** (page 98)
by Don McCroskey, BE consulting editor

Standards in the broadcast and communications industries refer to basic specifications that allow operational interchangeability among different pieces of equipment. Such specifications develop at various levels—from within a company for economic reasons to the efforts of professional engineering societies, who often play mediator between interested parties. Over the years a number of organizations have taken part in recommending and adopting standards.
Key words: interchangeability, SMPTE, ASA, IEC, ISO, ITU, CCIR, ANSI, EIA, IEEE, RETMA, AES, guidelines, recommended practices, NTSC, NAB, ATSC, fair trade.

SBE Update (page 108)
• Board adopts licensing policy that directs the national SBE to pursue modifications of statutes, should licensing crises arise; no rationale for state licensing of broadcast engineers has been found.
• Ennes Scholarship Fund awards to part time broadcast engineer studying electrical engineering and master control/tape operator pursuing a bachelor's degree. Foundation award to another student who is master control operator and is responsible for transmitter and satellite operations.
• "SBE Signal" editor hired.
• Ennes workshops, to be held the day before the national convention, will be conducted by factory instructors using a hands-on approach.

August 1989

Theme: Video Technology Update

Editorial (page 6)
▪ Postcard from Montreux
(Montreux is a nice place to visit, but its viability as the venue for International TV Symposium is questionable.)

FCC Update (page 8)
▪ Congress urged to repeal copyright law.
• Tax certificate decision reversed (December 1988 decision involving a minority-owned St. Louis cable company).
• Repeal of 2-year affiliations limit.

Strictly TV (page 10)

• Designer test signals aid troubleshooting
(Numerous changes in TV technology have reduced the relevance of some test signals, particularly in component facilities.)

re:Radio (page 12)
• Taking the measure of your station, Part 1
(Operating frequency measurement remains a requirement; bandwidth compliance for AM is important,too, but an NRSC-1 filter is an acceptable alternative to the FCC.)

Satellite Technology (page 14)
• The making of a space station
(NASA plans for Space Station Freedom, a joint project between the U.S., Japan, Canada and the European Space Agency, to be assembled in space in mid-1990s, following a sequenced launch of individual sections.)

Circuits (page 16)
• Thermistors used in temperature control
(Background on positive and negative temperature coefficient thermistors includes a sample thermistor circuit controlling a crystal oven.)

Troubleshooting (page 18)
• CCD troubleshooting, Part 3
(Possible variations from the Red Book standards in the preparation of CD media are the focus, along with a look at physical damage or imperfections in the manufacturing process.)

Management for Engineers (page 20)
• On being a leader, Part 5
(As manager of an engineering department you need not solve every problem, but you are responsible for seeing that the problems do get solved. A team approach and structured plan to problem solving are valuable concepts.)

• Easing into Newsroom Automation (page 26)
by Rick Lehtinen, TV technical editor
Automation represents a substantial commitment of station resources and demands decision-making that can prescribe choices in the future. A phased approach allows concentration on automation for a maximum return on the investment and gains perspective toward evaluation of subsequent automation steps. Until standardization of data and control protocols exists, caution toward long-term goals is advised.
Key words: robotics, information and signal flow, LAN topologies, interfacing.

• Inside Standards Conversion (page 38)
by Rick Lehtinen, TV technical editor
The purpose of standards conversion is decoding of composite video to components with interpolation and storage of the components in a memory. The memory buffers the data which is extracted in accordance with different line and frame rates and subsequent re-encoding of the components into the new timing structure. At the heart of conversion are filtering processes that perform weighted averaging on a series of adjacent samples. Selection of coefficients determines the value of a sample if one were taken at a certain location, introducing an interpolation process.
Key words: transmission standards, color difference component formats, A/D-D/A conversions, encoders, decoders, temporal and spatial filtering, motion artifacts, judder.

• Advances in Analog Instrumentation (page 56)
by Margaret Craig, Tektronix, Beaverton, OR
The advances of digital equipment in metrology and in the video signal chain might suggest that analog instrumentation is passé but analog test equipment has improved, with waveform monitors and vectorscopes processing signals completely in the analog domain and displaying the result in real time as the waveform actually occurs. Analog monitor frequency response exceeds that of practical digital equipment. Microprocessor-control circuitry adds more flexible capabilities with on-screen alphanumeric information on equipment status.
Key words: real time processing and display, frequency response, microprocessor control, alphanumeric readout, cursors, analog component measurement.

• The Ins and Outs of Microphones (page 70)
by Brad Dick, radio technical editor
A tutorial on microphones includes cutaway drawings to explain the differences among dynamic, condenser and ribbon mics. The discussion focuses on sensitivity, pickup patterns and

selection of microphones for particular applications. The mid-side stereo system is examined with conversion matrices to produce left-right output signals. Boundary microphones and remotely adjustable units with multiple capsules in a tetrahedral arrangements allow control over the apparent pattern, angles and even "shape" of the room.
Key words: moving coil, dynamic, condenser, electret, ribbon, performance characteristics, directional patterns, frequency response, coloration, proximity effects, multiple mic setups, stereo systems, Blumleinn configuration.

• **Role of Film in Television** (page 98)
by Jerry Whitaker, editorial director
A perspective over 30 years of broadcasting examines the use of film as a production medium; the developments by George Eastman in film technology; the Edison camera; and the role of film in TV operations today. Although changes have occurred in how film is used, the light-sensitive medium remains viable.
Key words: George Eastman, Thomas Edison, Kodak, glass plate, gelatin emulsions, Kinetoscope, Photophone sound, news departments.

Show Replay (page 106)
• International TV Symposium at Montreux
(A PAL version of NAB, the ITS exhibition focused on Eureka EU95, HDTV and fibercasting.)

SBE Update (page 110)
• Register early for Ennes workshops, a hands-on approach introduced at this year's convention.
• 25th anniversary celebration of SBE and spouse program planned.
• New officers to be installed.

Applied Technology (page 111)
• Film-to-tape transfer systems
(Flying spot telecine systems maintain their position as transfers from film to video continue to be an important part of television.)

Station-to-Station (page 115)
• Vertical interval AGC meter
(Construction project provides alternate method to simplify remote unit microwave link setup.)

News Special Report (page 118)
• An ATTC progress report
by the **BE** staff
(A review of subcommittees making observations on proposed advanced TV systems. A number of approaches to improved TV transmissions and associated systems are scheduled for consideration.)

September 1989

Theme: Audio-Video Control Systems

Editorial (page 6)
• Rethinking EBS
(The Emergency Broadcast System is designed for presidential contact with the nation in times of emergency, not for warning of pending disaster, although states can and do use the system in various ways, including broadcasts of severe weather conditions. Additional funds are being funneled to harden 30 stations positioned to allow continued operation in time of disaster. Perhaps it's time to reconsider our attitudes about the EBS operation.

FCC Update (page 8)
• Class A FM power increased to 6kW if certain separation requirements are met.
• Multiple ownership rule changes affirm February '89 action, allowing multiple facility ownership based on waivers.
• Antenna light requirements enforced by commission, produces fines for stations not complying with lighting rules.
• Sonrise Management Services under investigation for possible conduct abusing FCC processes and violations of criminal code.

Strictly TV (page 10)
• Exploring battlefield fiber
(Fiber-optic applications for ENG uses designs developed for military purposes.)

re:Radio (page 12)
• Taking the measure of your station, Part 2
(Bandwidth compliance or splatter control—attenuation of the station's output lying outside the assigned spectrum—to reduce interference with other stations receives critical FCC attention. A poor man's spectrum analyzer is described, and incidental phase modulation is discussed.)

Satellite Technology (page 14)
• Team goes to work in robotics center
(NASA's Goddard Space Flight Center develops robotics technology to support future space flights, but before that technology is needed, satellite relay is being used for international medical teleconferencing.)

Circuits (page 16)
• Using thermistors for time delay
(The thermal characteristics of thermistors serve in timing circuits and time delays.)

Troubleshooting (page 18)
• CD troubleshooting, Part 4
(In this installment regarding CD system difficulties, user-caused damage to the CD surfaces and the physics of scratches are examined.)

Management for Engineers (page 20)
• On being a leader, Part 6
(Management depends upon effective decision making, which requires active listening.)

• **Switching Fiber-Optic Signals** (page 26)
by Rick Lehtinen, TV technical editor
The value of fiber optics in avoiding external signal pickup has given the technology a boost of acceptance. Inside the station, where such problems are usually of less concern, applications for fiber may not be developed until higher definition signals must be routed. Then, signals on the fiber will need to be switched. Various methods include tree and star configurations with bidirectional optical couplers and mechanical moving-fiber switches. Switching speed is a concern.
Key words: FO splicing, connectors, star and tree couplings, bidirectional coupling, moving fiber switching, Raman scatter.

• **Writing Applications Programs for a PC** (page 42)
by Ron Balonis, C.E., WILK-AM, Wilkes-Barre, PA
PCs have a position as the electronic assistant in many broadcast facilities. Most useful are pre-written and user-written application programs that enable the computer to perform tasks or solve problems. Writing your own programs requires more than just coding; you must determine how the problem is to be solved, then convert that to code that can be understood by the computer through the use of an interpreter or compiler.
Key words: algorithms, programming style, BASIC, debugging.

• **The CCD Scoreboard** (page 57)
by Rick Lehtinen, TV technical editor
CCDs have advanced the art of ENG significantly, reducing the size of camera equipment and the budget for pickup devices. There are still problems, such as the matrix structure of the CCD itself, that may produce undesirable characteristics, but advances in technology are addressing those issues. The capabilities of the cameras, when combined with smaller tape formats have increased the possible sources of video material for broadcast.
Key words: CCDs, aliasing, spectral response, sensitivity, cost, S-VHS/ED-Beta formats.

• **Lenses: Is What You See What You Get?** (page 66)
by Carl Bentz, technical editor
Some background material on lens systems and the physics of optics also examines the microprocessor in lens designs. With a microcomputer to keep lens glass groups optimally positioned for best performance, a new generation of optical systems, designed for effective use with CCD cameras stays a step ahead of camera pickup technologies. A few words about lens care help to extend the performance of lens systems.
Key words: circle of confusion, dispersion, cam followers and element position methods, servos.

• **Designing an FM Booster System** (page 72)
by Steve Broomell, Omega International, Irvine, CA
Lower-power FM transmitters, to increase reception reliability within the assigned service area, are permitted, with frequency assignments being on the same channel of the primary station. Operation is governed by FCC rule parts 73 or 74, depending upon the power output, with emphasis on the booster providing the appropriate service without signal degradation or generation of interference. An intercity relay (ICR) may also be in order, requiring additional licensing approvals.
Key words: supplemental transmitters, ICR links, modulation noise, contour maps, service area contours, synchronous repeaters, directional antennas.

Show Preview (page 90)
• Don't miss the anniversary party
(SBE national convention plans, coupled with 25th anniversary celebration and newly introduced Ennes workshops, offer numerous drawing cards to attend event.)

Show preview (page 106)
• SMPTE to be the season finale
(A preview of events for the 131st SMPTE technical conference and equipment exposition, Oct. 21-25 in Los Angeles.)

Field Report (page 108)
• Audio-Technica AT4462 portable mixer

SBE Update (page 114)
• Choose your candidate carefully
• Qualifications for board of directors candi-

dates for SBE are outlined.

• **Radio: the Roots of Broadcasting** (page 116)
by Jerry Whitaker, editorial director
Another segment in the "30 years of service" series, this installment celebrates the role of AM radio in the evolving industry. A few of the early pioneering AM stations are cited, along with some visionaries and the introduction of networks that helped to make the industry grow.

October 1989

Theme: Managing Broadcast Operations

Editorial (page 6)
• Taking audio beyond "basic black"
(TV has added diversity to audio that requires new thinking on the part of consumers—consider mono, stereo, SAP and SAP + mono.)

FCC Update (page 8)
• Policy agenda set by new chairman for FM Class A minimum distance separations.

Strictly TV (page 10)
• Organize maintenance with software
(Software packages help track employee hours, keep inventory, generate work orders and parts orders.)

re:Radio (page 12)
• Pre-winter maintenance checklist, Part 1
(Although a thorough inspection of the station facilities takes some time, it will be short compared with repair times in freezing temperatures in the middle of winter.)

Satellite Technology (page 14)
• Winter's coming; prepare now!
(The earth station is prone to damage by winter elements. The antenna surface is as critical as positioning of the antenna, relative to a satellite, in receiving the best signals.)

Circuits (page 16)
• Thermistors measure microwave power
(Glass beam thermistors in a direct-coupled bolometer circuit measure microwave power.)

Troubleshooting (page 18)
• CD troubleshooting, Part 5
(Scratches on a CD surface produce data dropouts similar to other surface incidents that upset interleaving error-correction techniques used in CD reproduction.)

Management for Engineers (page 20)
• On being a leader, Part 7
(Would the station be better off without a certain employee? Be assertive with the individual, without taking a heavy-handed approach, but make it clear that his behavior is not appropriate.)

• **The 1989 Salary Survey: Dividing the Pie** (page 26)
by Brad Dick, technical editor
Most salaries have increased, even if just a little, but TV engineers would like to have seen the small increase. In general, across all markets, radio salaries have continued an upward trend. Unfortunately, TV engineering salaries also have maintained a continuing trend of little or no upward movement. The survey covers all markets and includes radio and television management, engineering and operation levels of employment.

• **Selling Management on AM Stereo** (page 48)
by John Bisset, Delta Electronics, Alexandria, VA
Upgrading a station to AM stereo may find deaf ears from management on technical matters. From a sales point of view, improved sound quality, greater appeal to the listening audience and increased revenue is information management will want to hear. Conversion may be less costly than expected.

• **AM Stereo: Its Time Has Come** (page 58)
by Ronald F Balonis, C.E., WILK-AM, Wilkes-Barre, PA
Compatible AM stereo is a reality that does not make 400 million mono AM receivers obsolete. Originally thought technically infeasible, AM stereo is possible and awaits a "marketplace" decision for a standard.

• **Audio Fidelity: the Grand Illusion** (page 68)
by Dennis R. Ciapura, VP, technical operations, Noble Broadcast Group; president of Technimax Telecommunications, San Diego
The brain operates with perceptions based

on a continuous analysis of the acoustical environment. Binaural recording, intended for listening with earphones, produces serious alterations in the acoustical path from headphones to the eardrum, resulting in reduced resonance and reality. Low-frequency response depends upon bone-conduction transmission, detracting from reality effects.
Key words: fidelity, mic selection/position, effects, binaural recordings, acoustical transmission paths, transaural techniques, anti-crosstalk, close-field, control room EQ, LEDE acoustical treatment.

• **SCA Technology Update** (page 77)
by Phillip Kurz, consulting editor
An SCA carrier on a standard FM signal provides more than elevator music. Data services via SCA bring in additional revenues, as long as interference to normal service is not introduced by the unrelated auxiliary information. Several modulation techniques are available that offer individual strengths and weaknesses.
Key words: SCA channels, baud ranges, 67kHz, 92kHz, FSK on FM on FM/triple modulation, direct FSK on FM, AM on FM, wideband direct linear suppressed carrier, birdies.

• **The Mechanisms of Tape Wear** (page 84)
by Richard Maddox, chief engineer, Muzak, Seattle
The normal life of tape is a hazardous affair, enduring dirt, solvents and physical abuse. Short- and long-term wear factors reduce the useful life of tape. When handled with care and kept clean, tape has a longer useful life.
Key words: PET base, backcoat, dropout, dirt, cleaning techniques, head wear, storage conditions, machine environments, temperature effects, print-through, tape packing, lubricants, water, x-rays, loudspeakers, metal particle tape.

• **The Revolution of Television** (page 96)
by Jerry Whitaker, editorial director
TV has become the most effective communications medium in the history of man. From humble beginnings to its sophisticated status today, TV presents a story of surprises, successes and failures. The article details work by Farnsworth and Zworykin, both important to TV development, and extends to NTSC color, the CCD camera and UHF transmissions.
Key words: Nipkow disc, Zworykin, Farnsworth, Sarnoff, iconoscope, image dissector, flying spot, interlace, image orthicon, vidicon, CCD, additive color, Trinescope, shadow mask, NTSC, CBS whirling disc, PAL, SECAM, UHF.

Applied Technology (page 128)
• Surround sound for television
(An examination of the Dolby Motion Picture Matrix discusses producing the greatest possible reality in TV sound.)

Station-to-Station (page 138)
• Spare parts shortage leads to innovation.
(Depletion of spares stock and obsolete equipment in aging microwave system call for modification of a dual conversion unit to a single conversion system.)

Field Report (page 146)
• Hewlett Packard Goldline model 30 real-time analyzer

SBE Update (page 148)
• Sharing views on society issues helps officers provide positive, constructive solutions.
• Executive director and the possible move of the national office to Washington are discussed.
• Cooperative agreements: should SBE involve other organizations, such as NAB, in its convention? The responses are mixed.
• Society priorities: rewriting of Ennes books, certification, curriculum approval of schools and training seminars; communications and publicity; discussions of policy issues, rather than quick solutions by the executive board.
News Special Report (page 149)
• Broadcasting in a borderless Europe
by John Blau, European correspondent
A united European community is developing well with a rapidly expanding commercial television industry in satellite and terrestrial channels. Satellite technology is only part of the European TV revolution, with cable networks and ISDN showing rapid growth. The movement to a borderless European Common Market has until 1992 to break down national barriers. Limited laws govern the ownership of broadcast facilities with most restrictions controlling the percentage of foreign ownership. Controversial subjects include programming, a transmission standard (PAL or SECAM) and then what of HDTV?

November 1989

Theme: Station Maintenance, 6th annual

Editorial (page 6)
• Sacred cows or just bull?
(Prospects for HDTV carry price tags that are beyond the reasonable amounts stations are likely to be willing or able to pay.)

FCC Update (page 8)
• Agenda set by new chairman.
• Difficult issues: Common carriers, mass media and rule enforcement.
• Radio goals set; strengthening AM radio; speed up FCC procedures; radio pursuit of excellence; voluntary standards based on antitrust laws; shock radio.
• EEO actions; reports of EEO violations resulting in fines.

Strictly TV (page 10)
• Gateways open up the world
(Audiotext and videotext services offer a means for the audience to gain fast access to

information, but the service may take away from actual viewer and listener numbers.)

re:Radio (page 12)
• Pre-winter maintenance checklist, Part 2
(Antenna component inspection, lightning protection, spares, records and new rules for a suggested list for close observation.)

Satellite Technology (page 14)
• First bird launched 25 years ago
(Early Bird and INTELSAT launched the satellite communications era, along with the use of the geosynchronous orbit concept.)

Circuits (page 16)
• Use Smith charts for RF design
(Working with RF signals calls for an understanding of some mathematics to do design calculations. The Smith chart presents an easier way to make highly accurate estimations of impedance, VSWR and other RF characteristics.)

Troubleshooting (page 18)
• CD troubleshooting, Part 6
(Missing data, caused by media flaws or improper handling, has caused more trouble for CD program reproduction than mechanical and electronic failures.)

Management for Engineers (page 20)
• On being a leader, Part 8
(The message and its delivery to your subordinates, no matter what the subject, has a good deal to do with how well it is received.)

• **Servicing Local Area Networks** (page 26)
by Michael W. Dahlgren, Novell Service Division, Provo, UT

The LAN connection between products in the studio requires a different approach by the maintenance department and has become a very lucrative field in information systems operations. Operation is based upon the 7-layer OSI communications protocol. When appropriate fiber-optic interface hardware is available, LAN systems will expand to that area as well.
Key words: LAN, OSI; physical, datalink, network, transport, session, presentation, application layers; FDDI.

• **The New Breed of Test Instruments** (page 32)
by Conrad Persson, editor, *Electronic Servicing & Technology*

Maintenance technicians will appreciate the digital multimeters and logic probes as test instruments for use in troubleshooting digital-based products. Signal level measurements are based upon a slope of charge and discharge, which are proportional to the level being measured. Logic probes provide a means to look at the data moving along a databus, displaying the information with an LED array or an oscilloscope CRT.
Key words: DMM, LSI, logic probes, slope/multislope integration.

• **Advances in Digital Oscilloscopes** (page 42)
by Steve Montgomery, LeCroy Corporation, Chestnut Ridge, NY

Digital oscilloscopes offer benefits not available to analog instruments. One is memory storage, allowing a waveform to be stored for later observation as a reference for comparison with more recent measurements. Once stored, various manipulations, including expansion of small sections, can be used to study signal activities in greater detail.
Key words: DSO, CRT cursors, single-shot, triggering modes; pulse-width, interval, pattern, state-qualified triggering; multiple channels.

• **Automated Test Instruments** (page 48)
by Gregory D. Carey, Sencore, Sioux Falls, SD

PCs may serve in the maintenance process through RS-232 and IEEE-488 GPIB interface cards. Both have advantages for different applications. Additional protocol may be necessary in some cases. The length of the lines between products may affect accuracy in signal transmission, but utility packages are available as line extensions. Another concern is use of the correct interface product for specific situations and some possible variations between different versions of protocol.
Key words: RS-232, IEEE-488, GPIB, HPIB, serial, parallel, connectors, line extenders, data transfer rates, handshaking, CD1/CD3 (X-On/X-Off), software.

• **Maintaining Small Format VCRs** (page 69)
by Brent Robinson, KSL-TV, Salt Lake City

Any video recorder maintenance sometimes presents problems, but small format systems

can pose special problems, often resulting from the reduced size of the equipment. As with any recorder, preventive measures and cleanliness are highly desirable for long life, as are correct tape tensions. The smaller sizes may also mean more critical adjustments of servo circuits and other attributes required to overcome the instabilities solved by inertial properties of larger equipment. Multiple channels and component video signals offer new challenges toward balancing of signal processing circuits.
Key words: component analog video, mechanical wear, tape tension, signal systems, component timing, Bowtie signals, comb filters.

• **Tape Recording Technology** (page 78)
by Jerry Whitaker, editorial director
Storage of audio and video information on magnetic media has had a greater impact on broadcasting than any other development since the invention of the two RF transmission systems. This article tracks the evolution of technology from the first Magnetophone machines brought into the U.S. to the present day. Numerous people and companies were involved in the process, with Bing Crosby being a driving force behind early U.S. developments. Kinescope recordings of video on film preceded magnetic video recording technology for early TV, but when the problems of high-density storage on tape were solved, video recording immediately became the standard approach to program storage.
Key words: Magnetophone, Poulsen, Mullin, AEG, Bing Crosby, Ampex, RCA, kinescope, Ritcheouluff, Schroeter, Marzocci, FM recording, Sarnoff, Sony, VERA, BBC, Axon, quadruplex, helical scan, NAB'56, audio carts, Nolte, Collins, endless loops.

Station-to-Station (page 112)
• ACTS sets computer time and much more
(The Automated Computer Time Service provides time data in an ASCII format via telephone lines to keep station clocks on time. Propagation delay correction is incorporated into the 2-way data transmission system.)

SBE Update (page 118)
• Some new staffers in Indianapolis will assist executive secretary.
• Ennes Foundation awarded free tuition for NAB 5-day satellite uplink seminar.
• Ennes Foundation grant awarded to SBE member living in the Philippines.
• Certification exams scheduled between Nov. 10-20; next test schedule during NAB '90.
• Ennes Foundation testing computerized study guide for five different levels of SBE certification tests.
• Insurance coverage program through New York Life continues to be offered.
• Members of SBE for 15 years or more can upgrade to senior status.

December

Theme: What's in Store for 1990?

Editorial (page 6)
• No rocket scientists

(A segment of **BE** starting in May has included material taken from back issues as well as other sources, giving a historic perspective of the broadcast industry. It has been 30 good years.)

FCC Update (page 8)
• 24-hour ban on indecency in broadcast under study.
• Action taken on 95 indecency complaints.
• LPTV filing window opened for early December; limit of five new stations.
• Station totals for AM, FM, TV, boosters and translators.

Strictly TV (page 10)
• Election network saves the day
(Equipment in the newroom converses efficiently through local area networks.)

re:Radio (page 12)
• From SBE to the elusive antenna
(Over time, descriptions of monitoring points may become confused. Aerial photographs, a topographical map and help from a surveyor can get your pattern back in shape.

Satellite Technology (page 14)
• Space age nose test
(A need to avoid unpleasant odors in manned space capsules uses a panel of expert noses checking every item that will be inside the occupied portion of the craft.)

Circuits (page 16)
• Use Smith charts for RF design, Part 2

(Estimations of impedance, VSWR and other RF characteristics are simplified.)

Troubleshooting (page 18)
• CD troubleshooting, Part 7
(Careful Handling of CD media and occasional cleaning prolongs the life of your investment and improves performance.)
Management for Engineers (page 20)
• Feeling important, Part 1
(Successful management takes into account the employee's self image. Positive reinforcement generates a good self image and promotes better work.

• **State-of-the-Industry Report** (page 26)
by Brad Dick, technical editor
Contrasting 1988 responses that indicated 1989 would show economic improvements, budgeting for equipment purchases is reduced for 1990. Only in the top 100 markets is an increase in facilities upgrades of 3% expected. An estimated median in equipment budgeting for 1990 shows cuts as much as 22% over 1989 for TV, although non-commercial stations show projected increases of 10%. For radio, the equipment budget median shows an increase of 28.5% industry-wide, offsetting a reduction that had been planned for 1989. Station staffing is expected to drop, perhaps by as much as 20%.

• **View from the Top** (page 38)
by Brad Dick and Rick Lehtinen, technical editors
Interviews with James McKinney, chairman, the Advanced Television Systems Committee (ATSC) and Raymond Smith, chairman, Bell Atlantic Corporation, explore the future of HDTV as a communications medium. Areas discussed include the transmission medium, off-air or wired; the role of Europe and Japan in a standard; and roles played by NAB, the FCC and government in general. One question begs for an answer before other decisions are made: What does the US want from HDTV?
Key words: HDTV, simulcast, improved NTSC, digital TV, phone companies (BOCs), Eureka, fiber optics, broadband networks.

• **New Dimensions in Integrated Circuits** (page 49)
by Jerry Whitaker, editorial director
Wafer-scale integration (WSI), the super chip, has been proposed as a major step in solid-state circuitry, but removal of heat from densely populated wafers presents problems. Predictions include superconductive tunnel effects as a means to increasing switching speeds by factors ranging from 10× to 100×. Vacuum ICs, including a microelectronic CRT, and 16Mb dynamic RAM also figure in future products, as do increased RISC and ASIC devices. The human imagination and device manufacturing yields, not the sky, are the limits of the future.
Key words: WSI, VLSI, ASIC, RISC, superconductor, vacuum microelectronics, DRAM, DSP, Harvard architecture, SHPi, GaAs-on-Si, Si-on-insulator, silicon-on-sapphire, molded circuit device (MCD), high-density multichip interconnect (HDMI).

• **Advanced Technologies** (page 74)
by Jerry Whitaker, editorial director
A revolution in communications began with the transistor effect, described by Shockley of Bell Laboratories in 1947. That revolution is still in progress, impacting communications in general and broadcasting in particular by means of increased device functional power and decreased device sizes. The satellite service became a reality, based upon the existence and capability of solid-state devices and the predictions of Arthur C. Clarke, and today continues to change the way the world communicates. Solid-state and computer technology has also introduced the automation revolution, a slowly growing phenomenon promising more productive and cost-effective operations.

SBE Update (page 124)
• New society officers installed at convention: Brad Dick, president; Richard Farquhar, vice president; Paul Lentz, secretary; Bill Harris, treasurer; directors, Phil Aaland, Dane Ericksen, Bill Hineman, Tom Weems, Fred Baumgartner, Chuck Kelly.
• Policy to stress director and officer accountability; a series of newsletters will keep society members informed.
• FCC Felker addressed convention, urged SBE engineers get involved in selection of HDTV standard.
• Ennes workshops, exhibit/seminar hours at convention deemed successful.
• McKain, Van Buhler awarded fellowships to recognize service to society.

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Continued from page 4

though the imminence of Hurricane Hugo reduced the attendance slightly on the last day.

Ian M. Waters, Varian TVT division, Cambridge, England, presented a paper, "Update On MSDC Klystron Transmitters." The TVT multistage depressed-collector klystron provides a figure of merit of 140 in the new TVT Vista transmitters. The first 120kW installation using this tube will be KVDA, San Antonio.

Larry Will, assistant of engineering of New Jersey Public Broadcasting, presented a paper on "The Design, Implementation and Installation of an On-Channel UHF-TV Booster." Photographs highlighted his paper, which demonstrated that off-air boosters are certainly practical.

Bob Surette, Shively Labs, presented a paper on "Five vs. Four-Pole Bandpass Filters for FM Combiners." Ali R. Mahmad, Jampro, added to FM interest by discussing "Spiral Antennas for Low VHF and FM Broadcasting."

At the Thursday evening banquet, James McKinney, Advanced Television Systems Committee, spoke to the audience about his governmental career. Friday morning, Philip Rubin discussed high-definition television.

The afternoon sessions included a presentation from Ogden Prestholdt, "Characteristic Impedance Prediction Using Logarithmic Potential Theory." This was followed by Jules Cohen, Jules Cohen and Associates PC, who presented an update on "Radio Frequency Radiation."

News from Europe

By John Blau,
European correspondent

Takeovers worry U.K. broadcasters

A "white paper" policy report issued by the British government warns that commercial broadcasters could become acquisition targets for European investors. According to Central Independent Television (CIT), the United Kingdom will be unique in allowing unfriendly takeovers of its broadcast companies. Except for Italy, opportunities do not exist within the European Community for British TV companies to enjoy the level of freedom the government is proposing to offer. A British broadcaster is not allowed to hold even a minority stake in Dutch or Portuguese television. Because of complex national and regional regulations, takeovers of European broadcast companies are almost unheard of.

New products

Editing software

Alpha Audio has introduced the Boss/2 automated audio editor software, which can be interfaced with Tascam ES-50 or Otari EC-101 synchronizers. Drivers for serial-controlled devices include the Studer A730 CD player, Panasonic M-II, Hitachi HR-230 and Sony VO-9850 VTRs as well as the Sony APR-5003V 2-track ATR. Code-only chase machines with a TCGEN driver allow hard disk recorders, sequencers and recording consoles to become a master machine for system control.

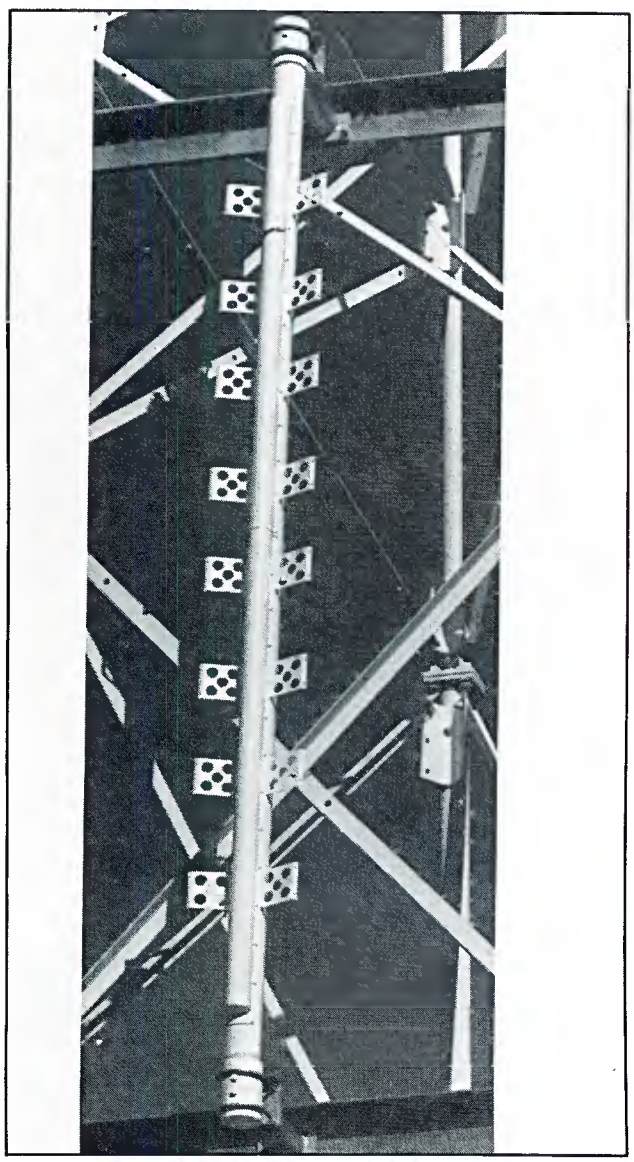
Circle (350) on Reply Card

Acoustic design software

Altec Lansing has introduced AcoustaCADD software for MS-DOS IBM and compatible PCs. Developed cooperatively with Electro-Voice, the program uses physical laws of sound propagation and predictions of sound behavior and equipment data files to calculate and graphically display sound paths in sound-system designs.

Circle (351) on Reply Card

LPTV antenna



Andrew has introduced the ALPine LPTV series of antennas for LPTV or low-power translator service. Various coverage patterns are included with radomes for environmental protection of the HELIAX-fed antennas. Aluminum modular construction is weather-resistant and places low-weight loads on support structures.

Circle (352) on Reply Card

Stereo microphone

AMS Industries has introduced the ST250 stereo microphone. A remote-control unit switches the mic from X–Y to M-S stereo or adjusts from vertical to end-fire operation. The 20Hz-20kHz response includes remote-controlled bass rolloff and true coincident stereo signal to 10kHz. The equipment operates from 110-250Vac or dc power.

Circle (353) on Reply Card

Video paint system

Aurora Systems has introduced the AU/260 videographics system. At 33.3MHz clocking, the 80386-based paint system offers 4Mbyte RAM, two frame buffers and a 660Mbyte fixed disk. Other system equipment includes a 1.2Mbyte floppy drive, 60Mbyte streaming tape backup and Weitek math co-processor. An icon-menu operating system runs 32-bit RGB with alpha channels at all pixel locations, a key output, select/mask channel and numerous creation tools.

Circle (354) on Reply Card

Microphone products

beyerdynamics has introduced the following products:

- The SEM 186 is a hand-held microphone transmitter that uses an EM 81 condenser capsule to withstand sound-pressure levels to 138dB. Limiting circuits regulate modulation of a 174-216MHz carrier as pressure levels increase.
- The TS 190 is a bodypack system for lavalier microphones with input sensitivity selection to match particular microphones. NE 185.10 non-diversity and NE 185.11 diversity wireless receivers complete these systems.
- The A/V pack has lavalier, hand-held interview and shotgun microphone models M58, MCE86 and MCE5 or MCE10 packaged in a black attache case. These three instruments cover nearly all mic requirements.

Circle (355) on Reply Card

Routing control systems

BTS has introduced the BRC-2000 series routing and distribution switcher controllers, which work with user-supplied IBM AT and compatible with MS-DOS 3.20 or later, 640k RAM and serial/printer ports, and floppy and fixed drives. Models include a BCR-2000 configuration controller, BCR-2100 switcher automation control and BCR-2200 facility automation control. The application software runs on XT systems with speed controlled by the PC operating speed.

Circle (356) on Reply Card

Maintenance management software

Computer Assisted Technologies has introduced the BCAM maintenance management software. It is menu-driven and the program maintains records of the equipment inventory and history of repairs needed or completed. Reports on IBM PC/compatibles screen or hard-copy prints may be made of individual pieces of equipment, the working parts inventory and a knowledge base of problems/solutions for questions about particular pieces of equipment.

Circle (357) on Reply Card

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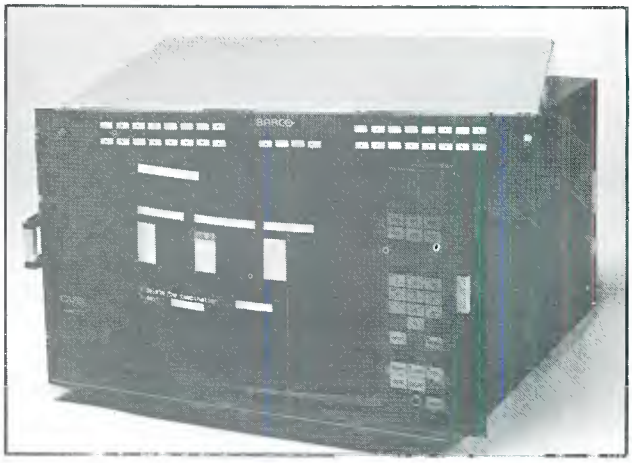
Circle (93) on Reply Card

Auto setup monitors and routing system

Barco has introduced the following products:

- The AVM grade 2 monitor series are 10-, 14- and 21-inch models, which fit in standard equipment racks with the automatic setup and alignment circuitry formerly introduced in the CVS grade 1 color monitors. The units provide RGB-S, S-VHS and Y/R–Y/B–Y input capabilities.
- The BVRS 16×16 routing switchers support wideband component signals and NTSC, PAL or SECAM composite video with microprocessor programmable reconfiguration. Switcher control can be from a local panel, from a PC or from a CVS monitor with source ID notations keyed into any signals as desired.



Circle (358) on Reply Card

Camera support systems

Cinema Products has introduced additional versions of Steadicam, which is designed for EFP and ENG applications and lightweight 16/35mm film cameras ranging from 15 pounds to 23 pounds. Although lighter in weight, the unit retains all features of previous models. Steadicam/JR for personal 8mm and VHS-C type camcorders weighs only 1.8 pounds. The product removes hand-held shakes and bouncing of a walking camera operator. The JR includes a low-intensity light and oversized monitor. For film camera users of studio Steadicams, SteadiMag is a 400-foot film magazine for Arri 3 and 2C cameras, which has reduced weight and improved loading and threading features.

Circle (359) on Reply Card

TBC controller

Ensemble Designs has introduced the TC400 4-machine TBC controller. Interfacing to the GVG-200 switcher with E-MEM and an Apple Macintosh computer, the controller offers full procamp control for four TBCs. A 100-setup memory allows manual, GPI or serial recall of setups for each TBC. Learn and recall activity on the video switcher are duplicated by the controller, while an AppleTalk-type LAN interconnects multiple TC400s and permits control of any TBC in the network from any controller panel.

Circle (360) on Reply Card

Equipment slide mounts

General Devices has announced the ChassisTrak C-300 series rack-mounted slide units. The telescoping equipment mounts use solid bearings with a dry film lubricant to avoid a buildup of dust. They offer load capacities to 85 pounds with lengths in 2-inch increments in the range of 10 inches to 30 inches.

Circle (361) on Reply Card

Multiformat processing

I.DEN has introduced the IVT-9 Plus, which samples at 4:2:2 rates for time base correction and format conversion among VHS, Betamax, S-VHS, ED-Beta, U-matic/dub, M-II, Betacam and NTSC video signals. A full frame of correction is offered by 8-bit circuitry in addition to a variable speed tracking range of −1 to +3×. Optional packages extend to transcoders for RGB and CTDM/CTCM compressed component VTRs.

Circle (362) on Reply Card

Expanded workstations

Harris Video Systems has expanded the HarrisVws workstation systems with an advanced creation model, including 2-D animation and journal animation, which allows a sequence of instructions to be recorded for later playback. Frame animation controls external VTRs for image recording and capture from tape. Series 5000 workstations have additional keying facilities to capture, store and output linear key frames with associated images. An integrated linear keyer produces effects directly on the program output channel. An erasable optical disk drive introduces a capacity of 750 4:2:2 images per cartridge using 5¼-inch disks.

Circle (363) on Reply Card

Power protection

Kalglo Electronics has introduced TeleSpiker, an upgraded series of protective power systems. UL 1449 clamping levels decrease the voltage allowed to pass after a 6,000V surge is applied.

Circle (364) on Reply Card

Still-storage equipment

Leitch Video has introduced the enhanced Still File system. An optional frame buffer provides a digital video D-2 interface. Compatibility is available with Abekas A42 systems direct transfer from A42 tape cartridges. Still Net and an ethernet connection give multi-users access to images in networked single-user systems. The 2600ES Prom-Slide full-frame display can be programmed to display NTSC logos, test patterns or other video and graphic material. Images can be transferred from Still File to Prom-Slide.

Circle (365) on Reply Card

Audio effects equipment

Lexicon has introduced the following products:

- The program cartridge 1.0 is for the 480L effects processor, which features four algorithms, including ambience, random hall, panorama and stereo digital compressor/expander features.
- The LXP-5 processor allows five simultaneous effects with three octaves of pitch-shift range, a variety of delay sweeps, chorusing, flanging, ambience and reverb. Operable with MIDI equipment, the unit incorporates 64 permanent factory presets and provides 128 user-programmable memories.

Circle (366) on Reply Card

Post-production console

Rupert Neve has introduced the VRP audio console designed for multiformat use in stereo television, film or multitrack operations. The system features a variety of output capabilities including 4- and 8-track to stereo or mono for television and separate feeds for music and effects. Capabilities also are provided for Dolby DS4 stereo surround, 2- and 4-channel LCRS monitoring and independent master recorder and stereo monitoring.

Circle (367) on Reply Card

Video prompter system

Listec Video has introduced Scrollbox, a video prompter interface in serial or parallel with any word-processing computer and software. The lightweight unit operates from an integral, rechargeable battery or from an ac supply and offers a remote, bidirectional scroll-rate control. Text appears in two font sizes with a cue marker.

Circle (368) on Reply Card

Frame synchronizer

Microtime has introduced the FS-10 frame synchronizer, a 10-bit architecture unit of 4fsc composite digital sampling to wideband, transparent processing. Operational options include detect/pass bad video, freeze on last good field, cut to black or cut to local auxiliary input. Glitch-free switching between nonsynchronous sources is possible and a D-2 composite digital output is provided for integration in all-digital facilities. NTSC, 625-PAL and 525-PAL versions will serve 1/2-inch and 3/4-inch VCRs.

Circle (369) on Reply Card

Fluid head systems

Miller Fluid Heads has introduced the model 30 and model 50 Series II products, which are revised from previous products with attention given to protecting the mechanisms from moisture and dust. For 30-pound and 50-pound loads, both use a 3-stage drag setting in addition to a neutral position. Additional features include a bubble level, non-wearing handle carrier mounts and compatibility with a 100mm ball-leveling or flat-base tripod.

Circle (370) on Reply Card

Modulation measurement

Modulation Sciences has introduced the FM ModMinder measurement circuitry, which responds only to longer events defined by the FCC as overmodulation, ignoring brief peaks that do not increase occupied bandwidth or cause overmodulation. A resulting 3dB increase in modulation is possible with moderate signal processing. Panel indicators include readouts for the highest peak in the previous second, the number of events occurring in the previous minute and a flasher when a preset modulation level is exceeded.

Circle (371) on Reply Card

Production slate

Nalpak Video Sales has announced the VID-SLATE in 4×5 and 7×9 sizes. Both slates are constructed of 0.06-inch styrene with permanent black silk-screened markings.

Circle (372) on Reply Card

Time-code products

TimeLine has introduced the Lynx SSL data interface, keyboard control unit, universal time-code module and VSI module. The SSL interface links direct conversation between the SSL studio computer and various ATR, VTR and film transports and expands the number of transports controlled from the SSL computer. Software for Lynx keyboard controllers expands machine control to six transports through Lynx modules. Additional features in the universal time-code module software update include additional ATR, VTR and digital audio recorder models. The VSI video system interface update controls ATRs through serial emulation of an Ampex VPR3 transport from a serial port of most editing controllers.

Circle (373) on Reply Card

Post-production audio mixing

Neve Electronics has introduced the model VRP, one of a series of post-production audio consoles. Special features provide for 4- and 8-track to stereo or mono outputs; independent master recorder with stereo monitoring; 2- or 4-channel left/center/right/surround monitoring; separate feeds for music and effects; and Dolby DS4 stereo surround capability.

Circle (374) on Reply Card

Tape library system software

Nesbit Systems has introduced the NSi tape library software to assist in locating videotapes and creating an active storage/retrieval archive system with 18 search fields, key word search and bar-code functions. A synopsis window that permits free-form text descriptions and a time-code window for tape logging are included in the PC display.

Circle (375) on Reply Card

Power inverter

Nova Electric has introduced the G3K60-120 sine wave 3kVA inverter. The solid-state system uses sine pulse-width modulation for 120Vac at 60Hz single phase, with less than 3% THD. Voltage and frequency regulation are ±1% and ±0.5%, respectively, operating from an input range of 105-140Vdc.

Circle (376) on Reply Card

Enhanced TBCs

Nova Systems has enhanced several products. Model 710S includes dropout compensation in the wideband TBC. DOC is added in VTR-SC/direct mode, S-VHS processing and heterodyne mode. The NOVASync frame synchronizers are expanded to four models. NOVASync 2 adds a TBC mode for VTR-SC direct mode, S-VHS and heterodyne processing with auto-select of synchronize or TBC mode. NOVASync F has freeze frame, field 1/field 2 capability with auto-default freeze to the last good field. NOVASync 2F introduces AGC to the synchronizer, freeze/field frame and TBC unit.

Circle (377) on Reply Card

TBC and synchronizer

Prime Image has introduced 7.5MHz time base correctors and frame synchronizers. Models are variable to 20dB noise reduction with flat response to 7.5MHz. VITS, VIRS and closed-caption data bypass processing that may include digital effects options. Transcoding among composite and component video formats is standard.

Circle (378) on Reply Card

HD still camera

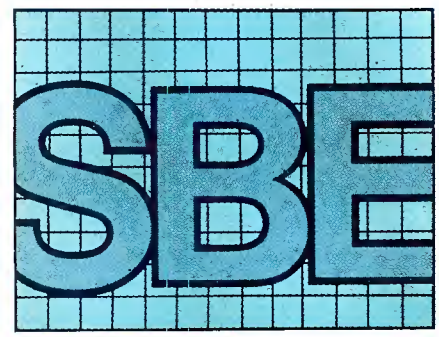
REBO Research and *Nikon* have introduced the HQ-1500C HDTV still camera with a REBO ReStore HD framestore. Image capture time is 0.3 seconds per frame with error-free color registration. A 1,920×1,035-pixel frame size stems from a 1-inch Saticon tube and requires a Macintosh II computer through a NuBus slot interface.

Circle (379) on Reply Card

Time-code software

Tele-Image has introduced the time-code conversion software, which accepts film-frame numbers or feet and frames for conversion to video time-code data. The program stores time-code information on an 5¼-disk and converts data from the 5¼ to 8-inch disk for system use.

Circle (380) on Reply Card



New president sets agenda

By Bob Van Buhler

The new officers and board members of the Society of Broadcast Engineers assumed their offices at the 1989 SBE national convention, held in October in Kansas City, MO.

Brad Dick, president, is a 20-year veteran of the broadcast industry and a 7-term past secretary of the society. He is a technical editor for **Broadcast Engineering** magazine and the former director of engineering and operations for KANU-FM at the University of Kansas, Lawrence, KS. He and his family live in Lawrence.

President's comments

Dick has announced a new policy of director and officer accountability, which was instituted at the October board meeting. Roll call votes on all important questions and attendance records at board and committee meetings will become public record.

Dick said, "When you see your ballot next year, you will see a list of the members of the board of directors, and you will know how they voted on specific issues, whether or not they attended the meetings, what committees they served on, and whether or not they've done a darn thing during the past year." According to Dick, the previous method of voting for people based on where they work was "totally unacceptable."

In response to a question concerning the "SBE Signal," Dick promised that members would receive a "stack of information" from the national office by the time the next convention rolled around. He also urged members to communicate their wishes to the board of directors. "Your leaders don't work in a vacuum," Dick said. "You're responsible for telling us what you want and need."

He also said a new series of newsletters will be issued from the national office. Three newsletters have been developed. Bob Goza, chairman of the convention committee, and Jim Wulliman, executive director of the Ennes Foundation, will issue their own newsletters. The certification newsletter will be sent to all certification chairmen. The convention newsletter will be sent to chapter secretaries and chapter newsletter editors. The president's newsletter will be sent to all members. The newsletters occasionally will include survey questionnaires to obtain feedback from members.

Board meeting attendance

Several directors were absent from the meeting of the board of directors in Kansas City. Some members who are not on the board attended and contributed to society business. All outgoing and incoming officers were in attendance.

Directors attending the meeting were Bob Goza, Dane Ericksen, Bill Hineman, Ed Roos, Paul Montoya and Steve Brown. Directors who were absent included current directors Jeff Baker and Joe Manning and re-elected incumbents Phil Aaland and Tom Weems. Newly elected director Fred Baumgartner also was absent.

Ennes workshops successful

Daylong workshops, conducted free for attendees, preceded the SBE national convention and **Broadcast Engineering** conference. The workshops provided hands-on factory-type training on a variety of broadcast equipment. The workshops were organized by Don Borchert, director of engineering at WHA-TV, Madison, WI.

Workshops were conducted by Sony, Grass Valley/Dubner, Ampex, Harris, Broadcast Electronics and Mitchell Vo-Tech School. Don Markley taught an overflow crowd on AM and FM maintenance. Brad Dick discussed management for engineers.

Limited registration for the workshops was set at 200, but swelled to a total of 239 attendees as late registrants were admitted. Many exhibitors, impressed with the value and success of the workshops, have already requested permission to participate in next year's seminars. Jim Wulliman, Ennes Foundation executive director, confirmed that a day of sessions is being planned for the 1990 convention in St. Louis.

SBE convention schedule works

Despite some skepticism, SBE's convention policy of scheduling non-conflicting seminar and exhibit hours was greeted with enthusiasm by attendees and exhibitors. Attendees, relieved of conflicts between their desire to view new equipment and attend technical sessions, turned out in record numbers on the exhibit floor.

A total of 147 exhibitors were present at this year's convention, displaying an impressive array of audio, video and RF products. All exhibits were targeted directly at the broadcast engineering community, precluding the usual assortment of bumper sticker and traffic system vendors found at other trade shows. Exhibitors expressed satisfaction with the quality of contacts made at the show and the number of working engineers and engineering managers in attendance.

Fellowships awarded

Two Fellowships were awarded at the convention. Outgoing president, Jack McKain, and outgoing vice president, Bob Van Buhler, each were recognized for their many years of service to the society.

McKain served on the board of directors before being elected vice president. He served as director for two years and was then elected president, retaining that position from 1987 to 1989. He also held positions in his local chapter and was responsible for starting several Midwest chapters.

Van Buhler served as vice president from 1987 to 1989. He had been elected to the board of directors in 1986, a position he held for two years. Van Buhler also served as vice chairman of the All-Industry National Frequency Coordination Committee and on the National SBE Frequency Coordination Committee. He is a certified senior broadcast engineer.

The SBE Fellowship recognizes the contributions of individuals who have devoted significant time and effort to the growth and well-being of the society. Nominations, which are made by the Fellowship committee, are voted upon by the directors and officers of the society.

Van Buhler is manager of engineering at KNIX-AM/FM, Phoenix.

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HELP WANTED

MAINTENANCE ENGINEERS needed for Christian teleproduction facility. Experience in maintenance and component level repair required. Ampex AVC, ADO, VPR-3, Beta. Scientific Atlanta/MCL satellite. Resume to Chief Engineer, P.O. Box 819099-9099, Dallas, TX 75381. 8-89-6t

BROADCAST ENGINEER SHADOW TRAFFIC NETWORK'S New York network center needs a second engineer. Duties include repair and maintenance of audio, RF, computer and telecommunications equipment. Applicant must be familiar with needs of a broadcast operation. Reply to: Shadow Traffic Network, 201 Route 17, Rutherford, New Jersey 07070, Attn: Jim Walling. 10-89-3t

MAINTENANCE ENGINEER for UHF TV station. Need technician with experience repairing studio equipment. Send resume to: Gary King, WXON-TV, 27777 Franklin Rd., Suite 708, Southfield, Michigan 48034. Equal Opportunity Employer. 11-89-3t

TV TX MAINTENANCE TECHNICIAN: Minneapolis, MN, TV station is seeking a maintenance technician with strong background in VHF-TV transmitters, microwave and satellite equipment. Minimum of three years full-time VHF transmitter maintenance experience required. Experience with RCA TT30-FL transmitters preferred. Valid FCC and drivers licenses are required. Qualified individuals should send resumes (no phone calls) to: Chief Engineer, WCCO-TV, 90 South 11th St., Minneapolis, MN 55403. 12-89-1t

MAINTENACE ENGINEERS: Must have successful technical background with 3 to 5 years experience with betacam and 1 inch videotape. We're looking for winners! Major West Coast broadcasting group. Send resume and salary history to: R. Terneuzen, 663 Maulhardt Ave., Oxnard, CA 93030. EOE. 12-89-2t

SENIOR FIELD SERVICE TECHNICIAN. Adcom Electronics Limited seeks a person with a 3-year technical college diploma and 5-years broadcast maintenance experience for this position. Knowledge of Sony ½", ¾" and 1", Grass Valley switchers, editors, DVE's, and all associated test equipment. Principally based in Toronto, occasional travel maybe required for service in Canada and for training in the USA. Please reply in confidence to: **Customer Service Manager, Adcom Electronics Limited, 310 Judson St., Unit 1, Toronto, Ontario, M8Z 5T6.** 12-89-1t

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BROADCAST PRODUCTION MANAGER—Agressive, growing video production company needs a production manager who can take us into the 1990s. We're already moving fast; we need someone who can move faster. Send resume & salary history to: Broadcast Engineering, P. O. Box 12901, Dept. 709, Overland Park, KS 66212. 12-89-1t

SENIOR BROADCAST TECHNICIAN—WOSU-AM/FM of the Ohio State University is seeking a Senior Broadcast Technician to repair and perform preventive maintenance on radio studio equipment and all AM/FM transmitters. This individual will also assist in the construction and installation of studio equipment and transmission facilities. Candidtates must have extensive experience in electronic engineering, experience in broadcasting with technical or military school training or an equivalent combination of education and experience, and a FCC General Class Radio Telephone Operators license or S.B.E. certification. Experience in AF and RF maintenance procedures desired. Starting salary: $18,360-20,640. To assure consideration, materials must be received by December 22, 1989. Send resume and a copy of this ad to: Professional Employment Services, The Ohio State University, Lobby, Archer House, 2130 Neil Avenue, Columbus, OH 43210. An Equal Opportunity, Affirmative Action Employer.. 12-89-1t

BROACAST ENGINEER—Aggressive, growing video production company needs an experienced engineer who thinks young. Must be familiar and comfortable with all video formats. Send resume and salary history to: Broadcast Engineering, P. O. Box 12901, Dept. 710, Overland Park, KS 66212. 12-89-1t

VIDEO MAINTENANCE ENGINEER. Detroit area post house seeks a person to maintain and modify post-production equipment. Experience with Bosch FDL, Sunburst Color Corrector, Quantel Paint Box, Sony BVH/BVU, GVG 200/Kaleidoscope, or Abekas DDR an asset. Send resume to: Postique, 23475 Northwestern Highway, Southfield, MI 48075, Attn: Engineering Manager, or call (313) 352-2610. 12-89-2t

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MAINTENANCE ENGINEER—Central California NBC affiliate seeks maintenance engineer with minimum 3 years experience in the maintenance and component level repair of modern broadcast equipment. Resume to Personnel, KSEE, P. O. Box 24000, Fresno, CA 93779. EOE M/F/H. 12-89-1t

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1. Please check the ONE type of facility or operation that best describes your business classification.

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21 ☐ AM Station
22 ☐ FM Station
23 ☐ AM & FM Station
24 ☐ TV & AM Station
25 ☐ TV & FM Station
26 ☐ TV, AM & FM Station
19 ☐ Low Power TV Station
27 ☐ CATV Facility
28 ☐ Non-Broadcast TV including Closed Circuit TV (CCTV)
29 ☐ Recording Studio
30 ☐ Teleproduction Facility
31 ☐ Microwave, Relay Station or Satellite Company
32 ☐ Government
33 ☐ Consultant (Engineering or Management)
34 ☐ Dealer, Distributor or Manufacturer
35 ☐ Other _____ *(Please specify)*

2. Which of the following best describes your title? Write the number in the box (select one number only):

A ☐ **Company Management** — (1) Chairman of the Board, (2) President, (3) Owner, (4) Partner, (5) Director, (6) Vice President, (7) General Manager (other than in charge of Engineering or Station Operations Mgt.), (8) Other Corp./ Financial Officials.

B ☐ **Technical Management & Engineering** — (9) Technical Director/Mgr., (10) Chief Engineer, (11) Other Engineering or Technical Titles.

C ☐ **Operations & Station Management/Production & Programming** — (12) VP Operations, (13) Operation Mgr./ Director, (14) Station Mgr., (15) Production Mgr., (16) Program Mgr., (17) News Director, (18) Other Operations Title.

D ☐ **Other:** Specify _____

3. If you checked 20 through 26 above, which of the following best describes your over-the-air station? (check only one):

A ☐ Commercial
B ☐ Educational
C ☐ Religious
D ☐ Campus Low Frequency
E ☐ Community
F ☐ Municipally Owned

4. What is your annual budget for equipment purchases? (check only one):

A☐ Less than $25,000
B☐ $25,000 to $49,999
C☐ $50,000 to $99,999
D☐ $100,000 to $249,999
E☐ Over $250,000

5. What is the ADI rank of your station?

A☐ Top 20 B☐ 21 to 50 C☐ 51 to 100 D☐ Over 100

6. Which statement best describes your role in the purchase of equipment components and accessories?

A ☐ Make final decision to buy a specific make or model.
B ☐ Specify or make recommendation on make or model.
C ☐ Have no part in buying or specifying.

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1	17	33	49	65	81	97	113	129	145	161	177	193	209	225	241	257	273	289	305	321	337	353	369	385	401	417	433	449	465	481	497	513	529	545	561	577	593
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7	23	39	55	71	87	103	119	135	151	167	183	199	215	231	247	263	279	295	311	327	343	359	375	391	407	423	439	455	471	487	503	519	535	551	567	583	599
8	24	40	56	72	88	104	120	136	152	168	184	**200**	216	232	248	264	280	296	312	328	344	360	376	392	408	424	440	456	472	488	504	520	536	552	568	584	**600**
9	25	41	57	73	89	105	121	137	153	169	185	201	217	233	249	265	281	297	313	329	345	361	377	393	409	425	441	457	473	489	505	521	537	553	569	585	601
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15	31	47	63	79	95	111	127	143	159	175	191	207	223	239	255	271	287	303	319	335	351	367	383	399	415	431	447	463	479	495	511	527	543	559	575	591	607
16	32	48	64	80	96	112	128	144	160	176	192	208	224	240	256	272	288	304	320	336	352	368	384	**400**	416	432	448	464	480	496	512	528	544	560	576	592	608

RD9

Which one advertisement in this issue was of most interest to you?

Advertiser's name _____ **Circle No.** _____

Your comments on this issue:

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ACTION CARD

IMPORTANT: Do you wish to ☐ receive or ☐ continue to receive your free subscription? ☐ Yes ☐ No

Your signature is required *Date*

Please answer all the following questions. Please print or type:

Name _____

Title _____

Company _____

Co. Address _____

City _____ State _____ Zip _____

Phone (_____) _____

For address change or literature request, place peel-off label from cover here

FREE LITERATURE REQUEST

For issue of December 1989 Use until April 1990

(After this date, please contact supplier directly.)

FASTER ACTION!

If you have immediate interest in any products in this issue, write in the number(s) below and check all the appropriate boxes.

I am interested in these items ▼	✓ Immediate Need	✓ Have Sales-person Call	✓ Name Nearest Dealer	✓ Send Literature	✓ For Future Reference
#					
#					
#					
#					

Use this form to...

☐ **Apply for or renew your FREE subscription**

☐ **Request FREE literature on items in this issue**

☐ **Submit change of address**

(Check all that apply)

ALL INFORMATION MUST BE PROVIDED!

1. Please check the ONE type of facility or operation that best describes your business classification.

20 ☐ TV Station
21 ☐ AM Station
22 ☐ FM Station
23 ☐ AM & FM Station
24 ☐ TV & AM Station
25 ☐ TV & FM Station
26 ☐ TV, AM & FM Station
19 ☐ Low Power TV Station
27 ☐ CATV Facility
28 ☐ Non-Broadcast TV including Closed Circuit TV (CCTV)
29 ☐ Recording Studio
30 ☐ Teleproduction Facility
31 ☐ Microwave, Relay Station or Satellite Company
32 ☐ Government
33 ☐ Consultant (Engineering or Management)
34 ☐ Dealer, Distributor or Manufacturer
35 ☐ Other _____ *(Please specify)*

2. Which of the following best describes your title? Write the number in the box (select one number only):

A ☐ **Company Management** — (1) Chairman of the Board, (2) President, (3) Owner, (4) Partner, (5) Director, (6) Vice President, (7) General Manager (other than in charge of Engineering or Station Operations Mgt.), (8) Other Corp./ Financial Officials.

B ☐ **Technical Management & Engineering** — (9) Technical Director/Mgr., (10) Chief Engineer, (11) Other Engineering or Technical Titles.

C ☐ **Operations & Station Management/Production & Programming** — (12) VP Operations, (13) Operation Mgr./ Director, (14) Station Mgr., (15) Production Mgr., (16) Program Mgr., (17) News Director, (18) Other Operations Title.

D ☐ **Other:** Specify _____

3. If you checked 20 through 26 above, which of the following best describes your over-the-air station? (check only one):

A ☐ Commercial
B ☐ Educational
C ☐ Religious
D ☐ Campus Low Frequency
E ☐ Community
F ☐ Municipally Owned

4. What is your annual budget for equipment purchases? (check only one):

A☐ Less than $25,000
B☐ $25,000 to $49,999
C☐ $50,000 to $99,999
D☐ $100,000 to $249,999
E☐ Over $250,000

5. What is the ADI rank of your station?

A☐ Top 20 B☐ 21 to 50 C☐ 51 to 100 D☐ Over 100

6. Which statement best describes your role in the purchase of equipment components and accessories?

A ☐ Make final decision to buy a specific make or model.
B ☐ Specify or make recommendation on make or model.
C ☐ Have no part in buying or specifying.

Circle reader service numbers below for more information

1	17	33	49	65	81	97	113	129	145	161	177	193	209	225	241	257	273	289	305	321	337	353	369	385	401	417	433	449	465	481	497	513	529	545	561	577	593
2	18	34	**50**	66	82	98	114	130	146	162	178	194	210	226	242	258	274	290	306	322	338	354	370	386	402	418	434	**450**	466	482	498	514	530	546	562	578	594
3	19	35	51	67	83	99	115	131	147	163	179	195	211	227	243	259	275	291	307	323	339	355	371	387	403	419	435	451	467	483	499	515	531	547	563	579	595
4	20	36	52	68	84	**100**	116	132	148	164	180	196	212	228	244	260	276	292	308	324	340	356	372	388	404	420	436	452	468	484	**500**	516	532	548	564	580	596
5	21	37	53	69	85	101	117	133	149	165	181	197	213	229	245	261	277	293	309	325	341	357	373	389	405	421	437	453	469	485	501	517	533	549	565	581	597
6	22	38	54	70	86	102	118	134	**150**	166	182	198	214	230	246	262	278	294	310	326	342	358	374	390	406	422	438	454	470	486	502	518	534	**550**	566	582	598
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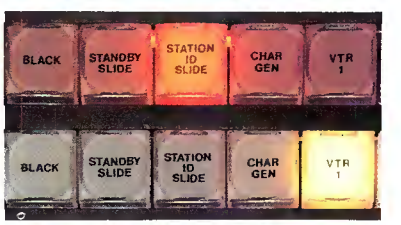
The PROM-SLIDE™

the card to play

Whether you're frustrated with maintaining your old master control slide chain, or tying up expensive equipment for those same few stills, the Leitch **PROM-SLIDE™** is what you've been waiting for.

This single compact card will ensure that your station ID, logo, standby message, or custom test signal is always available, with full color frame resolution, at the input of your switcher.

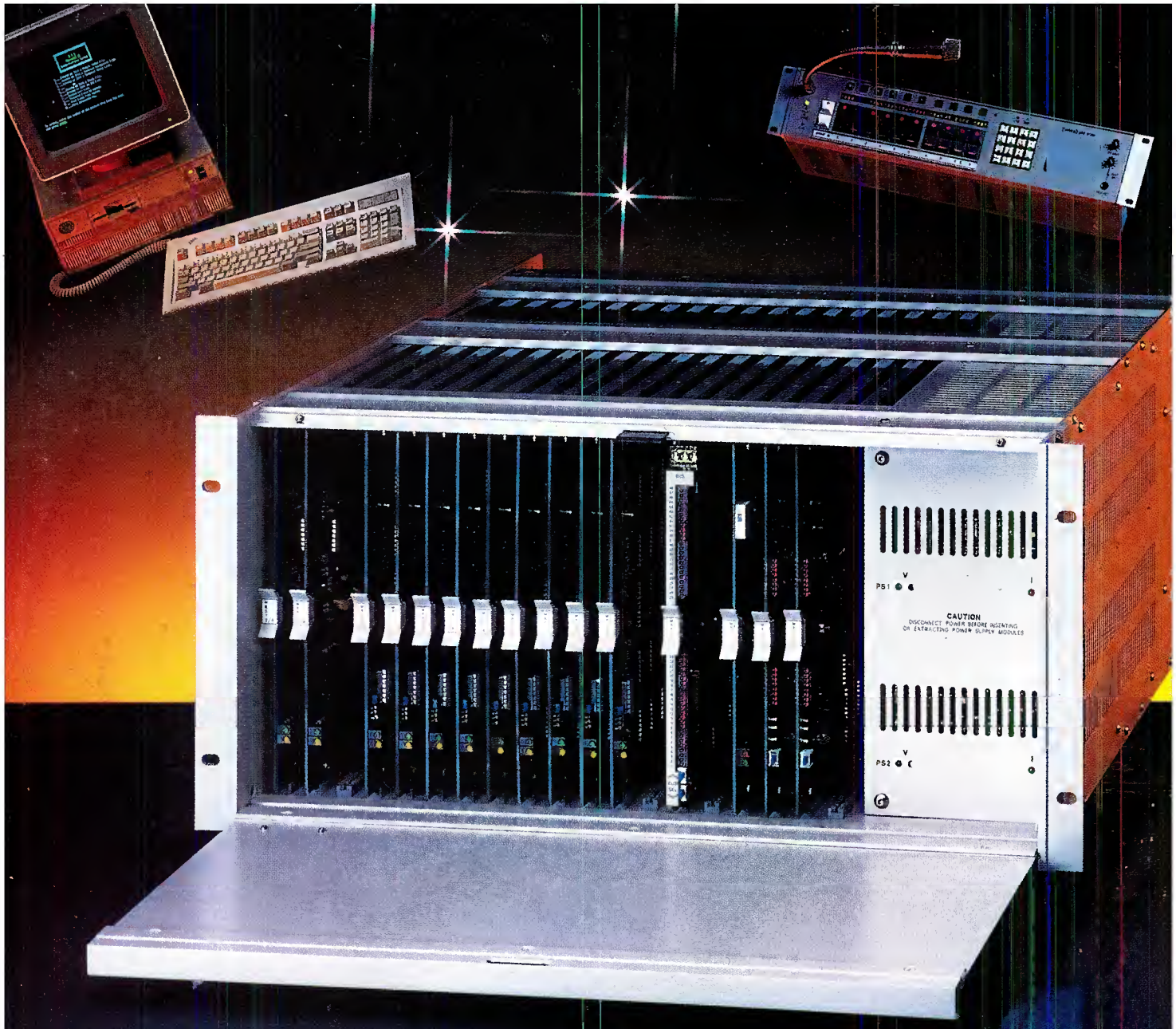


Play your cards right and call us today to find out more about the **PROM-SLIDE™**.

LEITCH ®

Leitch Video of America Inc., 825K Greenbrier Circle, Chesapeake VA 23320 - Tel: (804) 424-7920 or (800) 231-9673 Fax: (804) 424-0639
Leitch Video International Inc., 10 Dyas Rd., Don Mills, Ont., Canada M3B 1V5 - Tel: (800) 387-0233 Fax: (416) 445-0595 Telex: 06 986 241

Circle (2) on Reply Card



MiniCOM® brings a totally new dimension to professional communications!

Until now setting up a production communications system required bulky hardware and plenty of space.

MiniCOM® changes all that! It delivers mainframe performance in a ''desktop'' sized package. A 24 x 36 matrix in just 8¾'' of rack space (5 rack units).

And, because we've been able to put all that traditional Ward-Beck quality and performance into such a compact frame, the price has come down to ''desktop'' proportions too!

No need to dream any more about having a MicroCOM System sometime in the future... You really can afford one today!

WBS

WARD-BECK SYSTEMS

Ward-Beck Systems Ltd., 841 Progress Avenue, Scarborough, Ontario, Canada M1H 2X4.
Tel: (416) 438-6550. Fax: (416) 438-3865.