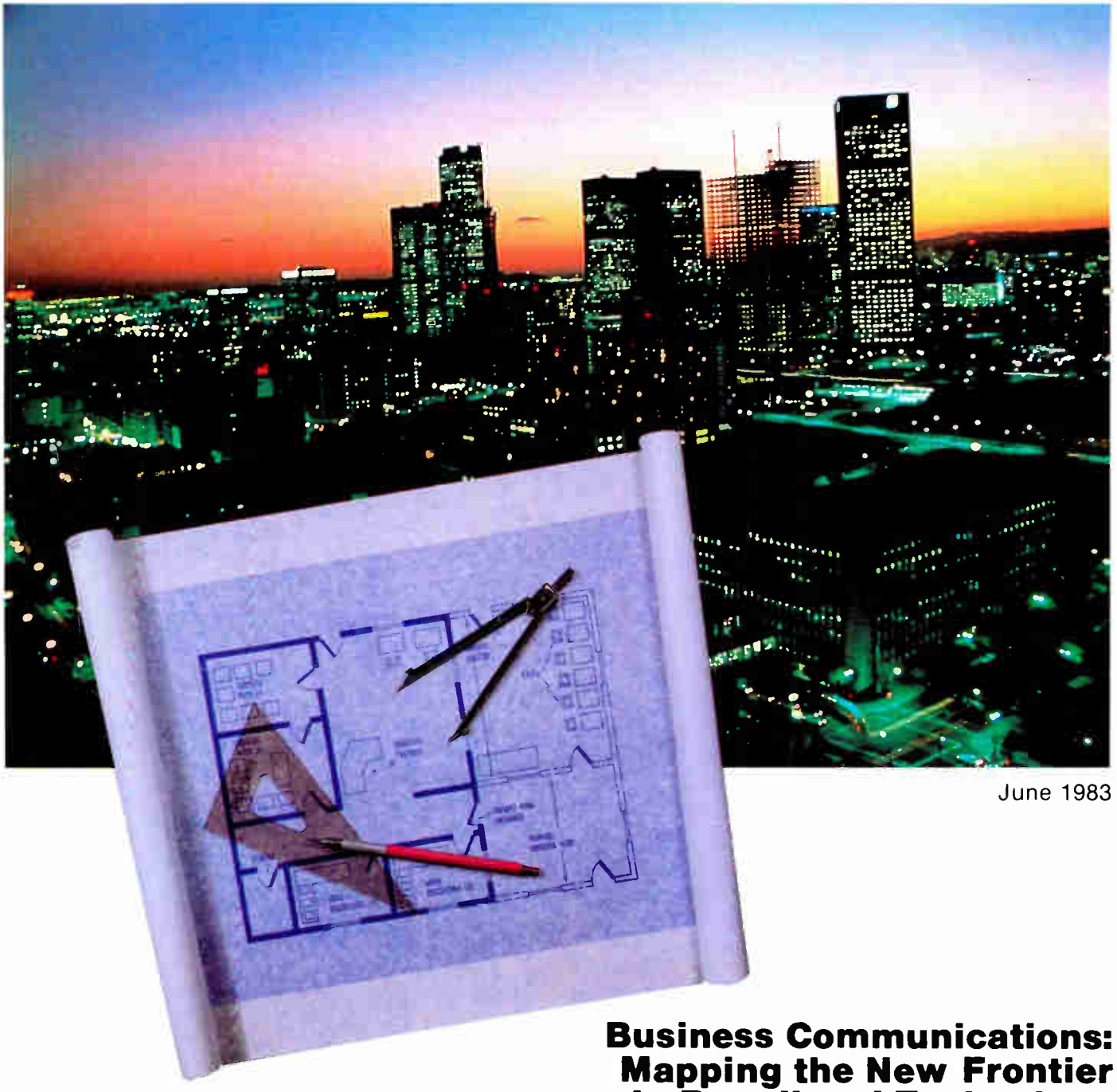
# CED™

Communications Engineering Digest/The Magazine of Broadband Technology

TECH II
Alphanumeric
Programming



June 1983

## Business Communications: Mapping the New Frontier In Broadband Technology

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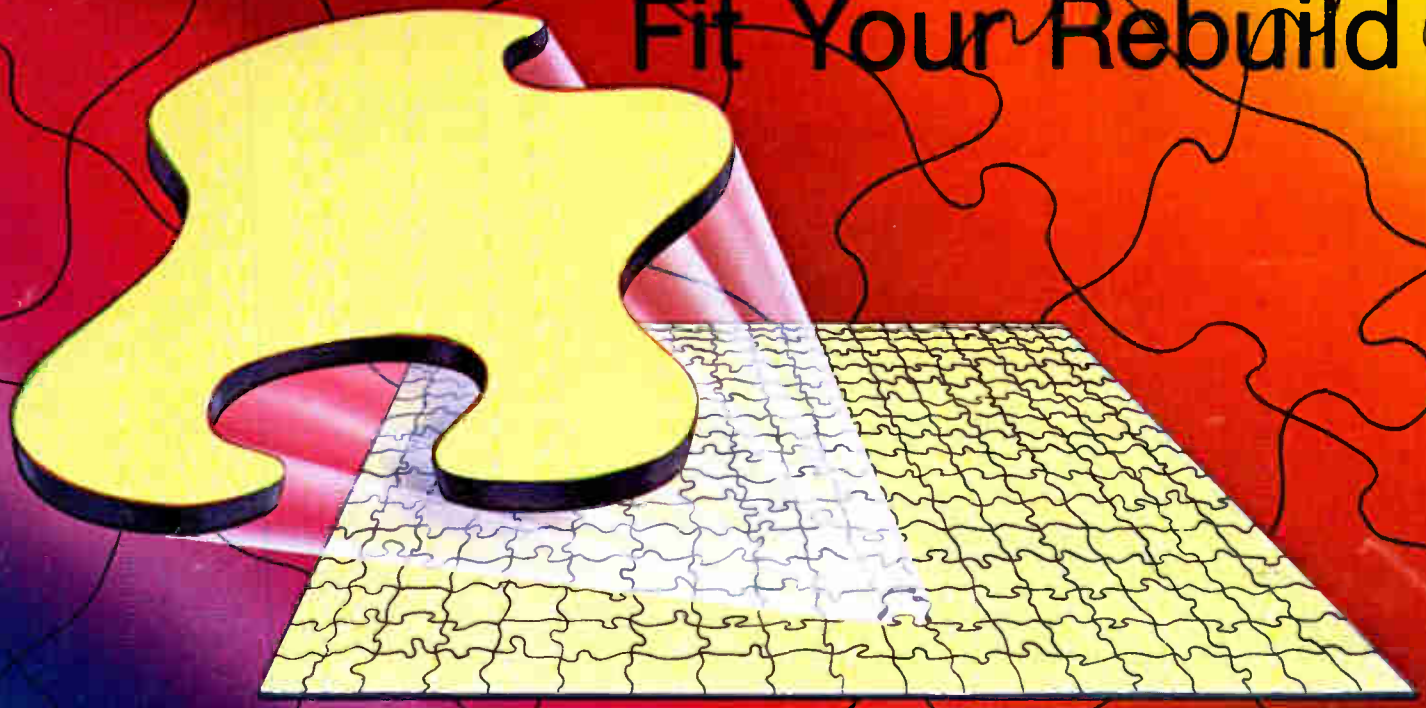

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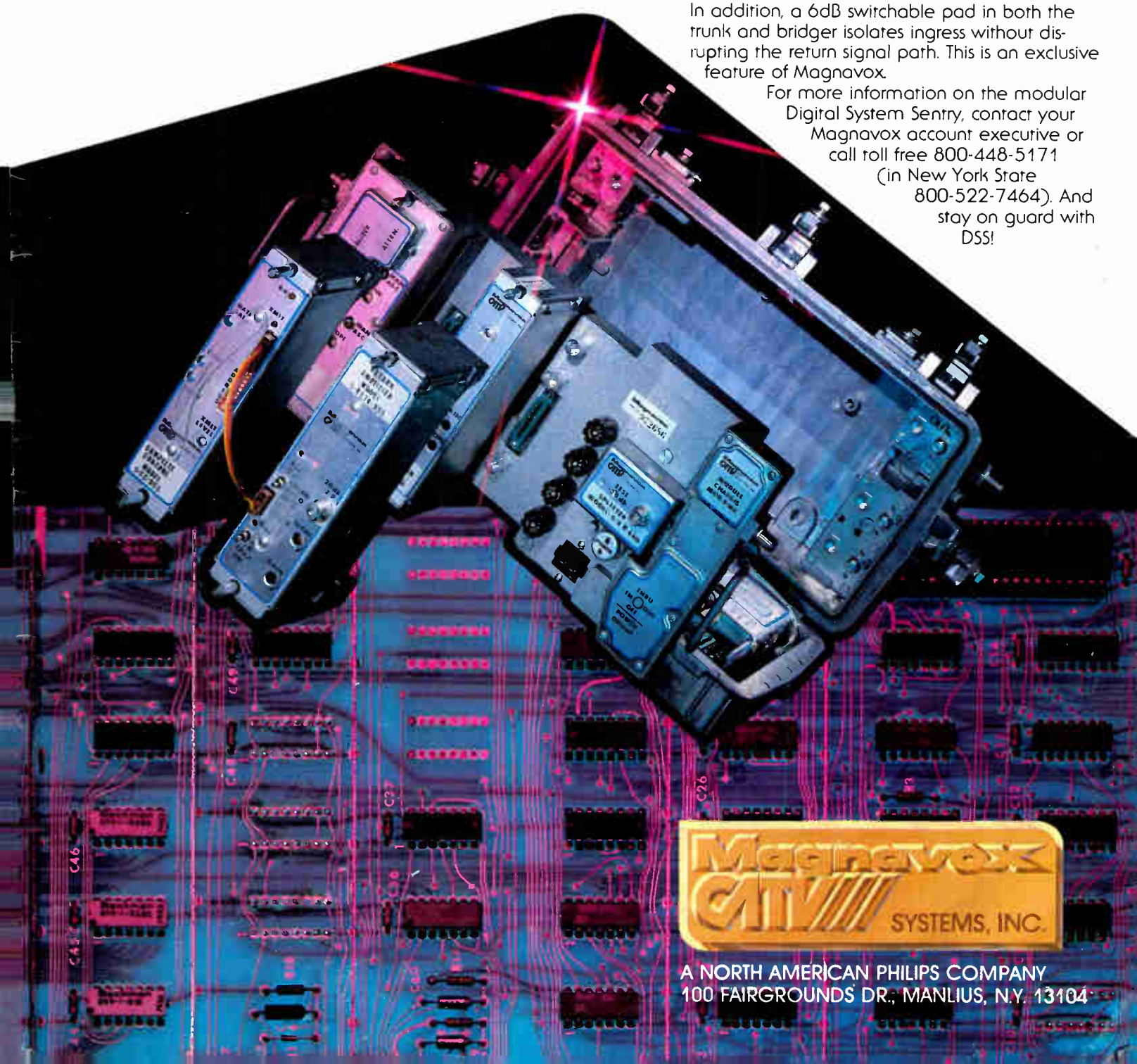

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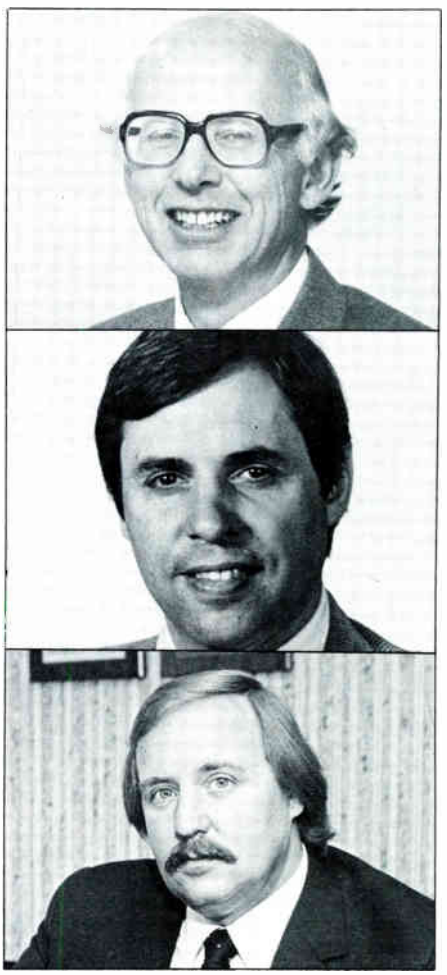

Engineering Forum participants include, from top to bottom, Ed Callahan, vice president of research and development, United Cable; Nick Worth, vice president of engineering, Telecable, and Bill Quinn, vice president of engineering, Cablevision Systems Development.

Peter Evanow, new publisher for *CED*, finds enthusiasm for business communications is mounting. In Perspective, page 11.

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## Amex eyes U.S. videotex service

Early this month, American Express took its first step toward becoming an information provider for U.S. videotex systems by contracting with Videodial, the U.S. subsidiary of the French firm Telesystemes, for the software and hardware needed to convert the company's U.S. data bases to usable videotex information. Amex officials want to make a variety of informational and transactional services available to videotex system operators in the U.S. by the end of the year and are preparing to begin tests in July using one of their IBM computers located in Phoenix. An American Express operation, Amex Europe Ltd., already is an active participant in several European systems and currently serves as an information provider for phone-based videotex services in the U.K., Belgium, France, Holland, Germany, Italy, Sweden, Denmark and Spain.

## DBS launches moved forward

The race to the DBS start line appears to be heating up with two firms—COMSAT and Inter-American Satellite Television Network—announcing plans for startup by the end of this year. ISTN, a new Los Angeles-based company backed by publisher Rupert Murdoch, has signed a $75 million agreement with Satellite Business Systems to lease five transponders for a five-channel DBS service, and indicated operations could begin as early as next September. Meanwhile, COMSAT's Satellite Television Corp. subsidiary announced readiness to take advantage of SBS satellites already in place or scheduled for launch early this summer. STC President Richard Bodman indicated that although the earlier startup of DBS service would require a shift in 1986 to STC's own satellites, the cost of reporting receivers at that time would be minimal.

## Gill to introduce management system

Gill Management Services will introduce a new turnkey computer system at this month's NCTA convention in Houston. Designed to provide small- and medium-sized cable operators with a means of handling equipment inventory, subscriber information and pay-per-view ordering, the AMS, Addressable Management System, can be customized by the cable operator himself to meet the specific needs of his system. The software package restricts access to important management functions and can address any vendor's descrambler. AMS also can communicate simultaneously with multiple vendor devices over the same system and interface with any billing system. The package operates with the Hewlett-Packard 1000 minicomputer, which can be located at the cable system site.

## Jerrold gear in UK test

HATBORO,Pa.—The Jerrold Division of General Instrument Corp. has contracted to supply two headends to British Telcom, a partner in several proposed cable ventures in the U.K. According to Jerrold officials, British Telcom will be using the two headends at its test site in Smallfield, Buckinghamshire, England, to define operating standards for future cable TV systems and to provide hands-on experience for its operating personnel.

While both headends are configured for 450 MHz channel loading and incorporate surface acoustic wave technology, Jerrold reports that British Telcom initially intends to use one headend to provide 26 channels and the other, to provide 30 channels. Under the terms of the contract, Jerrold has agreed to assist British Telcom in the installation and start-up of the systems and to offer follow-up service support as needed.

## C-COR expands warranty

STATE COLLEGE, Pa.—C-COR has replaced the two-year warranty it had been offering with its products since 1976 with a three-year warranty. Effective this past March 1, the extended warranty covers the same products that used to be covered by the two-year warranty. Under the terms of the warranty, C-COR agrees to repair and/or replace any product that fails to perform as specified during the three-year period after its purchase. Products not covered by the warranty include the SCAT Series 10 off-premises addressable system and those product parts not manufactured by C-COR. The warranty will be offered with all C-COR amplifiers, main line passives, distribution equipment and accessories.

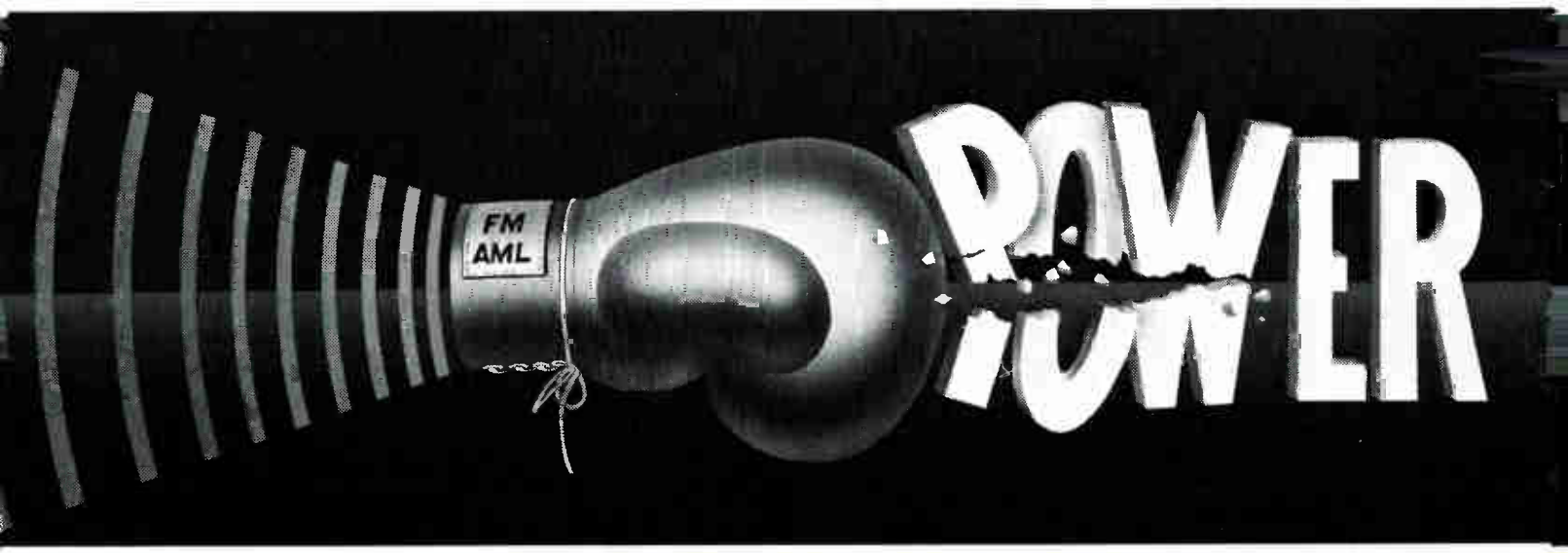
## Wang offers CATV modem

DENVER—Wang Communications Inc., a wholly-owned subsidiary of Wang Laboratories has made its debut into cable TV business communications with the introduction of a CATV modem that enables commercial data transmission across broadband cable. Designed for use with institutional networks, the DX 9600 CATV modem works with industry standard PS 232 C interface equipment and employs a reverse or transmitting bandwidth of 5-106 MHz and a forward or receiving bandwidth of 162-400 MHz. Wang Communications is marketing the modem on its ability to provide greater utility of bandwidth to allow more business users per TV channel. Applications for the modem include: multiple high-speed data transmission, electronic mail, electronic banking, distributed data processing, CAD/CAM factory automation, computer graphics and other communications services.

## Ku-band teleconferencing slated

OCALA, Fla.—Hewlett Packard Co., an electronics firm specializing in the instrumentation and computer hardware fields, has entered into a $300,000 agreement to purchase 50 earth stations from Microdyne Corp. as part of a plan to establish a teleconferencing network between its corporate offices and U.S. manufacturing plants and field sites. According to Microdyne, the teleconferencing system Hewlett-Packard has in mind will be the first of its kind to use the Ku (12 GHz) band. Hewlett-Packard plans to install the 50 Microdyne earth stations across the U.S. and to utilize all 50 to receive signals from the Satellite Business Systems SBS-2 satellite.

# *More FM power with FM/AML!*

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# Seminars

## June

**2-3: Architecture Technology Corp.** will sponsor a two-day seminar on "Local Area Networks" in Boston. Contact Architecture Technology Corp., (602) 935-2035.

**5-7:** The annual convention of **The Microwave Communications Association** "MCA '83: Opportunities in New Technologies," will be held at the Marriott Hotel in Washington. Contact Chris Selin, (914) 576-6622.

**10-12:** An SMATV seminar for start-up companies sponsored by **Eagan & Associates** will be held in Houston. Contact Larry Hannon, (904) 237-6106.

**12-15:** The annual convention of the **National Cable Television Association** will be held at the Astrodome Complex in Houston, Contact the NCTA, (202) 775-3606.

**13-14:** A "Home Satellite TV" conference and exhibition sponsored by the **University of Wisconsin-Extension** will be held in Madison. Contact Heather Goldfoot, (608) 262-6512 or 262-8953.

**13-15:** A **Community Antenna Television Association** basic technical training seminar co-sponsored by the **Southern Cable Television Association** will be held at the Prince Murat Inn, Baton Rouge, La. Contact the CATA Engineering office, (305) 562-7847.

**19-22:** The International Conference on Communications sponsored by the **Institute of Electric and Electronics Engineers** and the **Communications Society Conference Board** will be held at the Sheraton-Boston Hotel. Contact Paul Spiers, (617) 743-3731.

**19-24:** The "Northeast Cable Television Technical Seminar" sponsored by the **New York State Commission on Cable Television** will be held at Camp Topridge near Saranac Lake, N.Y. Contact Bob Levy, (518) 474-1324.

**20-22:** The **Perspective Telecommunications Group** will hold a conference on "Intra-City Communications Networks" at the Halloran House in New York. Contact (201) 845-0110.

**20-25:** A training seminar for the working technician sponsored by **Ameri-Comm Cable Training** will be held at the Detroit Metro Airport Hilton. Contact (805) 254-4800.

**27-29:** "Videotex '83," organized by **London Online Inc.** in full cooperation with the **Videotex Industry Association,** will be held at the New York Hilton. Contact (212) 692-9003.

**28-30:** A **Jerrold** technical seminar will be held in Hillside, Ill. Contact Diane Bachman, (215) 674-4800.

**28-30: ABC TeleTraining Inc.** will present a course, entitled "Introduction to Microwave Radio System Engineering." The course will be given in Chicago. Contact ABC Teletraining Inc., (312) 879-9000.

## July

**5-8:** Video production techniques will be examined in a series of workshops sponsored by the **North American Television Institute** at the Chicago Marriott O'Hare. Contact (800) 431-1880; in New York, (914) 328-9157.

**13-15: Magnavox CATV Systems** will conduct a field training seminar with its Mobile Training Center in Minneapolis. Contact Laurie Venditti, (800) 448-5171; in New York, (800) 522-7464.

**15-16:** The **Rocky Mountain Chapter of Women in Cable** will sponsor a personal computer seminar in Denver. Contact Margy McKenna, (303) 740-9700.

**18-20: Magnavox CATV Systems** will conduct a field training seminar with its Mobile Training Center in Minneapolis. Contact Laurie Venditti, (800) 448-5171; in New York, (800) 522-7464.

**19-20:** The **Public Service Satellite Consortium** will conduct a workshop in San Francisco on "How To Video-Teleconference Successfully." Contact (202) 331-1154.

**21-23:** The annual meeting of the **Montana Cable Television Association** will be held at the Outlaw Inn, Kalispell. Contact Tom Glendenning, (406) 586-1837.

**22-23:** The **Rocky Mountain Chapter of Women in Cable** will sponsor a personal computer seminar in Denver. Contact Margy McKenna, (303) 740-9700.

## August

**7-10:** The annual conference of the **Cable Television Administration and Marketing Society** will be held at the Town and Country Hotel in San Diego. Contact Judith Williams, (404) 399-5574.

**10-12: Magnavox CATV Systems** will hold a field training seminar with its Mobile Training Center in Columbus, Ohio. Contact Laurie Venditti, (800) 448-5171; in New York, (800) 522-7464.

**15-17: Magnavox CATV Systems** will hold a field training seminar with its Mobile Training Center in Columbus, Ohio. Contact Laurie Venditti, (800) 448-5171; in New York, (800) 522-7464.

**19-21:** An SMATV seminar for existing companies sponsored by **Eagan & Associates** will be held in St. Louis, Mo. Contact Larry Hannon, (904) 237-6106.

**22-24:** The fifth annual Satellite Communications Users Conference sponsored by ***Satellite Communications*** magazine will be held at Stouffer's Riverfront Towers in St. Louis. Contact Cathy Chalmers or Cheryl Carpinello, (303) 694-1522.

**29-31:** The annual convention of the **New England Cable Television Association** will be held at the Dunfey Hyannis Hotel and Resort in Hyannis, Mass. Contact Gary Cain, (603) 224-3373.

## September

**8-10:** The Eastern Show, the annual convention of the **Southern Cable Television Association,** will be held at the Georgia World Congress Center in Atlanta. Contact (404) 252-2454.

## Looking ahead

**Aug. 7-10:** Cable Television Administration and Marketing Society conference, Town and Country Hotel, San Diego.

**Aug. 11-14:** Community Antenna Television Association's CCOS-83, Arlington Hotel, Hot Springs, Ark.

**Sept. 7-9:** Great Lakes Cable Conference, Indianapolis Convention and Exposition Center.

**Sept. 8-10:** Eastern Show, Georgia World Congress Center, Atlanta.

**Oct. 18-20:** Mid-America Cable TV Association convention, Hilton Plaza Inn, Kansas City, Mo.

**Oct. 30-Nov. 2:** Joint convention of the Subscription Television Association and the National Association of MDS Service Companies, Century Plaza Hotel, Los Angeles.

**Nov. 1-3:** Atlantic Cable Show, Convention Hall, Atlantic City, N.J.

**Dec. 11-12:** NCTA's National Cable Programming Conference, Biltmore Hotel, Los Angeles.

**Dec. 13-15:** Western Cable Show, Anaheim Convention Center, Anaheim, Calif.

**Jan. 18-20:** Texas Show, San Antonio Convention Center, San Antonio, Texas.

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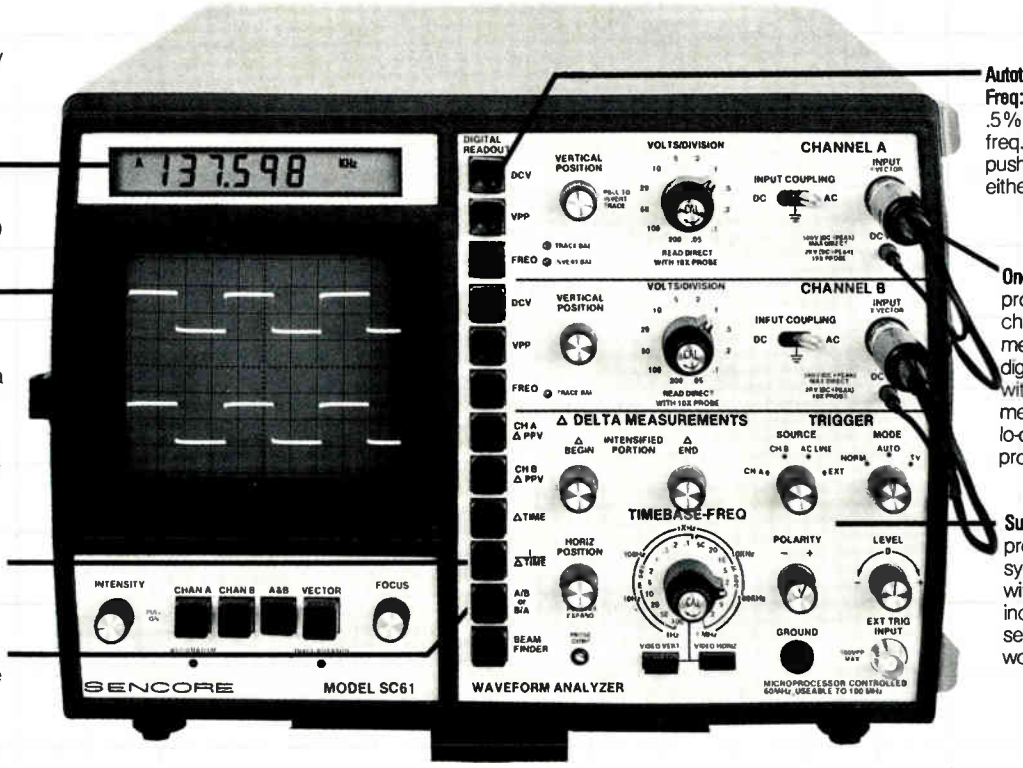


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A special Delta function even lets you intensify parts of a waveform and digitally measure the PPV, time or frequency for just that waveform section.

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# In Perspective

## Reshaping Responsibilities

We were convinced of the viability of business communications and data transmission for cable television long before we hit the convention trail last month; announcements at SCTE's inaugural CableTec Expo in Dallas and the Canadian Cable Television Association's 26th annual convention in Calgary—as well as other recent developments—strongly reinforced that conviction.

MCI's escalating advances on the cable frontier signal yet another line of development for operators to ponder. Though its experimental operation with Cox in Omaha has been halted, at least temporarily, by a public service commission ruling that service must be licensed under common carrier regulations, MCI took advantage of the CableTec Expo platform to inform the assembled engineering community there of its intention to continue its experiments with voice communications via cable. The latest move, involving Cable Atlanta, is reported on page 17.

Even in Calgary, where the real concern surrounded increased penetration for the country's new pay television networks, data transmission via cable was more than a significant side light. Canadian convention-goers listened with interest as NABU Manufacturing Corp., an Ottawa-based company, described another potential revenue source for opertors-the transmission of computer programs via cable to personal computers in private homes.

While some cable operators and manufacturers "also serve who sit and wait," many others are making well-calculated first moves in the broadband data loop business. Such is the case with Wang Communications, which has just announced a new modem for two-way data communications, and Magnicom Systems, a new business system developed by Control Data Corp., Applied Data Research and Storer Communications. Both plan to make announcements at NCTA's Houston convention this month.

These and other important developments have prompted us to devote *CED*'s 1983 Convention issue to business communications. Our coverage begins on page 24 with an engineering roundtable wherein contributors discuss their sense of the business communications market potential as well as the directions their companies are taking in discovering that potential. Judging from their comments, there appears to be an emerging consensus within the engineering community that data and voice transmission services not only are technically feasible, but represent a specific profit potential for operators.

A second feature, written by Scientific-Atlanta's marketing manager for data products, Robert Schack (pages 32-35), lends support to this consensus with an overview of the business communications market and of the various ways cable companies can tie in with manufacturers and service providers to help develop that market. In addition, two articles by Jay Staiger, product manager for Magnavox CATV Systems, Inc. (pages 46-72), provide us with some of the detail essential to understanding the utilization of advanced equipment now on the market for cable operators moving into data communications.

The question of how present proposals will develop into future applications has been the impetus for the new cable media subgroup, created by NCTA's Engineering Committee's Subcommittee on Networks and Architecture. The subgroup's emerging responsibility is to research and offer insights into network topology and data transmissions. David Large, vice president of engineering for Gill Cable TV, as a member of the subgroup, has gone a long way toward meeting the subcommittee's mandate in his essay analyzing various transmission system arrangements with respect to transmission characteristics, costs, network management and flexibility. Large's essay begins on page 36.

Finally, a point must be made about our own business. As the one-time blue sky businesses of cable television begin to face the challenges of technological reality—and the marketplace—the stories must be told. In the months to come, *CED* will continue editorial focus on how the communications engineering community is meeting those challenges, in business communications as well as other types of new services.

We'll be in touch.

CED

Volume 9, No. 6

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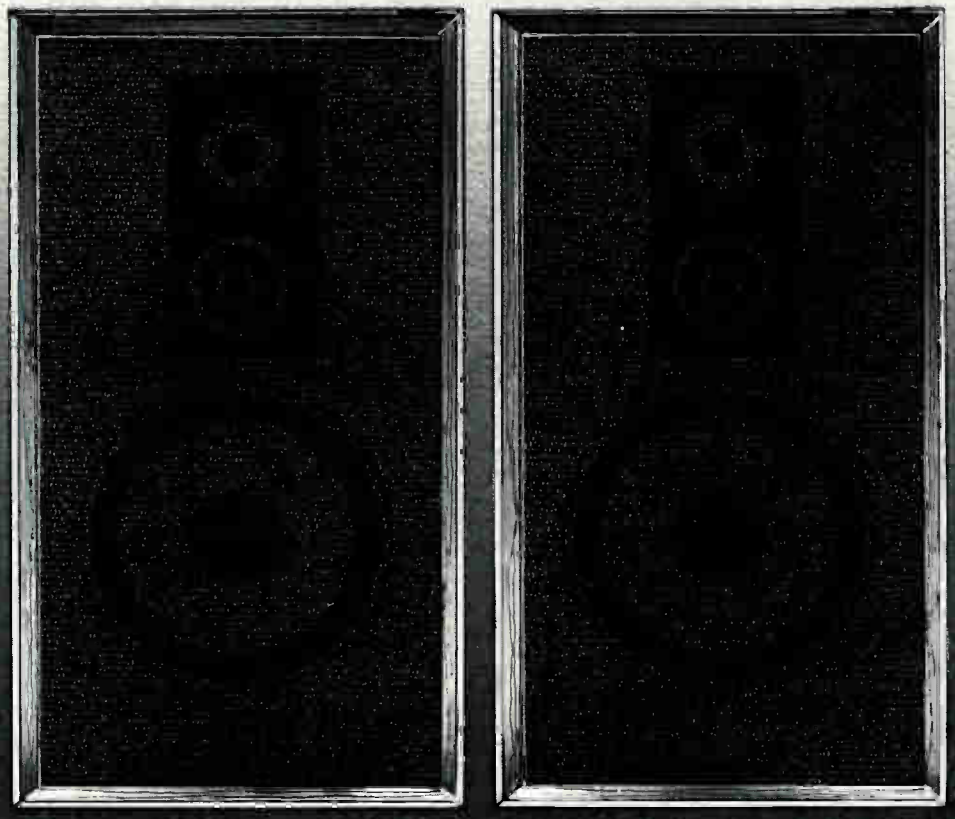
# MTV, The Movie Channel, The Nashville Network.



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# CableTec Expo
## No-nonsense approach clicks in Dallas

DALLAS—Initial uncertainties over the timing and usefulness of the Society of Cable Television Engineer's first "Cable Tec Expo" quickly gave way to general agreement that the three-day conclave held here May 6-8 was the much-needed "hands-on" hardware and training show manufacturers and technicians had been hoping for.

Some 900 cable technicians and engineers, 100 more than expected, turned out for the workshops, and an estimated 1,300 people visited the exhibit floor at the Dallas Convention Center, according to SCTE Executive Vice President Judith Baer. "I think this demonstrates the industry wants this kind of show and that the support will be even greater for the one we have scheduled for next year," she said.

That show, slated for Nashville March 5-7, will eliminate one of the major complaints aired by various concerns prior to this year's show. With the NCTA convention slated for Houston next month, many manufacturers stayed away from the SCTE floor, preferring to await the larger crowds in Houston, rather than deal with the logistics of attending two consecutive shows.

But among the 115 companies that did exhibit at CableTec Expo, the consensus seemed to be that, while the decision makers necessary for big purchases were not on hand in Dallas, the exhibition presented an all-too-rare opportunity to show their wares to system-level engineers and technicians and to get much needed feedback from the field on the performance of their products.

"This was a good show," said Stan Vonfeldt, sales representative for M/A-COM's Comm/Scope subsidiary. "These aren't the people riding the POs here, but they're the people who put in the requests for equipment. Most of them haven't seen our new Quantum Reach cable or some of the other new products we've introduced over the past year. Now they have a better idea of what's available and what it can do."

Similarly, Tom Chivari, account manager for Times Fiber Communications, found the show to be an excellent opportunity to communicate with people who might otherwise miss the message about the firm's minihub switched network distribution systems. Acknowledging that the hybrid fiber/coax approach was designed with high-density environments in mind, Chivari said that regardless of the type of system an engineer might represent, it was important to Times Fiber to have the opportunity to dispel misconceptions about fiberoptic applications in cable television. "They can come by here and see that fiber is really here, not way off down the road," he said. "Fear is based on lack of knowledge. We're getting the word out here."

Capitalizing on the no-nonsense training atmosphere of the show, Magnavox staged several sessions on troubleshooting its products. The firm reported that all three sessions at its booth on Saturday were full to overflowing. The result, according to one marketing representative, was that technicians not only learned about proper installation and maintenance, but they were able to offer suggestions for product refinements or new approaches to troubleshooting that proved valuable to their counterparts.

The hands-on quality of the show was apparent in conversations taking place across the floor as engineers aired complaints about products and offered suggestions for improvements. One manufacturer, for example, learned that its amplifiers, spec'd for 140 degrees, were malfunctioning in the Texas heat because of heat buildup in the box. "Why not paint the boxes white and reflect some of the heat?" was the simple suggestion offered by one young tech.

Among the few complaints heard from manufacturers about Cable-Tec Expo, the most common concerned lack of traffic or the absence of major sales. Nonetheless, these firms uniformly voiced interest in attending next year's show. "The word on it is out," said one marketing rep. "The companies not here will soon learn they missed an opportunity. They'll be on hand next year."

As for the training workshops, the attendees generally expressed satisfaction at the knowledge gleaned. The main problem was that conflicting schedules meant some good sessions had to be missed.

"We don't normally get to attend these shows or to see the manufacturers and their products all in one place," commented Dan Flynn, a preventive maintenance technician for Warner Amex. "We need more of this."

*—Fred Dawson*

**New tap-based out-of-home system:**

# Vitek addresses the future

DALLAS—A new phase in cable television's addressability saga began last month with Vitek Electronic's unveiling of a new tap-based out-of-home system designed to work with any type of simple converter or cable-ready television set.

The new VITAP two-way addressable system, while lacking the multi-tiering capability often required in major new urban franchises, affords operators the opportunity to move toward addressability with an out-of-home device that can supply five pay channels on an *a la carte* basis and one level of premium tier packaging to several TV sets on each drop at a cost of about $61 per drop.

Noting that last year CATV service theft losses were in the neighborhood of $200 million, Richard Prybyl, vice president of Vitek parent Augat Inc.'s Broadband Communications Group, told a press gathering here that VITAP will offer signal security that does not require scrambling at the headend and, therefore, does not use the type of coded key system that pirates have found to be relatively easy to defeat. Instead, he said, only those signals that the subscriber is not authorized to receive are scrambled at the tap box, using random sync generation. Richard Paynting, chief engineer for Vitek, added, "We can scramble very hard because we do not have to use keys buried in the sync pulses."

**Richard Prybyl, vice president, Augat Inc.**

Prybyl said his firm's approach to addressability reflects market research that has found a strong demand among

cable operators for an out-of-home addressable system that is sufficiently cost-effective and versatile to be applied in all types of cable systems as well as durable enough to minimize service requirements.

With regard to versatility, Paynting explained that VITAP is compatible with existing trapping systems and can be installed in isolated portions of a cable system where high churn or signal theft warrants addressability. Reliability, he said, is assured insofar as there are no microprocessors in the pole-mounted hardware. Instead, the VITAP "is an exceedingly dumb device" with a minimum of active electronic components.

The VITAP pole-mounted addressable tap box costs $250 with four ports permitting four drops per unit. The headend smart controller is an industrial grade computer assembled by Vitek with the ability to interface with computer billing systems. Each controller costs $10,000 and is capable of handling up to 256,000 subscribers.

Prybyl said limited field testing so far has found the average life span on the VITAP box to be 50,000 hours of use. He said several MSOs will begin more extensive field testing in systems in Colorado, Maine, Florida and Texas in the coming months. The units will go into full production and distribution in the first quarter of 1984.

# Jerrold introduces 550 MHz, addressable baseband converter

NEW YORK—General Instrument's Jerrold Division signaled its intention to remain in the vanguard of CATV product development with its announcement May 19 of a broad range of 550 MHz gear as well as various signal security and converter components, including a new baseband unit.

The new Starcom V addressable baseband converter provides enhanced mechanical security, software downloading, a diagnostic test switch for in-home troubleshooting, a variety of scrambling modes and a unique data encryption method. Headend-controlled software downloading will enable the system operator to address the converter with eight operating parameters after the converter is installed, including subscriber address, output channel, barker channel locations, frequency offsets, custom channel assignments, time-out, credit limit and mode.

Jerrold's move to 550 MHz equipment also includes a new line of "low-cost" amplifiers—Starline X—representing a completely new design that incorporates redundancy and fail-safe features. In addition, Jerrold has developed a new 600 MHz frequency agile headend modulator to complement the capabilities of the Starline X. The C4APC is an agile, phaselock headend modulator that is compatible with the new Starcom V baseband converter.

Also in the higher megahertz range are a new series of taps, system passives, connectors and satellite receiver. A technology spinoff of General Instrument's DBS program, the C4R satellite receiver, utilizes a new 4 GHz to 1 GHz block down conversion method to offer improved performance at lower costs, including elimination of internally generated harmonic and subharmonic interference.

Jerrold's new moves in the direction of enhancing signal security include introduction of a tri-mode digital scrambler/encoder (DS/E), which is compatible with both present and planned Jerrold terminal products. According to Marketing Manager P.E. Morse, the system represents "state-of-the-art RF scrambling competitive with any other scrambling technique now in use." While maintaining its cost advantage over baseband security, Jerrold's DS/E purportedly provides RF

signal security rivaling that available from more expensive converters.

As another measure to facilitate signal security, all Jerrold pay and addressable converters now are being delivered—at no cost to operators—with encapsulated digital control boards. The critical components on all printed circuit boards are being sealed in an epoxy coating compound that cannot be dissolved without also destroying the boards themselves.

Also on the signal-theft front, Jerrold's electronic program intrusion control (EPIC), which the company says has been successfully operated in several addressable systems so far, now is capable of serving non-addressable systems as well. Described as an intermittent random scrambling technique, EPIC offers cable operators the ability to periodically sweep the entire cable system in order to identify and render inoperable any pirate converters operating in the system.

"The intermittent scrambling and random application of EPIC make it an extremely difficult technique to outwit," according to Morse. "An illegal converter that descrambles the signal in a system one week could become quite useless in that same system the following week, and modifying the box still again will not guarantee it against the changeability of the EPIC technique. EPIC soon will approach the art of a shell game played behind a curtain."

**Jerrold's Starcom V converter**

Further news from Jerrold on the service theft issue includes reports of stepped-up pursuit of illegal product diversion and modification in the courts. Jerrold, with backing from General Instrument, said it will actively support system operators in legal prosecution of pirate converter merchandisers. "The MSOs are in a better position to halt the sale of modified converters, and in that area General Instrument attorneys are providing help and advice wherever it is needed," Morse said. "At the same time, we are aggressively working to identify and prosecute directly those people who are modifying our products without our approval and reselling those products to consumers. Those consumers will find they have paid a very high price for a 'free' cable TV reception."

*—Sharon Scully*

# Texscan finds GTE Sylvania is perfect fit

PHOENIX, Ariz.—Texscan, in an effort to expand its market base, purchased the Sylvania Division of GTE Communications Products for $16.5 million last month.

According to Carl Pehlke, Texscan president and CEO, the acquisition will entail some melding of operations between the two manufacturers at the management, administrative and sales levels, but will not involve any consolidation of R&D functions.

Texscan plans to replace the Sylvania name with its own logo within a year, but in the meantime, those products bearing the Sylvania insignia will remain under the Sylvania sales staff's jurisdiction. Some products—such as Texscan's Vital Signs status monitoring system and other test gear, character generator equipment and power supplies—will be marketed by both sales staffs, which will share the same offices, region to region.

Despite the similarities in the two manufacturers' product lines, Texscan

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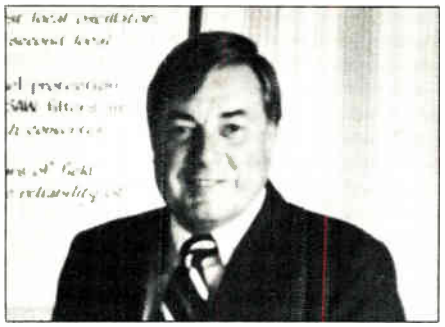

**Carl N. Pehlke, Texscan president and CEO**

and Sylvania serve different markets, according to Pehlke. He commented, "They (Sylvania) serve the rebuild market much more than we do, while we (Texscan) are selling more to the 450 MHz newbuild market."

Examples of the complementary relationship between the two operations' product lines are found in Sylvania's modular amplifier line and Texscan's trunk amps and line extenders and in the two manufacturers' converter lines. According to Pehlke, Sylvania has addressable RF set-top converters and regular, non-addressable RF devices, while Texscan has "plain Janes and the out-of-home addressable system, TRACS." In addition, Texscan is introducing a baseband addressable converter, which is expected to go into production this summer.

As for the effect the Sylvania acquisition will have on the distribution equipment market, Texscan could emerge as the market leader. In order to do this though, Texscan must retain both its own and Sylvania's market shares, which cable analyst Paul Kagan previously determined as 13 percent each. The combination of these shares is 26, one point above the share Kagan gave Jerrold, the current leader in distribution equipment sales.

## New company will sell EDP systems to CATV, broadcast industries

MINNEAPOLIS—Three corporations involved in the cable TV industry have combined forces via a new company to provide in-house computer-based business systems for cable and broadcast operations.

Control Data Corp. and ADR/CADRE, a joint subsidiary of Applied Data Research and Storer Communications Inc., formally announced the creation of Magnicom Systems last week. Control Data owns 60 percent of the new company and ADR/CADRE the other 40 percent of it.

Magnicom combines the resources of Control Data's Station Business Systems Division with ADR's software expertise, company officials said.

Neil Smith, who served as president of Station Business Systems, is heading the new firm.

# Cable America and MCI on line in Atlanta

ATLANTA—Cable America and MCI are about to enter into the first phase of an extensive experiment in voice communications patterned after the MCI/Cox "Cablephone" project in Omaha.

According to Noel Bambrough, executive vice president and chief operating officer of Cable America, MCI and the cable company intend to connect a business and an institutional user to MCI switching facilities in Atlanta using Cable Atlanta's institutional network. He said the company expects one of these users to be on the line by the opening of the NCTA convention in Houston June 12.

"No money will be changing hands" in the experimental phase of Atlanta Cablephone service, Bambrough said. All parties are participating in an effort to learn more about the complexities and potentials of using coaxial cable to tie in-house telephone networks to MCI long distance switching equipment. Bambrough declined to name the users involved in the experiment, except to mention that Cable America itself will be making the switch to a coaxial tie-in with MCI for its own headquarters' telephone needs in the next few weeks.

He said no agreements have been reached on how MCI and Cable America would set up the Cablephone business if it proves to be economically viable. He indicated there were too many unknowns from the cable company's viewpoint to make a commitment to a specific contractual approach.

**Noel Bambrough, president of Cable Atlanta**

Along with cost savings potential, a key question in the minds of the participants concerns the reliability of cable in telephone applications. According to Dennis Owen, vice president of engineering for Cable America, no one knows how well the cable system will perform under peak load conditions. Although a voice channel only requires three or four KHz of bandwidth, a cost-effective modem has yet to be produced that can permit the theoretical maximum of such channels to be delivered over a given coaxial bandwidth.

MCI has issued a request for bids for manufacture of a modem that would operate at maximum efficiency for CATV, but such a device is at least nine months away, Owen said. Consequently, the experiments in Omaha and Atlanta must rely on expensive customer-made equipment just to get the experience of operating in a realistic environment.

According to Steve Ross, MCI's sales project manager for Cablephone, no one knows yet whether MCI's use of cable systems to tie users of its long distance service to switching facilities will provide the cost savings essential to marketing Cablephone commercially. He said the company has been talking with several MSOs and anticipates further announcements of experiments in other cities in the near future. "We're trying different techniques using a variety of vendors in different cities," he added.

The Omaha project has been sidetracked, at least temporarily, by the recent Nebraska Public Service Commission ruling that the Commline/MCI service, as well as proposed Indax videotex services, cannot be delivered unless Cox applies for and obtains a permit to operate as a common carrier. Cox is currently appealing that decision to the Nebraska Supreme Court.

# Nebraska ruling draws Cox fire

OMAHA, Neb.—Cox Cable is contesting a recent Nebraska Public Service Commission ruling, which deemed Cox of Omaha's CommLine and Indax services to be by nature common carrier services. As such, the commission ruled, these services and their supplier, Cox of Omaha, are subject to tariff regulation by the state PSC.

The Nebraska PSC based its decision on several factors. First, it argued that Cox's CommLine Service, the experimental project that was begun last year in Omaha, was being used to transmit both voice and data. Secondly, it found CommLine to be neither franchised by the City of Omaha nor regulated by either the FCC or itself. And finally, in a mandate to Cox to cease and desist from providing data services to MCI through the CommLine service, it identified CommLine as a "carrier furnishing communications services for hire in Nebraska in intrastate commerce." "As such," the order con-

tinued, "(CommLine) is a common carrier subject to regulation by this commission."

With regard to Cox's Indax services, the commission ordered Cox to cease pursuing plans to provide data retrieval, banking and other proposed Indax services to businesses and private individuals. The PSC did say, however, that it would consider permitting both the Indax and CommLine services if Cox were to submit an application for a certificate of public convenience and necessity.

Cox Cable is battling the commission's ruling on two fronts. In a petition filed with the FCC, the operator asked for a ruling that the FCC and not the Nebraska PSC has jurisdiction over Cox Cable specifically and over its broadband communication services generally. Similarly, in a complaint filed in the Federal District Court of Nebraska, Cox asked for a declaratory judgment ruling the activities of Cox as beyond the scope of the PSC's regulatory auspices. The complaint also seeks an injunction against the PSC's enforcement of the cease and desist order.

While, at press time, the Nebraska PSC had not yet responded to Cox's complaint, Cox's battle with the Nebraska PSC has renewed interest and, in some cases, triggered debate in several states over the possible classification and regulation of cable, with respect to its data communications and related enterprises.

In New Jersey, the issue of cable's classification was first raised more than a year ago when the New Jersey Board of Public Utilities Commission began a generic proceeding to determine what type of jurisdiction should be imposed over cable's enhanced services. Now, according to a regulatory officer with the board, the proceedings are slowly coming to a halt.

Similarly, the New York Public Service Commission started debating the issue close to a year ago, but delayed taking any action because it didn't have the time. Roger Sutliff, chief systems planner at NYPSC, says a staff report that claims that "we (NYPSC) do have jurisdiction to regulate certain activities of Manhattan Cable," will be issued to the commission shortly. The report places those cable activities found to be essentially "telephonic in nature" under the commission's authority.

Among the issues considered during three days of California Public Utilities Commission hearings was an inquiry into the possible effects of cable competition on phone company service. The question of whether or not to impose common carrier status on cable systems was not addressed specifically during the sessions. In fact, no California proceeding to date has yet investigated the issue.

## ATC and Xerox: Training front-line troops

DENVER—ATC and Xerox Corp. have developed a customer service training program specifically geared toward cable employees, including technicians, who engage in customer contact. Already tested this past April, the program will be offered this August to 2,000 ATC employees, including sales and customer service representatives as well as technicians and installers.

According to ATC, the objective of the 15-hour course is to position customer-contact personnel as "customer service professionals" by teaching them the communications skills necessary for retaining and satisfying existing personnel and for converting non-customers to subscribers. The program also provides participants with "hands-on" opportunities to apply the skills they have learned in simulated, working environments.

The need for the program originated with the realization that "cable customers are basing their decisions to buy and retain our products more than ever based on the service we provide," according to John Dawson, ATC vice president for human resources. Since there was no universally proven training system for educating cable personnel on how to communicate effectively with customers, ATC sought Xerox's support in developing such a program. Xerox already had offered similar types of training programs to more than 50,000 employees at numerous organizations.

In addition to offering the program to its own employees, ATC has been licensed by Xerox to offer the program to employees at other cable and cable-related companies. ATC plans to make the course available to these companies sometime late this summer or early next fall.

## CATV suppliers tally up, down and all around

DENVER—A raft of annual, first, second and third quarter financial reports released to the public these past few months offers a mixed review of many cable hardware manufacturers and suppliers' financial standings.

For its second quarter, **M/A-COM** reported mixed results, with overall net income down and company orders up. Net income for the period from continuing operations was $7.2 million, down from the $11.9 million reported a year ago. Six-month net income for the company was below last year's total of $22.3 million. Factors cited by the company as primarily responsible for the decline in its income were effects of the recession, research and development costs, pricing pressures and the sale of a fiberoptics operation.

However, on the more positive side, company orders reached a record high of $199 million, an increase of 14 percent over last year's first quarter total.

A reverse in the trend of four preceding quarters was reported by **Scientific-Atlanta** for its third quarter ended March 31, 1983. Increases instead of decreases in sales and revenues were posted by the company for the period. Net income for the hardware supplier was $1.5 million, a substantial increase over the $73.4 million reported for the second quarter. Company income and sales figures for the period, however, were down from last year's third quarter results.

As **Oak Industries** had anticipated, the firm incurred a net loss for the first quarter of 1983, registered at $24.3 million on sales of $106.6 million. Last year's net income and sales figures for the first quarter were $7.4 million and $134.7 million, respectively. The company attributed its net loss to the termination of its two ON TV subscription franchises in Dallas/Forth Worth and Phoenix and to decreasing sales of cable TV equipment.

On a more positive note, **Zenith** reported a first-quarter gain of $8.9 million in earnings, as compared to an earnings loss of $2.4 million during the same period last year. The company's sales were also up to $333 million, substantially higher than last year's first-quarter sales of $319 million.

Sales and net income for **Times Fiber Communications Inc.** during the first period ended March 31, 1983, were up over sales and net income for the first quarter of 1982. The company reported $31,333,000 in sales and $1,228,000 in net income for the first quarter of 1983 as compared to $30,750,000 in sales and $898,000 in net income for the same period in the previous year.

Even though **Augat Inc.** reported a decline in net income and earnings for the first quarter, the company expressed optimism over the rate of incoming orders it received during the period. Net income for the company was $4.8 million, down from last year's $6.1 million. Revenues decreased to $46.8 million, below the $50.4 million registered for the equivalent period last year. Incoming orders for the period, however increased 20 percent over the previous quarter.

**C-COR Electronics** announced a gain in net income and a decline in sales for its third quarter as compared to the same period last year. Net income for the period was $909,000 and sales were $6,038,000. In last year's third quarter, C-COR realized net income of $881,000 and sales of $6,555,000.

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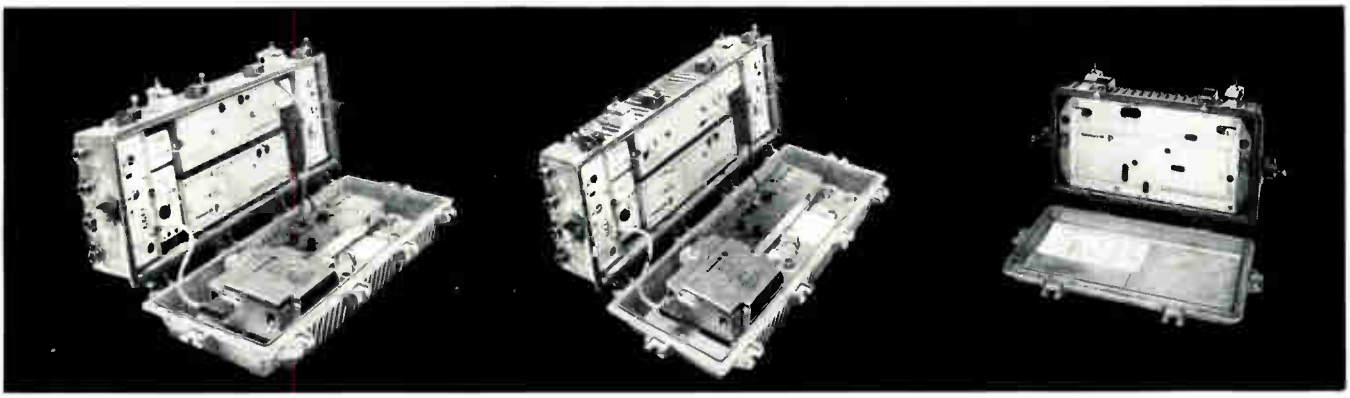

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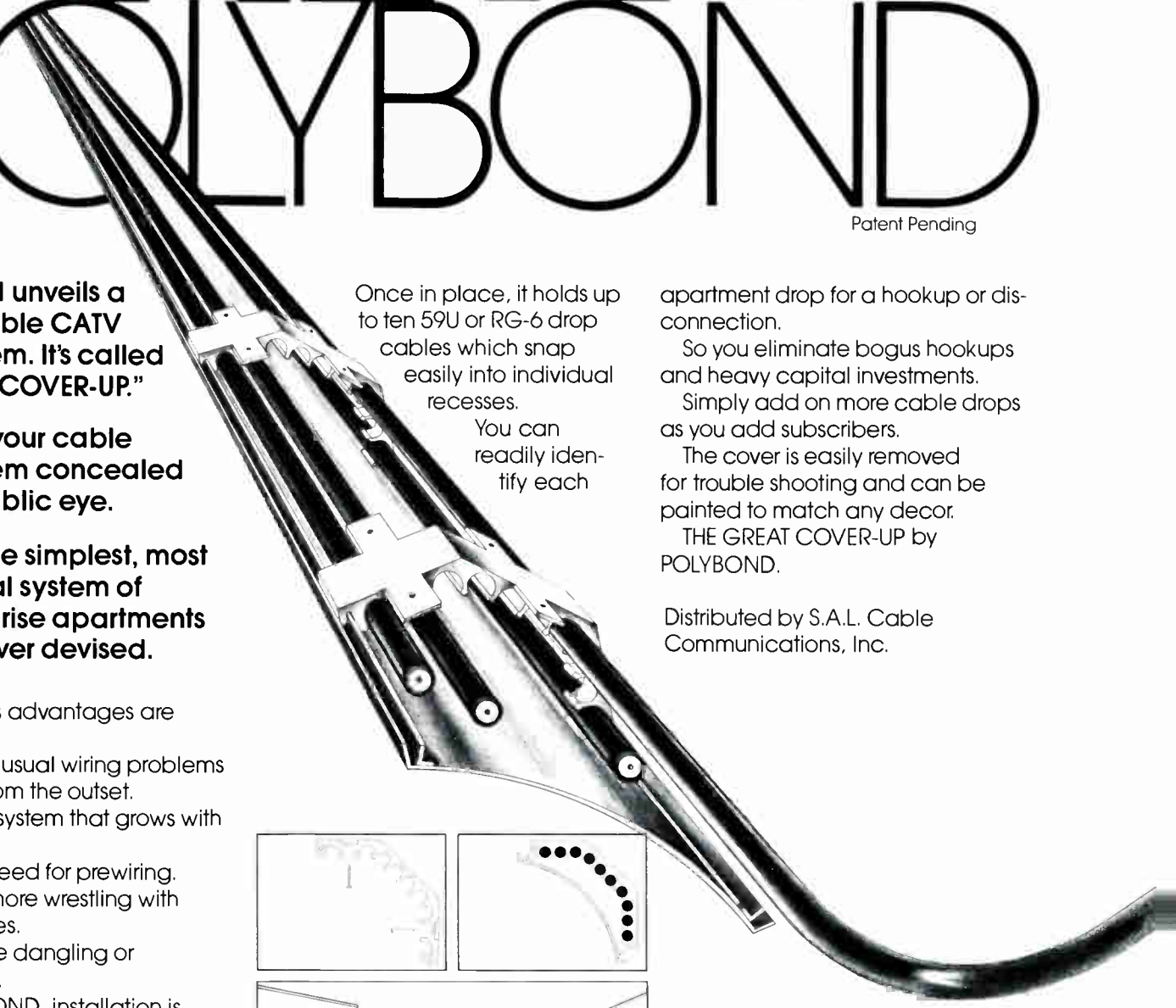

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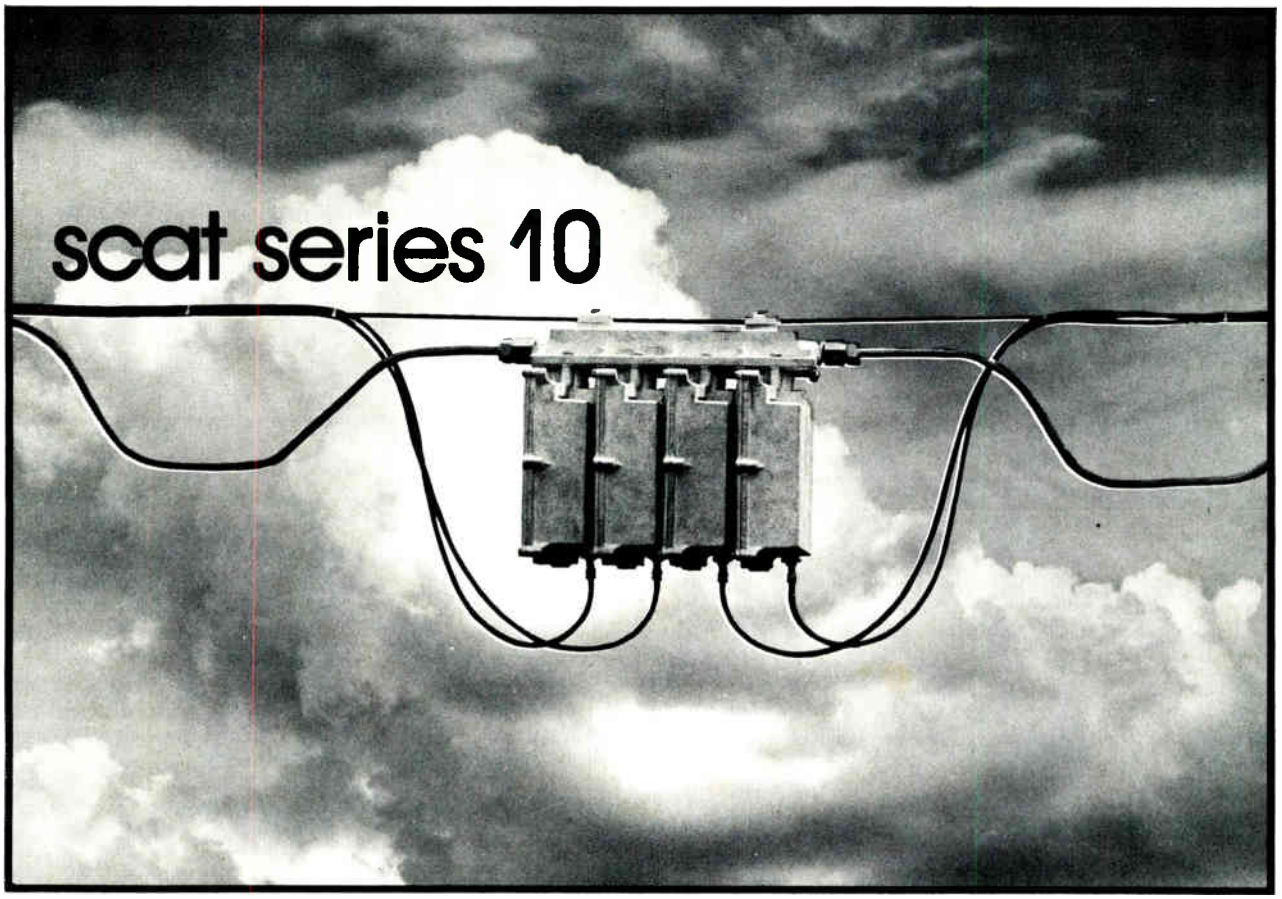


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# Business Communications:

# The Engineering Challenge in CATV

## An engineering and design perspective on application of broadband technology to two-way data transmission services for the business and institutional sectors.

CED's 1983 NCTA Convention issue is devoted to an examination of one of the primary topics of concern among engineers and other cable executives—business communications. Under that heading we include not only the data transmission, voice and video services which broadband technology can bring to the business community, but all the two-way signal distribution services that cable can provide the institutional and governmental sectors.

As the industry tests these new waters there is a good deal of uncertainty as to the ultimate shape and scope of the market as well as the way to go about ensuing efficient, reliable utilization of the institutional cable plant. In the ensuing pages, a number of leading figures have contributed their design ideas to the discussion currently underway in the industry regarding these questions.

Our coverage begins with an engineering roundtable wherein many of the industry's top engineers discuss their sense of the business communications market potential as well as the directions their companies are taking in discovering that potential. While the question of market potential remains a subject of lively debate among CEOs in the industry, there appears to be an emerging consensus within the engineering community that data and voice transmission services not only are technically feasible but represent a significant revenue stream potential that the industry should pursue.

We are grateful to the cable engineers who took time from their busy schedules to answer our questionnaire on business communications and to the other contributors whose work appears in these pages. Our engineering forum participants are: Tom Bird, vice president cable systems development, Rollins; Tom Rush, vice president of development, Warner Amex Cable; Nick Hamilton-Piercy, vice president engineering and technical service, Rogers Cablesystems; Bill Quinn, vice president of engineering, Cablevision Systems Development; Douglas Truckenmiller, executive director, technology, Colony Communications; John Grubbs, vice president, special projects, and Harold Null, vice president, engineering, Storer; Bart Gunter, director, planning and research, Sammons; Edgar Hassler, engineering manager, Armstrong Utilities; Eugene Walding, manager of engineering, Centel Cable; David Willis, director of engineering, TCI; Nick Worth, vice president of engineering, Telecable; Ed Gallahan, vice president of research and development, United Cable; and Larry Janes, vice president, CATV engineering, ATC.

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**CED: How would you rank business communications as an opportunity for cable operators in comparison to pay-per-view, videotex, security and the other new ancillary services on the horizon?**

**Bart Gunter/Sammons:** Business communications actually is more realizable as a service than the other services mentioned. Business communications is an established market with predefined needs for service; the other *developing* services require product definition, as well as hardware that is available on a very limited basis at this time.

**Tom Bird/Rollins:** Business communications in general is probably as important in an urban market as videotex or security, but would probably rank behind pay-per-view and other interactive services depending on the business environment and size of the market. The top-50 television markets in the urban corridors should certainly be able to support MSO entry into business services.

**Nick Hamilton-Piercy/Rogers:** Our present perspective ranks business communications as a profitable opportunity second to pay-per-view and ahead of videotex and security. Pay-per-view profitability may be somewhat impacted by studio product marketing.

**Edgar Hassler/Armstrong:** Speaking to the markets we serve, I don't see business communications as a lucrative business at this time.

**Harold Null/Storer:** There is good opportunity in business communications. Ranking would be second to pay-per-view, with security and videotex following.

**Eugene Walding/Centel:** I think you'll find that varies from system to system. It would depend where the number crunches are. We find in some of our areas there's a wonderful opportunity. In others it's fairly minimal.

**David Willis/TCI:** While it offers a lot of possibilities, business communications places the MSO in direct competition with the huge capability of the telephone industry. At best, MSO success in this area will be relatively isolated.

**Nick Worth/TeleCable:** We cover limited areas; the metropolitan area often is parcelled among multiple MSOs. What's a business consumer to do if its branch locations fall in different franchise territories? They do business with one telephone company able to connect *all* their branches. There are future MSO applications to business communications, but the main thrust is still the residential subscriber.

**Bill Quinn/Cablevision Systems Development:** Business communications is one of the brightest opportunities we have. In markets where franchises are divided among different MSOs, the MSOs will have to co-op a coordinated interconnect in order to offer the user a total package.

**CED: Which, if any, of your currently operating systems are providing data communications or other services specifically suited to the business or institutional sectors?**

With few exceptions, responding MSOs are actively servicing at least some

aspect of the business communications market. A cross-section of these varying MSO involvements and a description of the nature of their operations follow.

**Tom Rush/Warner:** We have institutional cable active in four operating systems. In Pittsburgh, a complete institutional cable currently serves four different customers. Westinghouse, one of the four, is the only business institutional-cable client we're publicly announcing, because the other three have requested anonymity. In the Cincinnati suburbs franchise, we're trading programming among various school systems over the institutional cable, and we have some data communications active in Farmers' Branch, Texas. In Dallas, utilization of the institutional cable—which I consider experimental—is a precursor for future school system and city library service.

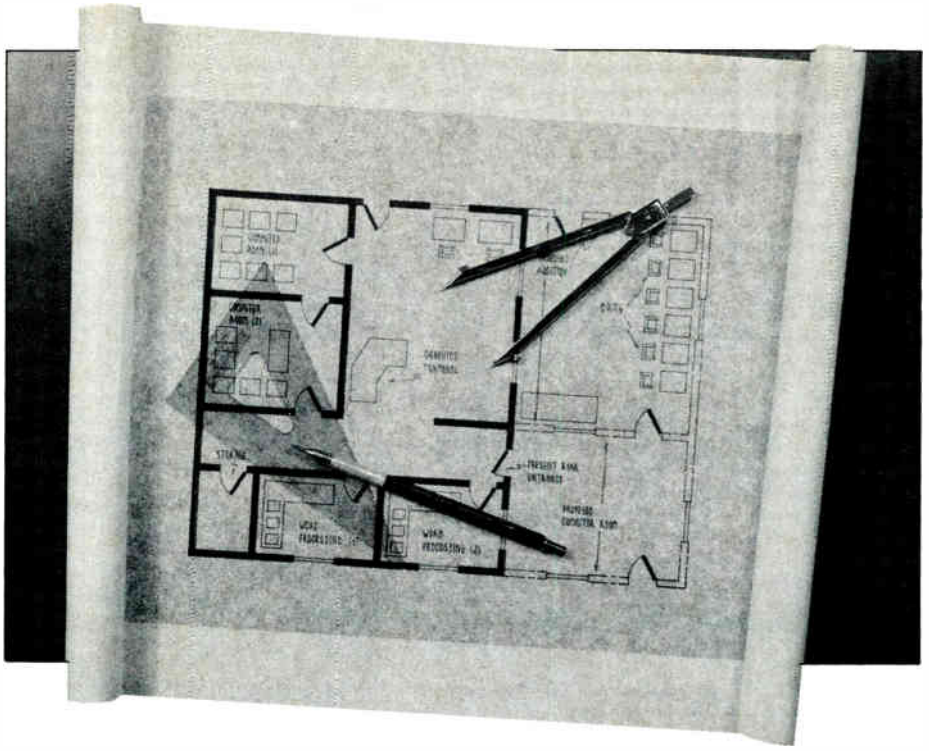
**Tom Bird/Rollins:** All of our cable franchise areas currently provide closed-circuit video, teleconferencing and data paths, at various levels of service, over the institutional cable. In our Wilmington, Delaware and North Boston-suburbs franchises, we currently are discussing a distributed-data interconnect to all subscribers for computer interconnect and teleconferencing from the home. Such end-user services as electronic mail are being considered.

**Bart Gunter/Sammons:** Currently, our only system with active data services is the Fort Worth, Texas, franchise. Circuits are used by businesses for remote terminal applications. Data are used extensively to control switching of video services in the various system hubs.

**Doug Truckenmiller/Colony:** In Upstate New York, we're transmitting high-speed data for IBM over unused bandwidth; however, we're considering building a dedicated cable to give IBM a wideband communications network for their individual in-house utilization. We are on the verge of expanding our business communications offerings. We've got the technology and the expertise; we just haven't marketed it yet.

**Nick Hamilton-Piercy/Rogers:** Two of our operating systems—Toronto and Portland—currently are providing substantial communications for the business and institutional sectors. Other operating systems are preparing to address this market but presently carry only insignificant amounts of video programming on a point-to-point basis for the institutional sector. The Portland operation is actively pursuing this market, and touts several paying clients at present. Most of these communications have been point-to-point and point-to-multipoint, such as would be found between headquarters' and branch offices.

**Harold Null, John Grubbs/Storer:** In Jefferson County, we currently provide phone and data service to five satellite business offices over the institutional



cable. In our Little Rock franchise, a radio communications service for the city on its loop and a medical network are in the planning stages, with similar services scheduled for a multitude of Storer systems including Bowling Green, Anaheim, Washington County, Glendale, Mesa, Phoenix, Houston, Minneapolis and Montgomery.

**CED: Please describe the typical design approach taken in both already-operating and soon-to-be operating networks dedicated to business and institutional communications, including the type of distribution system, hubbing, return path switching, interface with subscriber network and computer requirements.**

**Tom Bird/Rollins:** The typical design approaches are basically institutional networks with tree-type trunk systems from microwave hub sites. Switching is done by dedicated frequencies using frequency translators at the hub sites. Interface with the subscriber network takes place at the microwave hub site. Computer requirements vary widely. In some cases, there are no computer requirements because users are on dedicated frequencies. In still other cases, computer terminals are supplied by users.

**Tom Rush/Warner:** The best answer I can give is that there is no one typical design approach. We designed Pittsburgh without any hubs. Everything goes into the headend there, and we can and will put some business use on the subscriber cables. In turn, we'll bring that into the headend and marry it together, if need be, onto the institutional network. We took this particular design approach because we surveyed Pittsburgh beforehand. After conducting a very thorough survey of all the business communications' users, we reached an understanding of their potential—who they were, where they were, and how much traffic they might generate—and we found a non-hub system to be best suited for Pittsburgh. We are currently surveying Dallas and Cincinnati and, depending on the results of our surveys, we will architect appropriate systems there. In turn, we'll have each of these cities understand that franchise propositions may require alteration based on survey results. I can tell you that we are looking to change the number of channels upstream and downstream. Whereas some of these systems were originally planned with 13 channels upstream and 39 downstream, they'll probably finish closer to 25 upstream and 27 or 28 downstream. With so much communication being two-way, this configuration should give us a better balance.

**Nick Hamilton-Piercy/Rogers:** The subscriber network utilizes a unique return-path switching capability at each bridger station to minimize the chance of signal blocking by ingress. This unique switching controls specific parts of the return spectrum. A segment from 21 to 33 MHz is reserved for video programming and is remotely switchable at each bridger location. A segment of 5 to 12 MHz is also remotely switchable at each bridger location and is reserved for low-speed polled data applications such as home security and pay-per-view. The segment between 11 and 21 MHz is reserved for business and other types of high-speed data transmission with each bridger amplifier containing a vacant module through which this signal passes. In the future, when the need for high-speed data from each home is a proven service, this module is likely to be a

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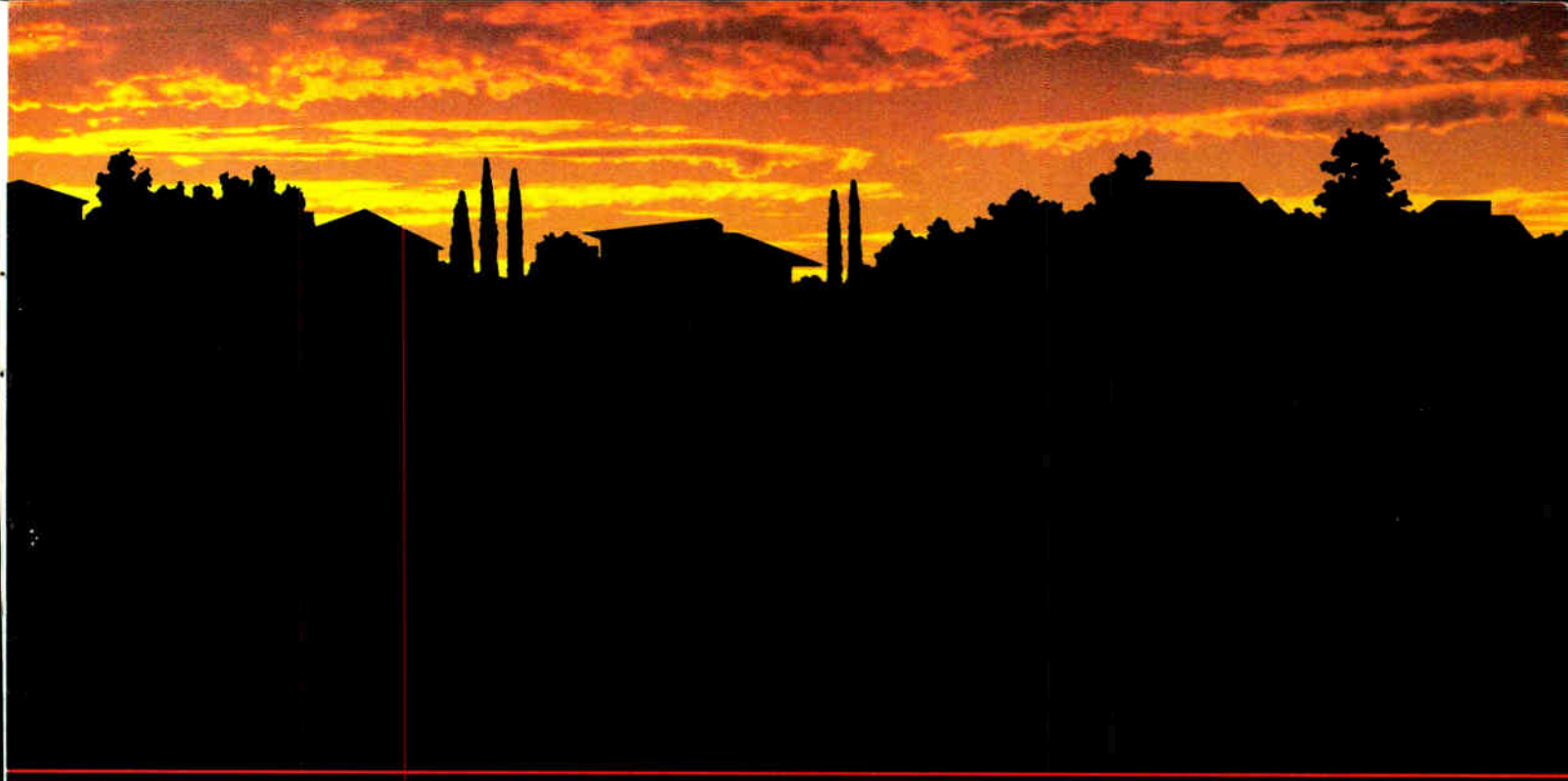

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packet switching device. The preferred protocol for our data communications uses is packet data, the Sytek equipment being the most frequently used.

**Bill Quinn/Cablevision Systems Development:** While the institutional network has unique applications, it still tends to be, by and large, something you build along with your other cable system. And at some point you could argue that a lot of the downtown business districts are well defined geographically, and you could go ahead and build a system that is better suited to business use. We feel, on the other hand, that we're better off going with the traditional design, because we think a lot of the business services we might be providing might have impact outside usual business areas: doctors' offices, small retail outlets that tend to be located in residential areas, etc. So I guess you could say that we are satisfied with current multiple hub design.

We have taken steps to increase those divisions, though. Boston, as an example, will be comprised of 16 separate cable systems. Each one of those will be separately programmable, and each will have the entire upstream capacity of the institutional net available. So we think we've spread somewhat the loading of those cables by providing so many separately programmable sections. If we do our spectrum allocation properly, in some cases where there's a very low use service in a particular frequency spectrum, we may combine those cables and produce either a single feed for that service or for one fourth of the city. And when we get into very heavy use in certain areas of the spectrum, we might process that particular service through each 16th of the city. So we think we've built in some flexibility there.

**CED: Do you consider your current design approach to be the optimum right now for meeting growing demand for business communications services? If not, what approach should be taken?**

**Nick Hamilton-Piercy/Rogers:** Our previously-mentioned architecture works well in all the applications we envision at this point. The remotely controllable bridger switching allows blockage of unauthorized communications from the domestic sector, and hence maintains integrity for other users. Midsplit dedicated-communications trunks have more than adequate capacity for any business communications demand we now see. Reliability enhancements through use of status-monitored amplifiers, automatic signal bypass during failure and maintenance and the use of standby power supplies throughout the network have given us a transmission availability of exceptional quality.

**Douglas Truckenmiller/Colony:** Until fiberoptic technology is developed to the point where we can utilize it in a star system and take one piece of fiber from the headend out to each business user, our current configuration seems optimum.

**Tom Rush/Warner:** In most of the cities I've discussed, we built or will build our systems with three cables. The A and the B Cables have upstream capacity of approximately five channels. So as not to ignore it, our design utilizes that capacity in less dense franchise areas. Our idea would marry the subscriber cables and utilize that cable for communications in and out of those less dense areas and only use the institutional cable as a dedicated cable for those types of services where traffic warrants.

**John Grubbs/Storer:** We are looking at every technological possibility for providing the most efficient delivery system, including fiberoptic technology.

**CED: Can your optimum design be cost-effective in smaller systems or in areas where demand for business communications is not as intense as it is in larger urban markets? Also, please address the feasibility of using subsplit distribution systems in older franchises for limited business communications applications.**

**Tom Rush/Warner:** The design approach I described above would not be feasible in smaller systems because the majority of these systems are not two-way. The cost of building dedicated cable is considerably less on a per-mile or other unit basis than it would be in a large urban area. We are negotiating in a few smaller systems to build a separate dedicated cable for business purposes. We'd probably put it in just for the first customer and then start expanding that cable as we add customers.

**Douglas Truckenmiller/Colony:** There are certainly some franchises where building an institutional loop as we now know it would not be feasible; however, in some of these cases there may be enough personal business use, i.e., via the home computer, to warrant building a hybrid system. Instead of providing two 54-channel subscriber systems, you might provide a 54- or 60-channel plus a midsplit wherein you would utilize the forward channels for an additional 20-channel capacity and the return path for business communications.

**Tom Bird/Rollins:** I would imagine the classic cable architecture would be adequate in smaller systems depending on whether or not you have an institutional network in place. Subsplit distribution could prove feasible in older systems for minimal or limited business communications if you have bridger switching. But the real problem in older systems, which we learned the hard way, is noise ingress.

**Bart Gunter/Sammons:** To date, the majority of our small system projects have dictated the use of a separate cable to connect two buildings. This relieves the normal plant from upgrades in redundancy and, in some cases, subsplit capability. The distances involved in smaller systems also warrant a dedicated-cable approach wherever feasible. Subsplit systems can be used for a small number of business communications circuits, but the problem of ingress becomes the major problem in these systems. The funneling effect of noise is also a problem when dealing with distribution systems as opposed to a trunk-only or limited distribution system.

**Edgar Hassler/Armstrong:** I guess in older systems—talking about subsplit distributions systems—really the older systems are probably more concerned right now with just being able to upgrade and to provide good quality entertainment services. I guess I don't see them doing anything with their old plant as far as subsplit is concerned unless we rebuild. But I don't see that really being feasible from a reliability standpoint. I think we need to have a little more reliable plant in our systems before we start talking data transfer, security, some of the ancillary services that are being thrown around right now.

**Nick Hamilton-Piercy/Rogers:** Our previously stated architecture is equally applicable to small systems and large urban environments.

The use of subsplit distribution systems for business communications is possible but care must be taken. Subsplit trunks would have ample capacity for any data requirements, but would be somewhat limited for large amounts of video or voice communications. The subscriber feeder area could jeopardize use of these systems unless special precautions are taken. Multiple connections within the feeder area, the type of hardware utilized and vulnerability to unusual interference signals generated within the home are factors which must be managed. The bridger return feeder disconnect switch is useful in this regard in that a harmful interference can be blocked from entering the main trunk network and contaminating communications there. Use of high-pass filters either at multi-tap spigots or at the ground block location certainly provides some safeguards against in-home or drop-generated interference. But experience with other plants shows other contributions originating within the distribution plant itself, such as connector noise ingress and power supply noise. Should a specific institution or business be located in the feeder area, it would be better to connect this location back to the trunk via its own dedicated 412 or 500 cable.

**CED: Would you like to see the industry move toward a switched-network star design in business communications? Is this a direction your company is considering? What are the barriers?**

**Eugene Walding/Centel:** The feasibility of the star design approach depends on the number of users.

**David Willis/TCI:** There are cases

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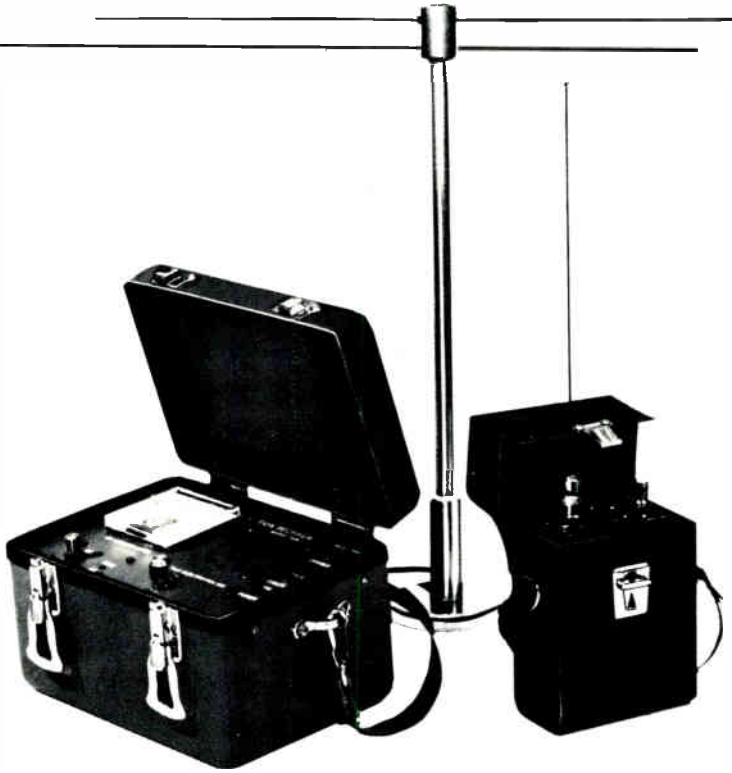

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where the star design may make a great deal of sense. If a system dictates very low noise on the return path, a switched network is the way to go.

**Bill Quinn/Cablevision Systems Development:** While we're very interested and think that as far as service is concerned switched networks and things like that are important and in some cases might be applicable, in general we're not limiting ourselves to the business district alone. We use our institutional networks for more than business communications. So they need to be spread more around the city. Some of the designs that I've seen in franchises we've been involved in limited the high-speed, high-capacity business communications only to certain areas of the city. And we think that that's not farsighted from the idea of growth and the idea that a lot of these business services could be applicable in homes and in small residential type commercial locations.

**Ed Callahan/United:** We're not definite about switched networking as an across-the-board concept, but we intend to try it in one of our smaller systems. It's certainly workable. You might change the design slightly depending on market conditions, but the basic idea is to limit the amount of plant built out of a particular hub, limit the hub size and put in more hubs. In this way, we can cut down on the length of the amplifier cascades and the amount of noise accumulation or ingress on the return path.

**Larry Janes/ATC:** It depends on the extent to which interactive services become a reality. If we were to get heavily involved in interactive services for the residential subscriber and/or higher-volume types of subscriber services, then the switched-network star design would make a lot of sense. There is a limit to how much you can do with the present tree-type design in terms of two-way services. Moving towards the switched-network design is likely to the extent that these kinds of services require something beyond the capability of present designs. In a business situation, you tend to have a smaller number of users, but each user wants a much larger volume of information transferred back and forth. I'm not sure a star network is as appropriate for that kind of application as it is for a consumer application where you've got a larger number of consumers. In a tree-type design you get bogged down quickly if you've got a lot of users wanting to use the system at the same time, whereas with the star network you can do a lot of buffering and time-sharing out at the nodes in the star. Business communications' needs tend to be adequately met on the kind of design we currently have—a specific design to interconnect specific points with large-volume capacity for a small number of users.

**CED: Are the products essential to providing data transmission, voice and specialized video services to the business and institutional sectors available off-the-shelf? Are prices a major barrier, particularly with respect to modems? What further developments in modems, amplifiers, power supply, switching, status monitoring, etc., are necessary to lessen the risk of entering the capital-intensive business communications market?**

**Tom Rush/Warner:** By and large, yes. Prices are not a major barrier. We'd like to see modem manufacturers go to a frequency-agile interface of some sort so that we can have flexibility in spare parts, as well as the frequency assignments we might need to make for any one customer in any one system. That's the major contribution the vendors could make right now.

**Nick Hamilton-Piercy/Rogers:** Quite a variety of products for providing institutional and business communications services are already available off the shelf. There are many data-modem suppliers such as Sytek. For the business sector, prices of these modems is not a major barrier; however, extension of data transmission into the home environment is significantly impacted by price. The $100 modem has yet to emerge. Voice on coaxial cable is still in the embryonic stage. CED

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# Capitalizing on a growing market: Modem developments facilitate move into data

**By Robert Schack**
Data Processing Marketing Manager,
Scientific-Atlanta

Far from promoting a "technology of the future," broadband cable systems are in a position now to meet a wide range of pressing business requirements for high-speed digital data transmission services.

Corporate telecommunications managers face growing user demands for faster and more reliable data communications facilities. But in many cases, corporate requirements for better performance are at odds with both the limited capacity and high cost of services available over conventional distribution networks.

These networks were, of course, designed to provide voice communications, not data. And the fact is, PBX switches and dedicated lease lines have successfully delivered cost-effective intrafacility voice communications throughout corporate America.

Efforts to provide combined voice *and* data services via modem links, however, have proven both costly and unsatisfactory in terms of performance. Transmission speeds above 9.6 Kbps require the use of increasingly complex and expensive modem modulation schemes to overcome the voice network's inherent bandwidth limitations. Compounding the problem is data's relative intolerance to line noise at higher transmission speeds, requiring the use of expensive conditioned lease-lines and sophisticated system diagnostics.

In dealing with today's voice and data communications requirements, businesses typically face long lead times and a series of performance and cost trade-offs. In the end, they must choose between buying and leasing multiple low-speed lines and modems or concentrating traffic via conditioned lines and costly multiplexing equipmnet.

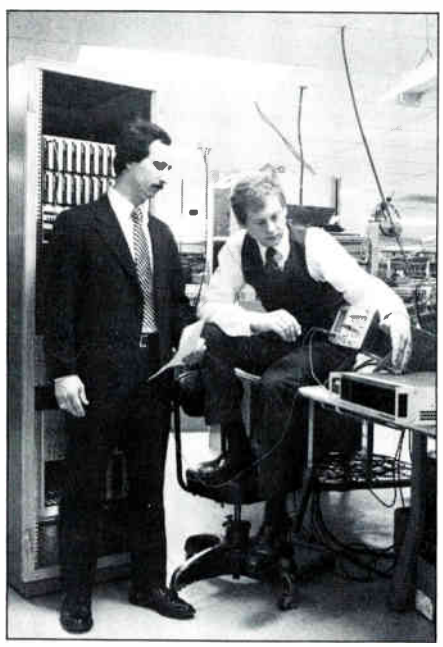
### Technological advantage

Suppliers of broadband cable services offer an excellent alternative to twisted-pair transmission line technology for one simple reason; well-engineered broadband systems can offer far more reliable high-speed communications capacity at significantly lower cost.

Point-to-point communications are established via paired modems operating in a duplex mode. A modem transmits data from a given location onto the cable network at a frequency in the reverse path. The data then travels to a centrally-located frequency translator and is translated into the forward frequency range. Frequency translators can be designed to translate data channels in 6 MHz allocations. The capacity of the translator and the number required depend on how data channels are allocated and the volume of traffic on the cable system.

Although twisted-pair modems can successfully interface digital devices with voice-grade telephone lines, requirements for switching, multiplexing and demultiplexing equipment expand greatly as transmission speeds increase. At transmission speeds approaching 19.2 Kbps, voice-grade technology is severly strained and subject to increasing reliability problems. In comparison, high-speed broadband data modems offer low cost, simplicity, and very high reliability.

The necessity of conveying several data signals simultaneously along a single cable is addressed by modulating each signal onto its own carrier, creating a Frequency Division Multiplex (FDM) scheme. The basis for most data transmission is the Frequency Shift Keying (FSK) system, in which carrier frequency is displaced between two discrete extremes of frequency.



**Robert Schack (left), data processing marketing manager, and David Slim (right), senior systems engineer, display the Model 6402 high-speed broadband data modem.**

A more sophisticated technique utilizes Quadrature-Amplitude Shift Keying (QASK-16). This modulation technique utilizes two carrier signals having the same frequency, but differing in phase by 90°. The data is configured in four-bit groups. Two of the bits determine the phase and amplitude of one signal, and the other bit pair determines the phase and amplitude of the second signal. Thus each carrier signal has four states, and the total signal has sixteen states.

Using this advanced modulation technique and bandlimiting filters, it's possible to transmit a data signal in a bandwidth of about half the fundamental bit-rate.

Scientific-Atlanta's approach in developing its Model 6402 Broadband Data Modem utilizes a QASK-16 modulation technique to achieve high-speed digital data transmission at the T1 (1.544 Mbps) rate while using only 750 KHz of spectrum per data channel at a designed bit-error rate of less than $10^{9}$. Such advanced modems can provide more than 100 full duplex T1 links on a dedicated high-split trunk system with 170 MHz of bandwidth in both the forward and reverse directions.

There are several broadband cable modems available in today's marketplace which accommodate a wide range of data transmission speed requirements. The basic question that must be answered in selecting the right modem is, which product offers the lowest bit-error rate—and therefore the highest quality transmission performance—for a given data rate? Modems which offer very low bit-error rates at T1 transmission speeds will provide markedly superior terminal-screen data presentation capabilities and will produce the finest transmission quality available in meeting a range of voice communications requirements.

### Ensuring quality

The degree to which broadband cable can fulfill its data-transmission potential ultimately depends on the integrity of the data communications facility. In preparing to enter the broadband data transmission marketplace, suppliers must commit the resources necessary to ensure the consistently high performance demanded by business customers.

The primary goal is the elimination or prevention of extraneous noise on the cable network. This requirement means that the entire system should be terminated and insulated properly, with all tap output ports booted to insulate exposed points where signal loss or ingress may occur.

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supplier should also consider installing high-integrity RF connectors along with multishielded or 94% braid-coverage drop cable to ensure adequate signal insulation.

Conducting stringent quality assurance inspections of existing systems and maintaining tight quality controls during new construction will obviously pay important dividends in terms of high system performance levels and customer satisfaction.

**Marketing**

The market for broadband data communications extends far beyond the most visible prospects—corporate managers of telecommunications services. And even though broadband data communications services can be marketed directly to corporations, getting corporate buyers' undivided attention is no small achievement. Corporations now must consider a host of suppliers. Among them are:

- Providers of long distance services such as MCI, Sprint, AT&T Long Lines and others;
- Equipment manufacturers such as Northern Telecom, Rolm, Stromberg-Carlson and Western Electric;
- Numerous interconnect firms which market configured turnkey systems, and
- Local distribution resources, including Bell operating companies, non-Bell providers of microwave transmission services and CATV broadband operators.

Cable networks can directly provide only local distribution services—a small part of most corporation's total communications requirements. As a consequence, time-pressed corporate buyers investigating intercity networks may be unwilling to seriously examine how broadband cable services can fit into their overall communications picture.

But the happy fact is that both direct corporate buyers and most service and product vendors are potential broadband cable transmission customers. In many cases those vendors will offer the most direct route to capturing mainstream corporate business.

For example, companies, such as MCI and Sprint, that market long-distance services require local distribution facilities to get their customers on-line. Broadband can provide significant capacity and cost benefits to those vendors, who can enhance their competitive positions by adding coaxial cable facilities to their corporate offerings.

Similar marketing opportunities exist with equipment manufacturers or interconnect firms that provide turnkey communications systems to the end user. By utilizing more economical broadband cable transmission services, those suppliers can significantly reduce total system costs to their customers—including lower hardware costs and line charges—thereby improving their competitive positions.

Not surprisingly, local Bell operating companies are soon to be another major user of broadband cable data transmission plants. Those newly deregulated firms will be hard-pressed to meet burgeoning corporate requirements for high-speed data communications with existing facilities, and economical broadband cable systems can provide capacity not otherwise attainable by BOCs in the near-term.

The basic approach in marketing to product and service vendors simply entails identifying local interconnect and telephone switching/computer hardware vendors and getting acquainted with their key people. There is very high awareness within the telecommunications industry of cable's potential for providing cost-effective broadband services, and buyers are enthusiastically looking to suppliers of this medium for innovative ways to approach the capacity/ speed dilemma. Those suppliers with in-depth broadband experience today are in a good position to carve out their niche in the emerging telecommunications scene. CED

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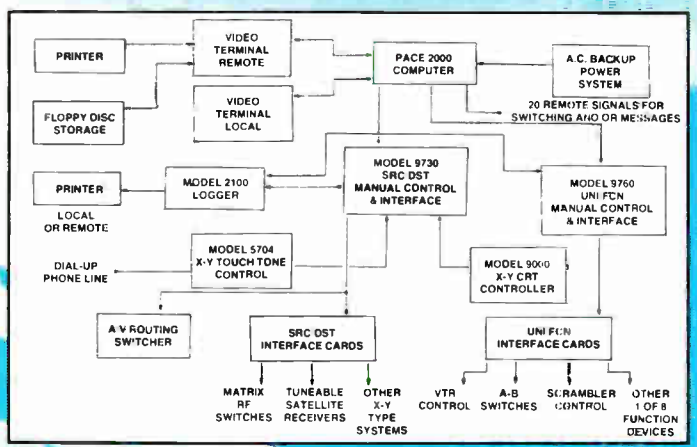


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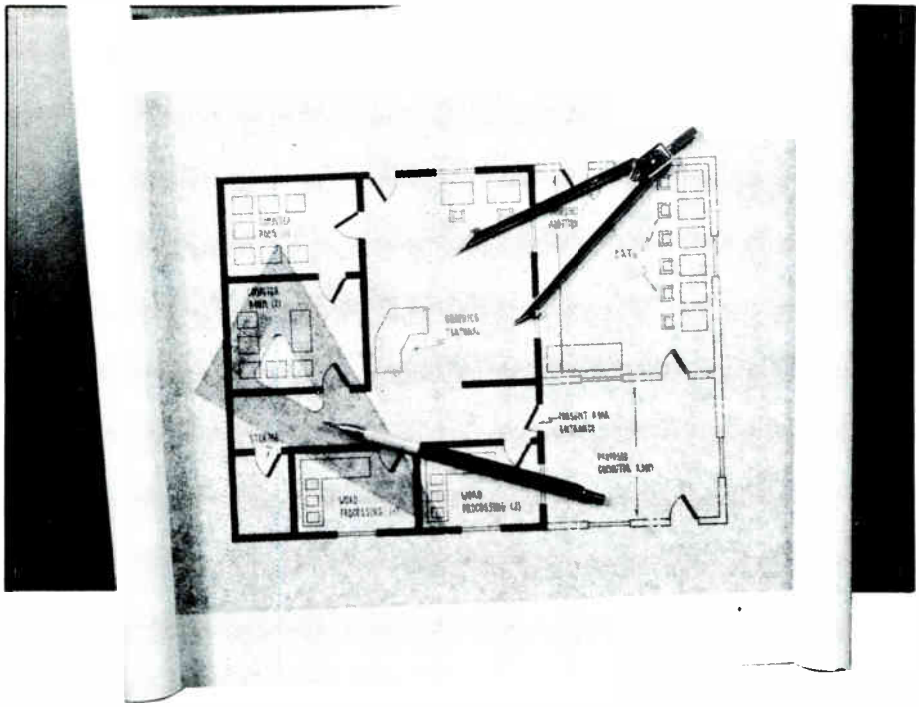

## Report to the NCTA:

# Effects of network topology on data transmission

**By David Large**
Vice President, Engineering, Gill Cable TV

### Overview

As markets develop for non-entertainment subscriber and business services, the cable industry has had to come to grips with the limitations of its conventional plant designs with respect to delivery of two-way services, in general, and data, in particular.

In an attempt to organize the industry's efforts on two-way services, the NCTA Engineering Committee has formed the Subcommittee on Networks and Architecture. This paper is adapted from a draft proposal prepared for that subcommittee.

No claim is made as to the accuracy or completeness of this analysis. All constructive comments are welcomed and will help to make the final product of the subcommittee more useful.

The Cable Media subgroup was charged by the committee with the task of studying and, hopefully, defining the environment through which data transmissions must be sent. Topics analyzed by the group include the effects of Gaussian noise, distortion products of active devices, frequency allocations and outside signal ingress.

All of these effects are critically dependent on the topology of the network. The study group decided to limit its consideration to simple tree-configured network designs, the dominant configurations in use today. That limitation is not as serious as it may seem since many other configurations can be analyzed as groups of connected smaller tree structures.

The purpose of this paper is to analyze some alternate transmission system arrangements and their differences with respect to data applications. The importance of this analysis is several fold:

1. Although the conventional tree network is the most common method for delivering one-way subscriber services, it is not readily apparent that it is best for two-way services. That network was designed specifically to deliver signals from a single point to as many terminations as possible within defined limits of distortion and noise.
2. An increasing number of data services are being carried on dedicated "institutional" networks in which there is no significant load of one-way subscriber services and thus less reason for a tree network.
3. A tree network beyond a certain size may simply have unacceptable reliability and signal quality in its reverse path.
4. A "wide open" tree structure is not only subject to outside signal ingress but also to intentional sabotage.

Each alternate topology will be analyzed in terms of its transmission characteristics, tradeoffs in cost, necessary network management and flexibility characteristics.

While it is apparent that the tree network does an acceptable job of delivering "downstream" signals, problems in delivery of two-way services arise in the return path. Some of the reasons for these problems are:

1. In the downstream direction, each amplifier has only a single input whereas in the reverse direction, many amplifiers have multiple sources, each adding noise and ingress components.
2. The downstream network is built with a controlled degradation using low-loss solid shielded cable and very low distortion amplifiers near the headend and simpler amplifiers and flexible cable near the termination points.
3. A fault in the downstream network can be isolated quickly by analyzing what portion of the network is affected, whereas a fault of the "too much signal" type in the reverse direction affects the entire network.
4. The portion of the radio frequency spectrum frequently allotted to reverse services, roughly 5-30 MHz, is occupied heavily by high power and spatially diverse sources of over-air radiation.

It is obvious that all of these effects are of less consequence in a smaller network. The various alternate topologies discussed below all result in networks that are partitioned, electrically or physically, into smaller and more manageable sections.

### Addressable bridger systems

In a normal tree-configured system, the main trunk line splits into major subtrunks and finally, into feeder lines. The feeder lines then serve individual subscribers through coaxial directional couplers (taps). In the reverse direction, each of the trunk and sub-trunk split points become points of signal (and noise and ingress) addition. The amplifier assemblies used to handle the splitting and combining tasks are known in the industry as bridging amplifiers or simply, bridgers. In an addressable bridger, a telemetry system is used to control each individual bridger in such a way that the signal path from each bridger input leg can be selectively activated. Depending on the implementation, control may extend over the entire return path bandwidth or just a portion. Similarly, control may consist of either a total disconnect or a defined attenuation level.

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The primary advantages of an addressable bridger system is that most of the noise and ingress from the majority of the reverse distribution network, which is not necessary for communication from a given terminal, can be eliminated. In a typical cable system design, a single bridger port may serve only thirty to seventy terminal points and, therefore, the isolation can extend down to that level. Providing that the control system itself is reliable and quiet, the quality of the transportation path from the last bridger to headend (at least with respect to noise and distortion products) should approximate that of the downstream path.

Other advantages are system reliability and ease of trouble isolation. The probability of a point of ingress, a faulty terminal transmitter or a deliberate interfering source degrading a given communications path is divided by the number of addressable system segments. This relationship allows service personnel to isolate problems to narrow geographic areas. A relatively simple addition to the telemetry system that controls the bridgers constantly can analyze the quality of the return signals and automatically generate trouble call reports.

An addressable bridger system is limited to applications that can be handled by headend polling. Since control of the return path lies with a master computer system, all two-way services must be coordinated into the system control structure. Specifically prohibited are communications initiated at random times by terminal devices. As a practical matter, this means that one service or one family of services may be all that is practical in a simple addressed bridger system. It should be pointed out, however, that the problem of customer access time due to the polling cycle can be reduced considerably by use of statistical polling techniques. In these schemes, customers who use the system most are polled more frequently.

An addressable bridger system in which only a portion of the reverse bandwidth is controlled does not have the disadvantage of tying up the entire usable bandwidth for a single service. It does so, however, at the expense of bandwidth lost to the finite selectivity characteristics of the band-limiting filters. It also leaves all the original problems to be solved by some other means for other types of two-way services.

A final problem is that, barring agreement on telemetry standards, each addressable bridger system must either be specific to one manufacturer of distribution equipment or require external switching equipment, which raises system cost. Therefore, installation of a two-way application requires a cooperative effort by the line equipment manufacturer, the terminal equipment manufacturer and the computer system developer.

**Subscriber line switching**

A line switched system is one in which the connection between the individual subscriber's service cable and the cable operator's distribution network is controlled remotely by the operator. It can be thought of as the complement to the addressable bridger system in that it controls all junctions in the distribution system, while the addressable bridger system controls all of the junctions between the distribution network and the individual subscriber's equipment.

Depending on the implementation, control can consist of simple one-way or two-way ohmic connection control or include frequency translation, conversion to fiberoptic format, bandwidth limiting, or require implementation of an LAN-type bus interconnection node.

Compared to a fully open tree structure, the improvement in signal transmission realized by line switching is principally due to the elimination of noise and ingress from subscriber service lines and equipment. For the same reason, the possibility of accidental or intentional "jamming" of the network is reduced considerably.

Depending on the features included in a particular installation, other advantages can be realized:

1. Improved data security, if bandwidth limiting or frequency translation results in only transmissions directed to a particular subscriber being present on his cable.
2. Addressable frequency translation at the connection point may eliminate the need for frequency agile user modems or, alternatively, for the cable operator to stock modems in a variety of frequency pairs.
3. Frequency translation capability would allow the cable operator to abandon a particular frequency without any equipment changes should that particular channel become affected by ingress.

A switched subscriber loop system appears to have many of the same limitations as the addressable bridger system. It is conceivable, in fact, to combine them in the same network. The system's polling flexibility, however, is somewhat better than that of the bridger system, which allows simultaneous access only to those customers who happen to be served from a common bridger leg (unless seveal legs are simultaneously activated, which reduces system noise performance). The subscriber switched system, on the other hand, can activate any combination of customers without regard to their physical location in the network.

**Localized customer switching centers, star networks**

An extension of the customer switched lines concept is localized customer switching centers. In this topology, the trunking network interconnects many distributed switching centers. Each center serves the customers in its immediate vicinity. Each customer is served by an independent connecting link to the local center.

Compared to individual subscriber switched systems, the network has far fewer interface points. The reduction in number of connections and branches may increase the physical shielding of the system from ingress sources so as to make a "wide open" return network practical in relatively large systems. In addition, network management may be improved if local diagnostic intelligence is employed at each switching center and automatically reports to the management computer.

The problem of random-time subscriber service requests also can be alleviated by queuing these requests and using a common upstream data service request transmitter at each center. The relatively small number of centers compared to total number of customers could make this a practical technique.

The use of signal processing equipment on each subscriber's service line makes possible many other techniques:

1. Possible use of fiberoptic transmission lines for either trunking or individual subscriber service lines.
2. Delivery on relatively low frequencies to realize the lowest possible transmission losses in those applications in which coaxial service lines are used.
3. Use of multiple trunk transmission lines.

As with switched subscriber lines in which frequency conversion is employed, security of transmissions is improved considerably and ingress from the subscriber loop generally is eliminated as a problem.

The primary problem with local switching center topology is its cost. The cable mileage required for local customer connection is significantly greater than that required for a conventional tapped line configuration. Additionally, any extra cost incurred in providing intelligence or mode conversion in the switching center must be distributed among the customer. Finally, there may be additional real estate costs for the switching networks.

**Block, segment, trunks**

In a block segment trunk system, the noise funneling problem that occurs at brighter locations is reduced by use of the FDM technique. (Figure 1 illustrates the principles involved.) A separate trunk line is provided parallel to the downstream trunk, with full bandwidth available for upstream transmissions. At selected points in the distribution system, the subsplit return line signal is diverted from the main trunk, frequency converted and combined into the return trunk spectrum.

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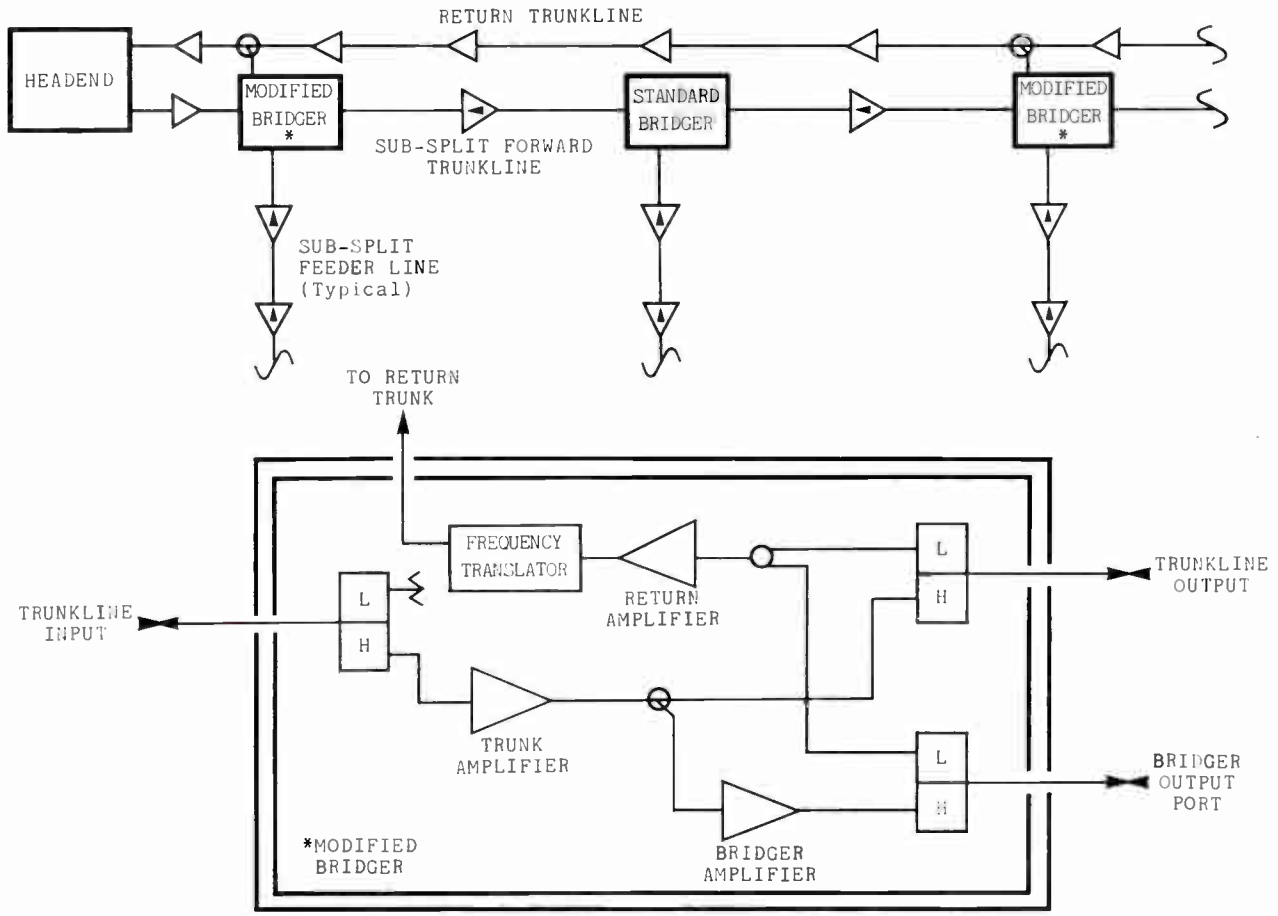


FIGURE 1 - BLOCK SEGMENT TRUNK SCHEMATIC

A different frequency offset is used at each crossover point.

The major gain in employing a block segment trunk is that noise, ingress and distortion products that otherwise fall into a narrow range of frequencies are spread out over the full bandwidth of the return trunk system. A second advantage is that the system's two-way bandwidth is increased over that available in a split-band system to full trunk amplifier capability, without incurring the cost inherent in providing a full dual distribution system. Thirdly, the return trunk carries the majority of its signals in frequencies that are not as subject to ingress problems. And, finally, system troubleshooting is simplified since observation of noise and signal behavior in various portions of the return amplifier's output spectrum can identify the physical part of the distribution system involved.

Conventional techniques in which a headend broadband frequency translator is used to convert return signals for retransmission are not compatible with this technique. The frequency on which the upstream transmission from a data modem is received at the headend, for instance, depends on the modem's physical location within the system.

Secondly, although a wide total return bandwidth is provided, the bandwidth provided to each group of customers still is limited to the split-band segment of the main trunk. This segment typically is located in the frequency range most subject to ingress and low frequency disturbance problems.

**Distributed intelligent system nodes**

In all of the system variations so far described, signal processing at nodal points has been limited to simple frequency conversion and routing control. For simple tree networks with headend frequency translation, a common characteristic of all the techniques discussed above is that transmission of a message, or message segment, through the network makes use of two frequencies, the upstream and converted downstream signals, throughout the entire network for the entire duration of the message. If the nodes in such a network are replaced by devices having independent receivers, storage and transmitters, then any given message only occupies one frequency in one segment of the network at a time.

For purposes of this discussion, a system with intelligent nodes is defined as one in which processing takes place on the messages being transmitted through the network at various distributed interconnection points in such a way that individual messages are received, demodulated, stored and retransmitted.

This technique is the only one discussed in this paper that is not an attempt to improve on the conventional tree design. The technique also can be used to mesh configurations and, in fact, gains both redundancy and efficiency in a multiple-linked network.

An important advantage of such a system is that messages need only be retransmitted through the most direct route to their destination. Depending on the network's physical arrangement and statistical message routing, a significant increase in theoretical message capacity can be realized by the system since it does not have to process all traffic through a single headend point and then broadcast all "downstream" traffic to all termination points. The uncorrected error rate of the system—due to transmission

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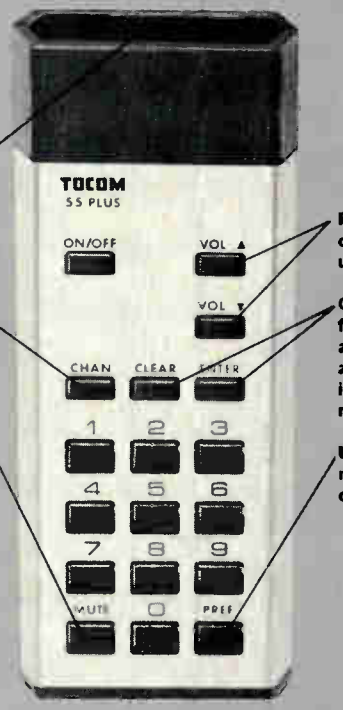


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line effects such as noise, ingress and cascaded distortion effects—also can be reduced to a point where the system is divided into smaller networks, with each network having fewer than the overall system.

The intelligence of each node may be such as to make overall network management functions superfluous. Furthermore, the more immune the system is to total shutdown, due to failure of any single element, the more reliable it becomes.

Another advantage is that the end-to-end error rate of such a system can be reduced significantly by using a system of error detection, reporting and retransmission at each node. If these functions are combined with error reporting to a central monitoring facility, automatic trouble localizing down to the segment and specific frequency level becomes possible.

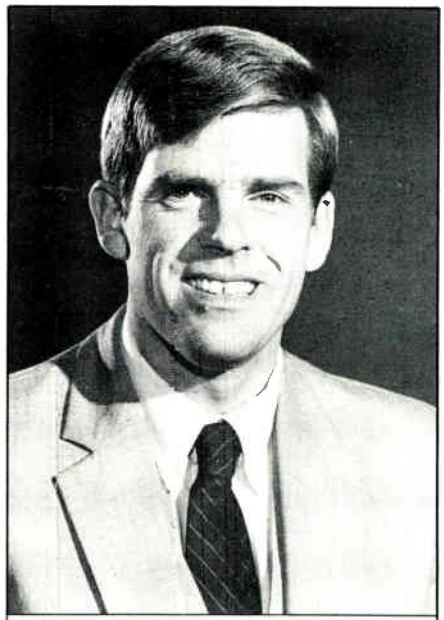
In addition, access and channeling methods can be optimized for each segment of the system to give greatest efficiency. Examples of this are: carrier sense multiple access with collision detection (CSMA/CD) techniques in the end-user segments, where access requirements are highly variable; and fixed frequency or time division multiplexed (FDM/TDM) assignments in major trunk segments, where the statistical variations have been evened out.

The fundamental problem with this scheme as with most distributed intelligence systems is that the initial installed cost tends to be much higher than that of either passive or centrally controlled networks. This can be made less severe if the implementation allows for gradual segmentation as traffic grows.

From the end user standpoint, the uncertainty of instantaneous transmission delays as messages are queued at various points along with other traffic may present other difficulties. Depending on the interconnection scheme and the possibility of multiple paths between various termination points, this also may result theoretically in message segments arriving in a different order than that transmitted.

Another problem is that all data on the network must conform to a standard format to be processed by the intelligent nodes. This formatting may be done by the terminal/network connection equipment, further escalating the network's cost, or by the user, and thereby restricting access to those having compatible equipment.

If such a network is to handle both digital and analog services bi-directionally, then either all of the analog signals must be converted to digital form at significant increase in cost, or the processing equipment must operate only on a portion of the available bandwidth—in which case, network limitation effects on the analog services must be dealt with. CED



*David Large is vice president of engineering at Gill Cable TV. He began his engineering career approximately twenty years ago after graduating with a B.S. in electrical engineering from Cal Tech in 1963.*

*Five years ago, Large joined Gill Cable and has spent the last three years as vice president of the company's engineering department.*

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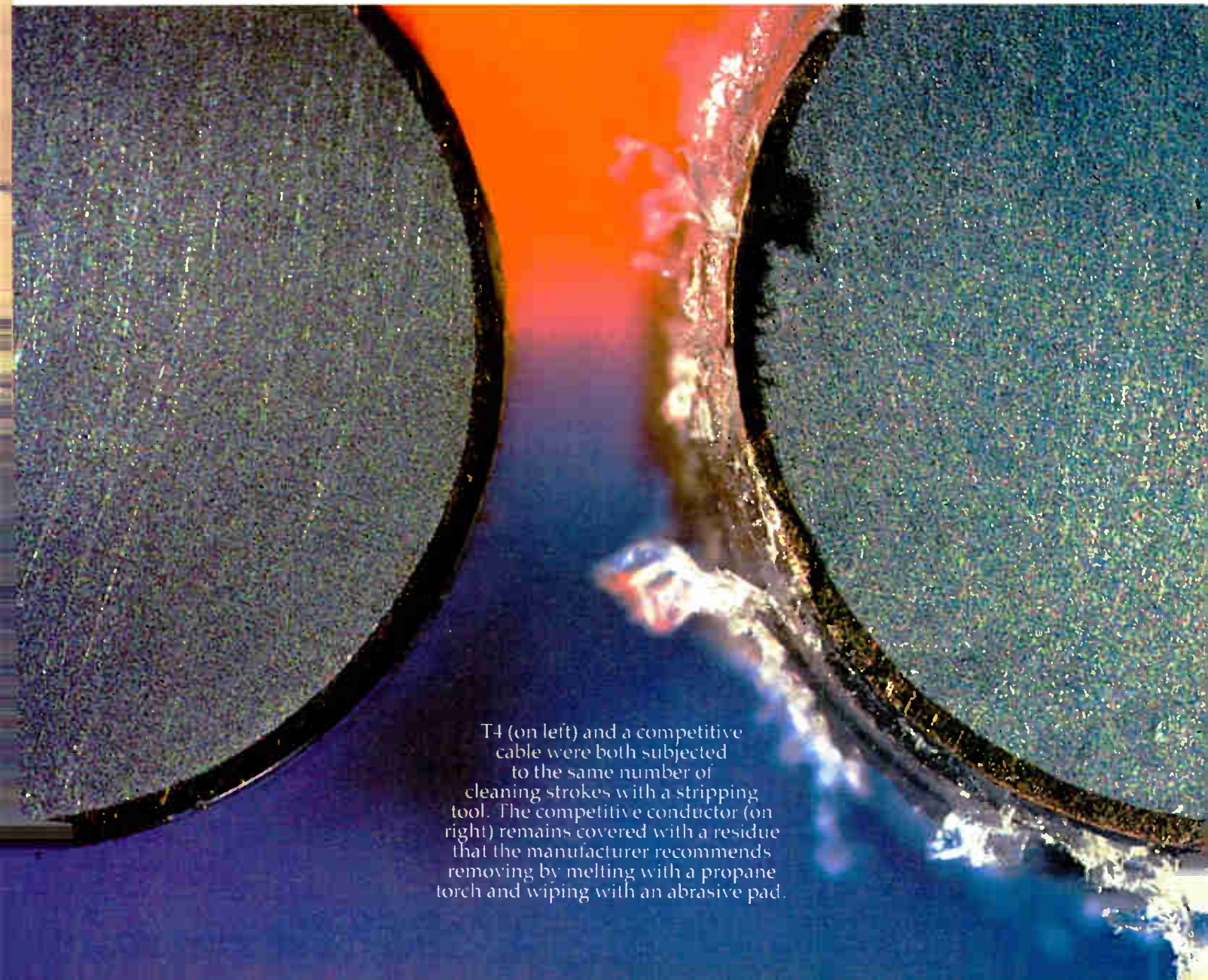

T4 (on left) and a competitive cable were both subjected to the same number of cleaning strokes with a stripping tool. The competitive conductor (on right) remains covered with a residue that the manufacturer recommends removing by melting with a propane torch and wiping with an abrasive pad.

# Step by step:
# A mathematical trip through the return system jungle

**Now that interactive CATV distribution systems have become a reality in the United States, system engineers are presented with a new set of problems for the implementation of two-way operations. This paper discusses some of the problems and describes methods and tools to aid in minimizing these problems.**

**By Jay Staiger**
Product Manager
Magnavox CATV Systems Inc.

Several factors must be considered during pre-system engineering and design. After the design and construction phases are complete, the return system must be made operational. There are several methods that have been tried for the purpose of setting up a return system. Some of these require that the forward and the return system be balanced as completely separate functions. Other methods require that two field people, minimum, plus over-the-air radio communications be used. Set-up procedures have evolved to the point where only one technician can set-up and balance both the forward and return systems simultaneously without the need for two-way radio communications. This method, along with the test equipment required, is presented.

The maintenance of a return system has been found to require significant effort, more so than the forward system. This problem is due mainly to RF interference, or ingress. The tools for minimizing the maintenance effort in return system maintenance and trouble shooting also are presented.

**Design objective**

One approach is to design for unity gain in the return system. Return system unity gain is defined as 0 dB gain from input of any amplifier in the distribution system to output of the return system at the headend (see Figure 1). This means that if, at amplifier #7 of Figure 1, there is an input level of 20 dBmV, an output level measured at the return system output would be 20 dBmV. Again, Figure 1 illustrates a 20 dBmV input at amplifier #4, and, again, it results in a 20 dBmV level measured at

*continued on page 49*

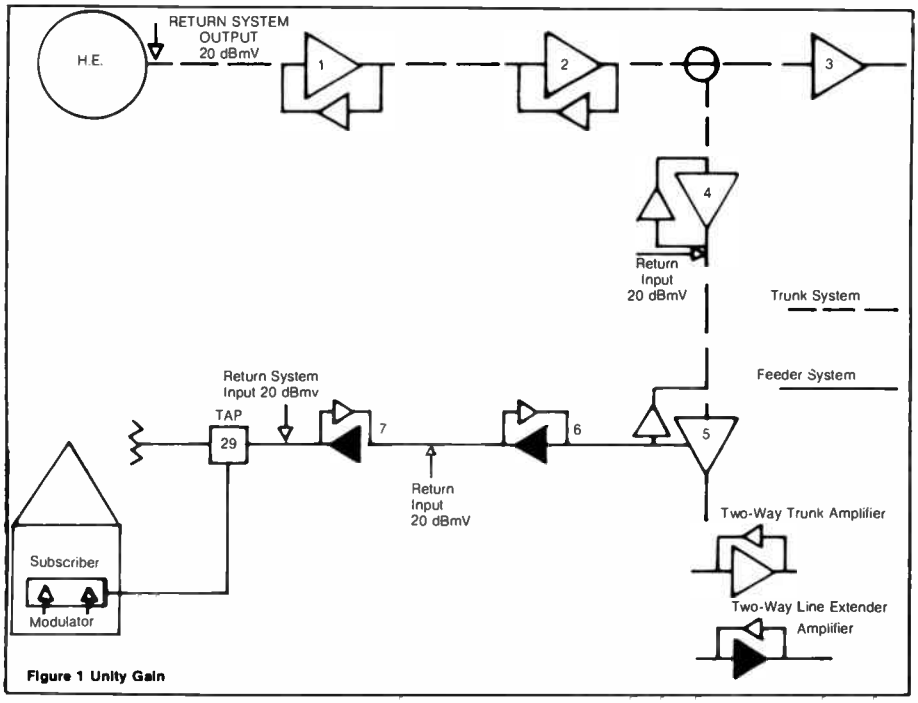


**Figure 1 Unity Gain**

# Magnavox breakthrough produces power doubling in hybrid amplifiers

Through the application of superior impedance matching and thermal design techniques, substantial improvements in hybrid I.C. amplifiers have been achieved. These improvements have provided a unique, cost-effective means to achieve better noise and distortion performance for a CATV distribution system. When implemented in a CATV design, several benefits can be realized:

- Longer trunk cascades.
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- Elimination of expensive hub architectures.
- Elimination of expensive distortion cancelling techniques.

The CATV industry (the franchiser, in particular) has been demanding higher levels of performance from CATV distribution systems. Reasons for the demand in improvement include increased channel loading requirements to cover large areas; competition from a large number of high quality, local, off-air signals and the economics of system architectures.

As bandwidths expanded and were loaded in excess of 58 television channels, the tolerable trunk cascades were shortened. The trunk system, which was designed to be typically transparent, became less transparent, and contributed significantly to the total system distortions. To compensate for the decreased transparency of the trunk, the bridger and line extender levels, along with the higher cable attenuation, significantly increased the initial and ongoing costs of the CATV distribution system.

Techniques such as harmonically related headends were applied to offset some of the reductions in system trunk reach and lower feeder levels. These systems, however, had to deal with different problems. The trend now is to avoid harmonically related systems and

*continued on page 66*

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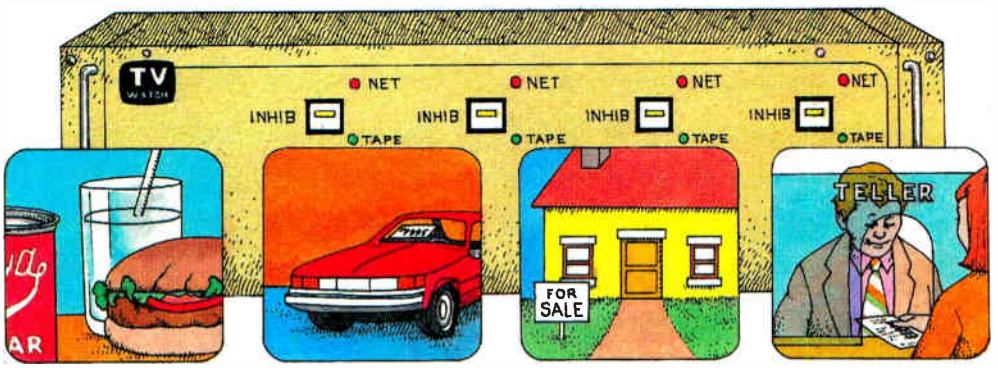


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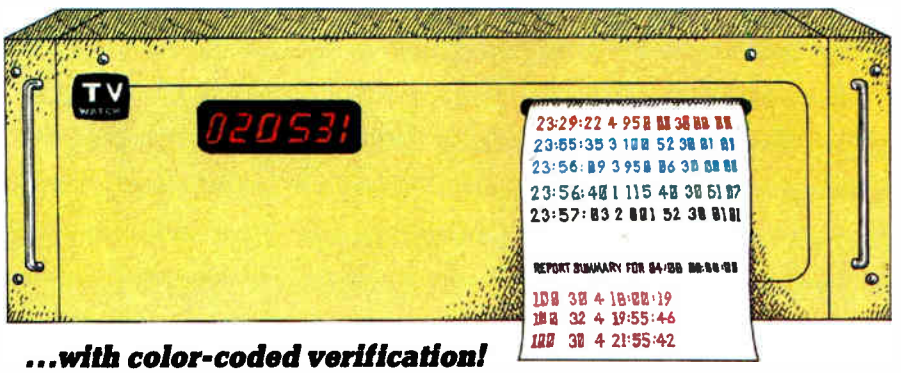


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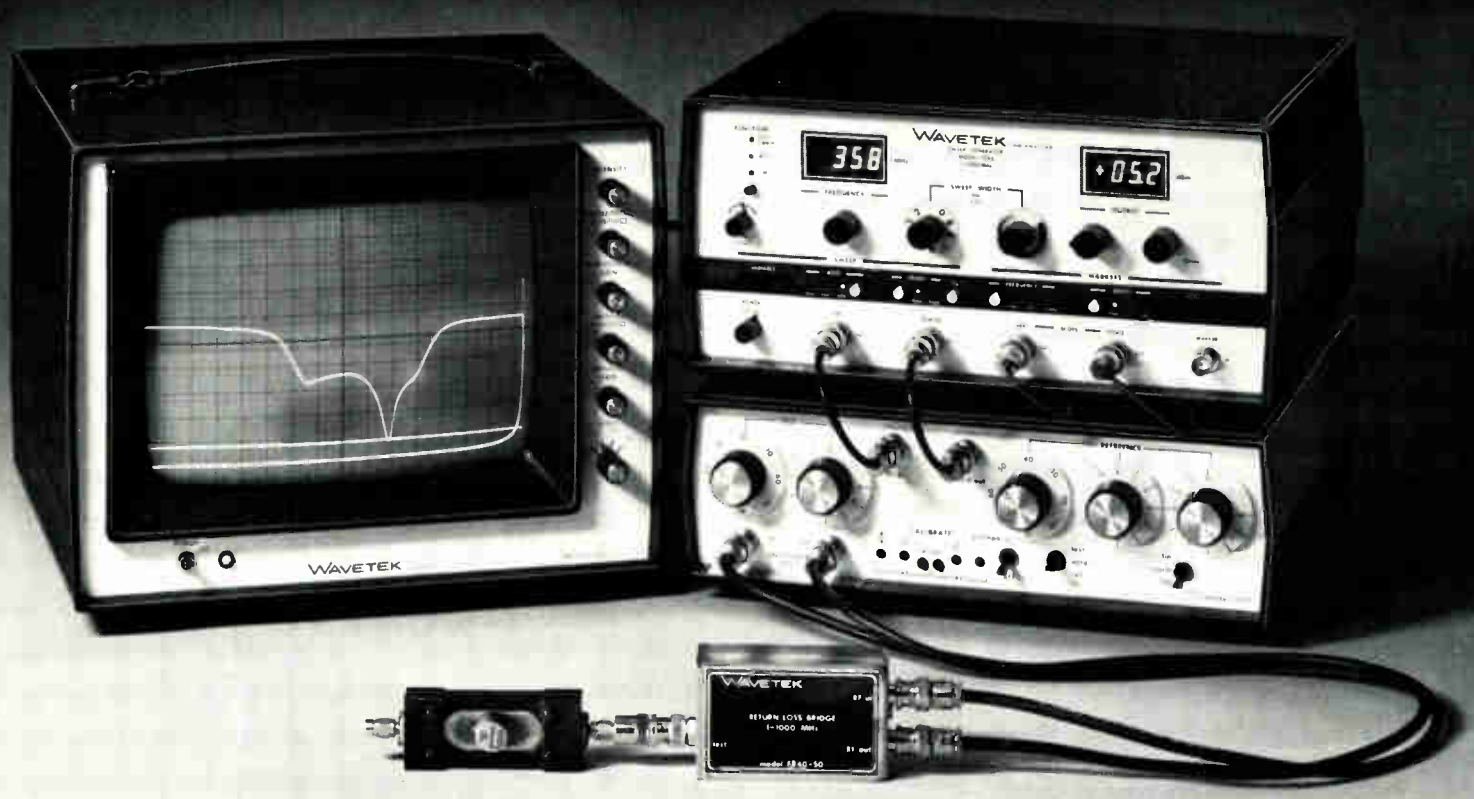

*continued from page 46*

the return system output.

Normally, the CATV distribution system is optimized based on lowest initial cost. Lowest initial cost is realized when the number of active devices is minimized. This requires, in some CATV architectures, that a less than unity gain system must be planned (see Figure #2 as an example). You will note that the overall system as measured from amplifier #7 to the return system output has a -5dB gain; or stated differently, a 5 dB net loss.

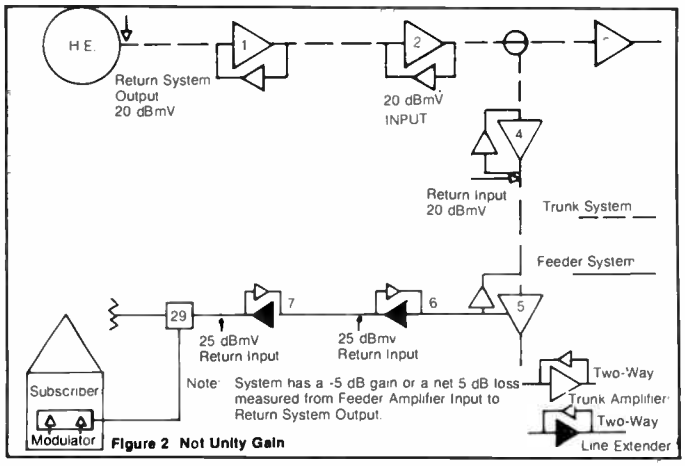


**Figure 2 Not Unity Gain**

The typical system architecture applied in the United States is the forward tree structure, and the return system can be thought of as a funnel architecture. The system is segmented into two systems:

1. The trunk system.
2. The feeder system.

Some system designs set-up the feeder system as having unity gain, and the trunk system as having unity gain, but the combination of the feeder and trunk system might have a net negative gain, or loss. This is as illustrated in Figure 2.

When planning the CATV system, the available gains from the feeder amplifiers and the trunk amplifiers in the return path, must be considered. In some cases, the available gains are not sufficient to overcome CATV losses. The reason for this net loss is the optimization of the forward system design to use the minimum number of active devices. Amplifiers typically require periodic maintenance and a source of energy, both ongoing operational expenses. The minimization of these devices serves the purpose of reducing the initial expense of building the system and the ongoing expense of maintaining the system. Therefore, the return system is secondary during the design process. Where possible, without adding unreasonable expense, unity gain should be achieved.

**Return system considerations**

There are a few considerations that must be made during the planning of the CATV return system. These are listed below and will be addressed individually in the succeeding text:

1. System thermal noise (system noise figure).
2. System carrier-to-noise ratio.
3. Terminal or modulator output level.
4. Amplifier input level.
   a. Cable loss.
   b. Flat loss (taps, splitters, directional couplers).
5. Receiver noise tolerance.

**System thermal noise**

The system thermal noise can be quantified. This quantity is known as the system noise figure and is defined as the amount of

thermal noise added to the input noise by a system or amplifier. The equation is as follows:

**Formula #1**

NF = ON - IN -G
where:
NF = Noise figure.
ON = Output noise.
IN = Input noise.
G = Gain of system or amplifier.

In Figure 3, -59 dBmV is the input noise to an amplifier having 20 dB gain, resulting in a -20 dBmV output noise. Using Formula #1, the noise figure of the 20 dB gain amplifier is 10 dB.

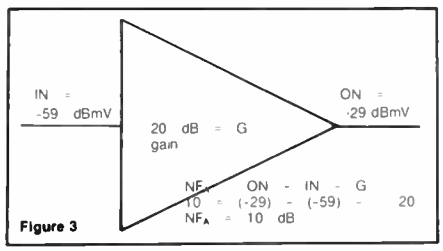


Figure 3

The amplifier noise figure is a specification that defines the thermal noise characteristics of the CATV amplifier, and is specified by the manufacturers. This number can be used to define the entire system noise figure. Referring to Figure 4, we will now apply the formula to determine the noise of the entire system. Figure 4 shows a hypothetical system consisting of 16 trunk amplifiers that are numbered from 1 to 16. The thermal noise output from the return system is measured at -36.96 dBmV. The noise input at amplifier #13 is equal to -59 dBmV. Additionally, the return system is capable of being set up with a unity gain (0 dB gain). Applying the input and output noise measurements and the system gain to the formula results in a 22.04 dB system noise figure.

The system noise figure can be calculated, if the individual amplifier noise figure is known, by the following formula:

**Formula #2**

$NF_S = NF_A + 10 \text{ Log } (N)$
where:
$NF_S$ = The system noise figure.
$NF_A$ = The noise figure of one (1) amplifier that is identical to every other amplifier in the system.
N = Total number of identical amplifiers.

Use Formula #2 to calculate the noise figure of the hypothetical system in Figure 4 as follows: Referring back to Figure 3, the hypothetical amplifier noise figure was calculated to be 10 dB.

**Noise funneling**

CATV distribution systems having the typical tree architectures with implemented return systems must deal with the factor of nose funneling. This is the summation of the noise that is generated by each active amplifier in the return system and accumulates at the common trunk output port at the headend. This is unlike the forward system noise that accumulates as a result of the number of amplifiers in cascade. In the forward system, there was only one path for noise to accumulate. This is from the first amplifier through each successive amplifier to the termination (see Figure 5). The noise of amplifier 1 adds to the noise of amplifiers 2 through 9. The noise from amplifiers 10 to 13 is added only to the noise generated by amplifiers 1 to 3. The noise generated in amplifiers 4 to 9 do not, in the forward system, contribute to the noise accumulated in amplifiers 10 to 13. Again, it is stated that noise in the forward system having a tree architecture, accumulates only as a result of sequential amplifiers in cascade. Therefore, the noise figure of the forward system is calculated as follows:

**Formula #3**

$NF_S = NF_A + 10 \text{ Log } (CSD)$
where:

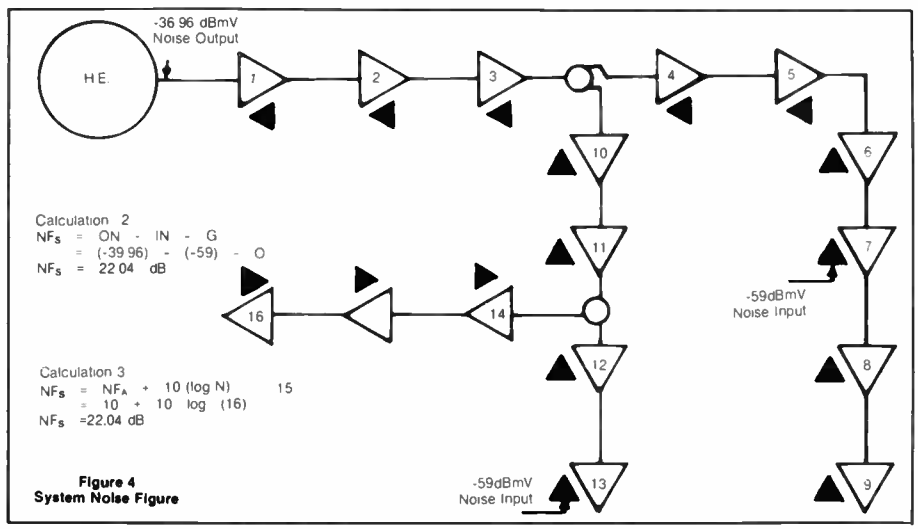


**Figure 4**
**System Noise Figure**

CSD = The number of amplifiers in cascade.

Assuming that the noise figure of an individual amplifier in Figure 5 is 10 dB, the system noise figure will be calculated as follows:

**Calculation 1**

$NF_S = NF_A + 10 \text{ Log (CSD)}$.
$= 10 + 10 \text{ Log } (9)$.
$= 10 + 9.54$.
$NF_S = 19.54$ dB.

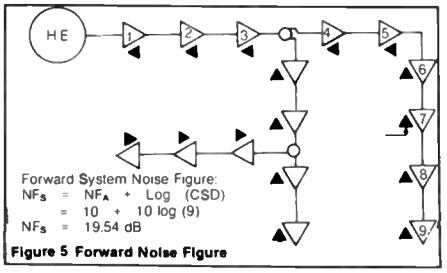

**Figure 5 Forward Noise Figure**

Unlike the forward system, the return system noise is accumulated at the common output port located at the headend from all amplifiers in the system (refer to Figure 6). Noise from branch #1 and noise from branch #2 accumulate at combining point #1. The accumulated noise at combining point #1 adds to the noise of amplifier 11 plus amplifier 10, which make up branch #3. At combining point #2, total accumulated noise from branchs 1, 2, and 3 accumulate with noise from the amplifiers in branch #4. This total accumulated noise adds to branch #5, and results in all amplifiers in the system contributing to the noise measured at the return output of the system. The calculation for noise figure in the return system is shown by Formula #2.

Some earlier CATV designs did not consider noise funneling problems. When the return path was implemented, it was found that the total noise accumulated back at the headend was excessively high and resulted in poor TV picture quality. There are some solutions to this problem and tools to apply the solutions. These will be discussed later in this article.

**Typical carrier ratio operational specifications**

| Type Receiver | Acceptable Carrier/Noise Ratio |
|---|---|
| 4 MHz TV receiver | 43 dB |
| 300 KHz FSK data receiver | 15 dB |
| Manufacturer — Model Type | |

**Carrier-to-thermal-noise ratio**

Another very important consideration in the design and implementation of a CATV

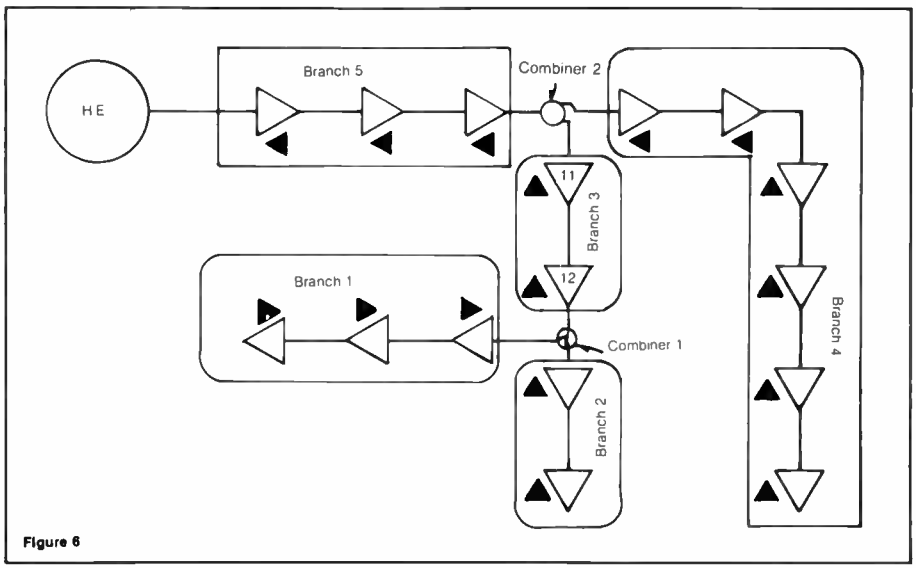


Figure 6

return system is the carrier-to-noise ratio. In the United States, the FCC defines a minimum carrier-to-noise ratio performance of a system, but the CATV franchiser and operator set a more demanding specification on the CATV system equipment supplier. This specification is based on the noise tolerance of the receiver designed for the signals being carried. The carrier-to-noise specified for a TV receiver would be different than the carrier-to-noise specified for a data receiver (modem, addressable interactive converter, interactive security terminals). If the noise figure of the system is known, it is very simple to calculate the system carrier-to-noise:

**Formula #4**

C/N = TN - IN + NF,

where:

C/N = The carrier-to-noise ratio.
T/N = The thermal noise level generated in a 75 ohm resistance at 68°F.
IN = The input level to the system at an amplifier.
NF = The noise figure of the amplifier or system.

It is important to note that the above calculation is a simplification and is more complicated in a system containing components with various gains and losses. The scope of this paper is to make the reader aware of the factors involved in return systems. The actual specific methodology in determining the proper operating levels and actual noise figures of the system are beyond the scope of this paper. Formula #4 is only accurate where the system has a unity gain.

The necessary input level to the system can be determined if the minimum carrier-to-noise of a receiver and noise figure of the system is known. The operational carrier-to-noise ratio specification of the receivers are available from their manufacturer for CN in Calculation 2. Using this specification, with some additional headroom added, the proper inputs to the system can be determined.

Rearranging formula #4 the input level to the system having video receivers requiring a 43 dB carrier-to-noise ratio, is:

**Calculation 2**

$IN = TN_{4\ MHz} - CN + NF.$
18 dBmV = - 59 - (-43) + 34.
Input level = 18 dBmV for 43 dB carrier-to-noise (video receiver).

It is interesting to note the difference between the system input levels for a video receiver and for a 100 KHz data receiver. Calculation 3 will illustrate the level required for a data receiver having a noise immunity equal to 30 dB carrier-to-noise ratio.

**Calculation 3**

$IN = TN_{100KHz} - C/N + NF.$
-11 = - 75 - (-30) + 34.
Input level = 11 dBmV for 30 dB carrier-to-noise ratio (100 KHz receiver).

It is significant to note that system input level requirements are lower for data applications. There is one other consideration that should be mentioned at this time. The -11 dBmV input level was based on thermal noise immunity and did not consider dynamic range on receiver input levels. CATV systems must deal with other types of noise, such as other ambient radio frequency signals or industrial noise. This problem can be summarized as general electro-magnetic interference (EMI), more commonly

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referred to as ingress. The CATV system operator would want to operate the inputs into his return system at the highest possible level in order to minimize the degree of interference caused by ingress.

There are two reasons that can be noted in Calculation 3 for the reduction in the input levels necessary for the data signal. One reason is the better noise tolerance of the data signals. In the example, the data signals had 13 dB better noise tolerance. The other reason is a narrower power bandwidth. The data receiver bandwidth in this example is 100 KHz (-75 dBmV thermal noise level compared to -59 for dBmV 4 MHz bandwidth). The RMS noise voltage for the input of a receiver having a characteristic impedence of 75 ohms is dependent on the bandwidth. The narrower the bandwidth, the lower the RMS power. The RMS voltage can be calculated by Formula #5.

**Formula #5**

$e_N$ = 4 x R x B x K,

where:

$e_N$= RMS Thermal Noise Voltage.
R= Resistance in ohms.
B= Bandwidth in MHz.
K= Constant @ 40 x $10^{16}$ @ 68°F.

Refer to Calculations 4 and 5 that show the difference between a 4 MHz video bandwidth and 100 KHz data bandwidth.

**Calculation 4 (Refer to Figure 7)**

$e_N$ = 4 x R x B x K.
= 4 x 75 x 4 MHz x 40 x 10 -16.
$E_N$= 2.2 x 10 -6.

Expressed in dBmV:

20 log

$$\frac{1.1 \times 10 - 6}{1 \times 10 - 3}$$

= - 59.17 dBmV.

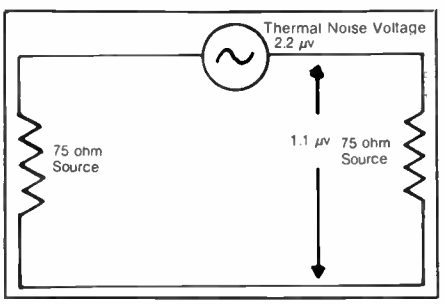



**Figure 7 Thermal Noise**

**Calculation 5**

$E_N$ = 4 x R x B x K.
= 4 x 75 x .1 MHz x K.
= .346 x 10 -6.

Expressed in dBmV:

20 log

$$\frac{.173 \times 10 - 6}{1 \times 10 - 3}$$

= - 75.23 dBmV.

**Data terminal and video modulator output levels**

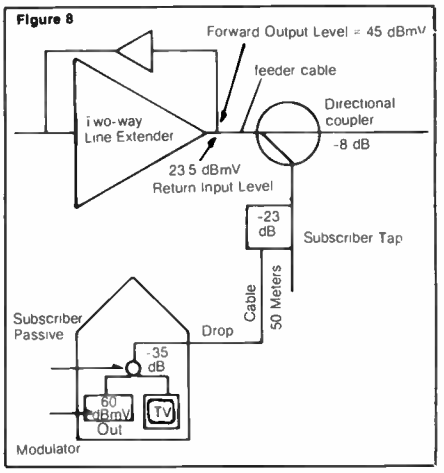
As demonstrated in the previous text, the system input level from a data modem can be relatively low to meet carrier-to-thermal-noise requirements for data receivers when compared to the carrier-to-thermal-noise of a video receiver. The system designer, however, must be able to achieve the required system input levels in order to meet the necessary carrier-to-noise ratios. In some instances it may be difficult to achieve the video signal input levels. Refer to Figure 8, which illustrates the factors involved in determining the achievable system input level. For the purpose of discussion, the system input level is defined as the level input to any return amplifier port in the system.

Figure 8 shows a diagram of a typical case that could exist in a feeder design. It shows a line extender amplifier having an output level of 45 dBmV in the forward direction. Directly at the output of the amplifier is a directional coupler, which routes the signal in two different directions. Directly at the output of the tap leg of the directional coupler, a subscriber tap is installed. The subscriber tap connects to the home terminals via a 50-meter drop cable. The drop is split two ways: One of the outputs connects to a TV set; the other output connects to a return modulator. In consideration of all the components just described, the maximum return system input level shown by the example in Figure 9 is 23.5 dBmV.

In a unity gain system, this input level would be the maximum input level achievable for a return system. This level could be used to apply to Formula #4 for the carrier-to-noise calculation for a video receiver. The same procedure for calculating carrier-to-noise of a data signal can be applied by substituting the data modulator output level in the first line of Figure 9.

Table 1 shows the maximum input level to the return system for various architectures, which might be typical of a CATV distribution system. Part A of Table 1 shows return system input levels in the last column for the architecture shown in Figure 8. The table varies the directional coupler loss and the tap loss, showing the resulting return system input level change. In Table 1, part B, the output level of the amplifier is increased by 3 dB to 48 dBmV. Then the same combinations of directional couplers are applied to determine

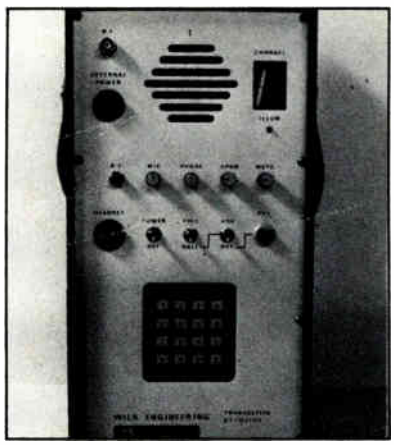
**Figure 8**




**Factors**

1. Operational Modulator Output Level
2. Operational Subscriber Passive Loss
3. Operational Drop Cable Loss
4. Operational Tap Loss
5. Operational Directional Coupler Loss
6. Operational Feeder Cable Loss (Including In-Line Passives)
7. Maximum Return System Input Level

+ 60 dBmV (Video)
- 3.5 dB
- 2 dB
- 23 dB
- 8 dB
0 dB
+ 23.5 dBmV



Wilk's tranceiver is a portable, battery-operated unit that will function over a wide temperature range (+50 degrees C to -20 degrees C). By connecting the unit with one coaxial cable to a test point or tap, the user can communicate with similar portables anywhere on the cable system.





the system input level. Take note that in Table 1, part B, the lowest maximum input level to the system is 3 dB less than in Table 1, part A. The worst case input levels of Table 1, parts A and B, are enclosed in a box. Again, note that the modulator output levels shown by the leftmost column are indicated as video or data modulators. Another indication given by this table is the fact that the higher the forward levels, the lower the input levels to the return system. If the carrier-to-noise requirement of the headend receivers cannot be achieved with these input levels, it is obvious that certain modifications in either the system architecture or the modulator output level will be required. The system architecture could be modified by a limitation of the forward system design. The net effect of the design modification would be a short spacing of system amplifiers resulting in increasing the initial cost and operating expense. The system designer in these cases would limit the loss of all the factors shown in Figure 8 so that the necessary input level to the system can be achieved.

The system engineer charged with responsibility of setting up and maintaining the return system must specify separate output levels for both data and video modulators, when contracting for system design services. A separate video and data receiver carrier-to-noise expected from the system also must be specified. If this information is not provided, the designer will not be able to plan for the most critical factors.

**Noise funneling solutions**

As stated earlier under the heading of noise funneling, some CATV systems in operation today would have an accumulated thermal noise, which would interfere with good picture quality. Newer CATV system designs consider this problem by limiting the total number of amplifiers funneling back on a single trunk.

One way to deal with noise funneling is to apply return trunk and return bridger switching. This is a product that has been applied for several years. Magnavox CATV Systems incorporates an on/off switch, as well as a 6 dB switchable pad in both the trunk and feeder return signal paths. These switches and/or pads can be remotely controlled from the headend via a computer system. The trunk and bridger switches also can be controlled manually at each of the amplifier locations. Bridger switching is effective when there is a requirement for video type return. With the bridger switch, all the noise contributing amplifiers in the return feeder system can be turned off, except for those carrying active TV channels. A sub-split system having 5-30 MHz return will necessitate having only four (4) bridger switches on at one time. A hypothetical application has a total of 500 amplifiers in the feeder

**Table 1**

**Part A**

Note Forward tap selected to meet

| | | | |
|---|---|---|---|
| a) Minimum tap output level | @ | 440 MHz | 12 dBmV |
| | @ | 50 MHz | 6 dBmV |
| b) Minimum tap output level | @ | 50 MHz | 6 dBmV |
| c) Forward amplifier output level | @ | 440 MHz | 45 dBmV |
| d) Forward amplifier output level | @ | 50 MHz | 37 dBmV |

Refer to Figures 8 & 9

| Modulator Output (dBmV) | Tap (db) | Directional Coupler (dB) | Return Input |
|---|---|---|---|
| · 60 (Video) | 23 | 8 | ·23 5 |
| · 35 (Data) | 23 | 8 | · 5 5 |
| · 60 (Video) | 29 | 0 | ·25 5 |
| · 42 (Data) | 29 | 0 | · 7 5 |
| · 60 (Video) | 17 | 12 | ·25 5 |
| · 42 (Data) | 17 | 12 | 7 5 |
| · 60 (Video) | 14 | 16 | ·24 5 |
| · 42 (Data) | 14 | 16 | ·24 5 |

**Part B**

Note Forward tap loss selected to meet

| | | | |
|---|---|---|---|
| a) Minimum tap output level | @ | 440 MHz | 12 dBmV |
| b) Minimum tap output level | @ | 50 MHz | 6 dBmV |
| c) Forward amplifier output level | @ | 440 MHz | 48 dBmV |
| d) Forward amplifier output level | @ | 50 MHz | 40 dBmV |
| e) Sum of subscriber passive drop cable feeder span loss | | | 5 5 dB |

| Modulator Output (dBmV) | Tap (db) | Directional Coupler (dB) | Return Input |
|---|---|---|---|
| · 60 | 26 | 8 | ·20 5 |
| · 42 | 26 | 8 | · 2 5 |
| · 60 | 32 | 0 | ·22 5 |
| · 42 | 32 | 0 | · 4 5 |
| · 60 | 20 | 12 | ·22 5 |
| · 42 | 20 | 12 | · 4 5 |
| · 60 | 17 | 16 | ·21 5 |
| · 42 | 17 | 16 | · 3 5 |

systems, and leaving only four legs of that feeder system open, you can reduce the number of noise contributing amplifiers to, maybe, four noise contributing amplifiers. This would result in a reduction in the feeder system noise figure of approximately 21 dB. The 500 feeder amplifiers and the 4 feeder amplifiers were selected just to illustrate the drastic improvement in feeder noise figure and, in some systems, may be representative of a system design (architectures vary drastically from system to system).

Another solution to the noise funneling problem is a block segmented trunk (refer to Figure 10 for a block diagram). This is simply a transportation trunk that originates at noise combining points along the return trunk. At the combining points in a two-way distribution system, the return path is extracted and block converted up to an unused frequency band in a separate transportation trunk cable. Referring to the block diagram, it shows that funneling of a system containing 900 return amplifiers can be limited to a maximum noise funneling of 300 amplifiers. This would result in a tolerable video carrier-to-noise ratio.

### Locked-on home terminals

Another problem that needs to be dealt with during return system operation is the potential failure of data terminals that

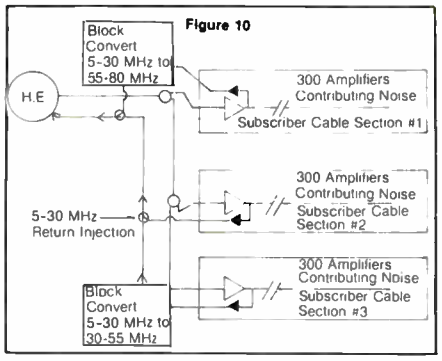


Figure 10

normally are polled for a response. These are the terminals that are applied for two-way addressable converters and home security systems. These terminals have an individual address and are interrogated by a central computer in the headend. When these terminals are addressed, they respond by turning on a transmitter modulated with a digital response. One failure mode of these terminals is a locked-on carrier. When this happens, all responses from other terminals being interrogated are interfered with and the entire security system or addressable converter system will fail. Manual trouble-shooting to locate this locked-on terminal is very time consuming.

The solution to this problem is to apply trunk and bridger switching and trunk and bridger 6 dB pad switching. With a system such as Magnavox's Digital System Sentry, the locked-on terminal can be located by remotely switching bridgers off until the interfering signal is located. Then, all switches in the system can be turned on so that the pole responses can flow back to the headend. One switch where the faulty terminal signal was entering the system should be left off. This procedure provides two benefits:

1. It locates the feeders where the interfering signal originated, so that service personnel can be routed directly to the fault area without hours of manual trouble-shooting.
2. It isolates the interfering signal from the rest of the system so that the other terminals can respond to the headend.

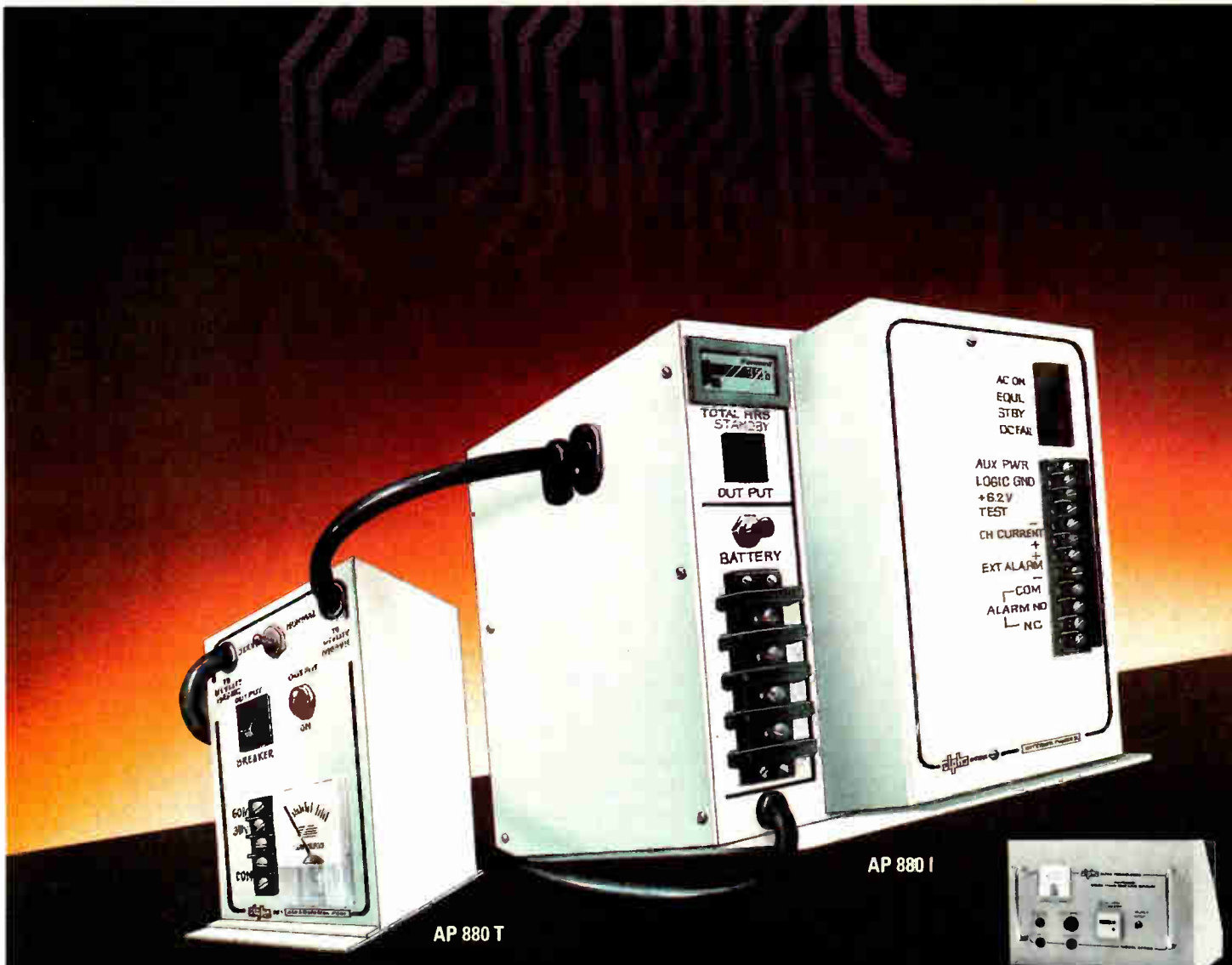
All of this can take place in a matter of minutes as opposed to a matter of hours when manual methods are used.

**Electro-magnetic interference (EMI)**

Electro-magnetic interference is caused by ambient RF signals for broadband noise created by industrial machinery leaking into the return path of a CATV system. If the CATV system is constructed and maintained in the proper manner, leakage into the cable system (ingress) is of minimal consequence. From time to time, over changing environmental conditions, the cable system tends to become less EMI immune. Tools are necessary to detect, locate and repair EMI leaks in an expeditious manner.

The subscriber output port from the cable TV system is another possible entry point for EMI. A subscriber may disconnect a cable from his TV set, thus leaving an unterminated cable and a source of EMI entry. Other sources are unterminated subscriber tap ports. It is mandatory in a two-way operational system to terminate all unused tap ports. The problems with unterminated subscriber drop cables can be minimized by installing highpass filters where two-way services are not required to the home. Magnavox CATV Systems provides a filter for this purpose. The cable TV drop must be of high quality, usually quad shield is used for maximum immunity. Feeder systems that applied low quality drop cables will have to invest in a higher quality cable.

Since EMI requires a continuous ability to efficiently locate ingress and repair the leak, a tool such as status monitoring and trunk and bridger switching is necessary. Using a switchable 6 dB pad in the return system located at the trunk and bridger input facilitates location of the ingress. The 6 dB pads can be used to locate a source of ingress without disrupting normal signal flow in the return system.

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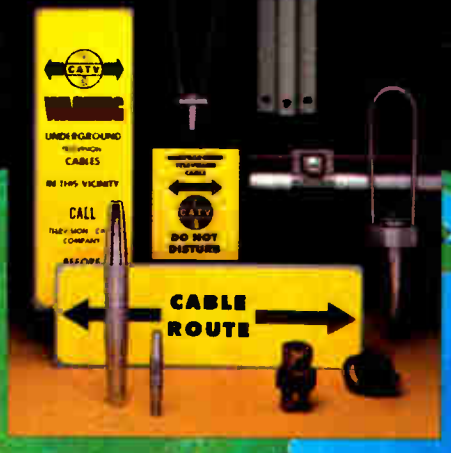


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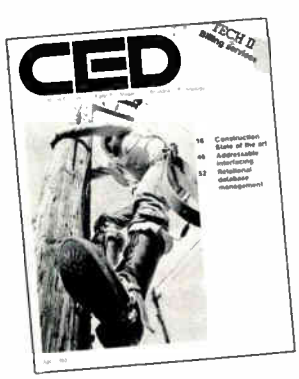


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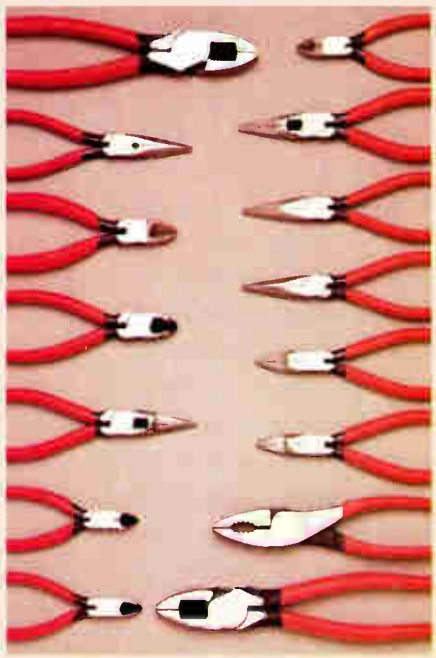

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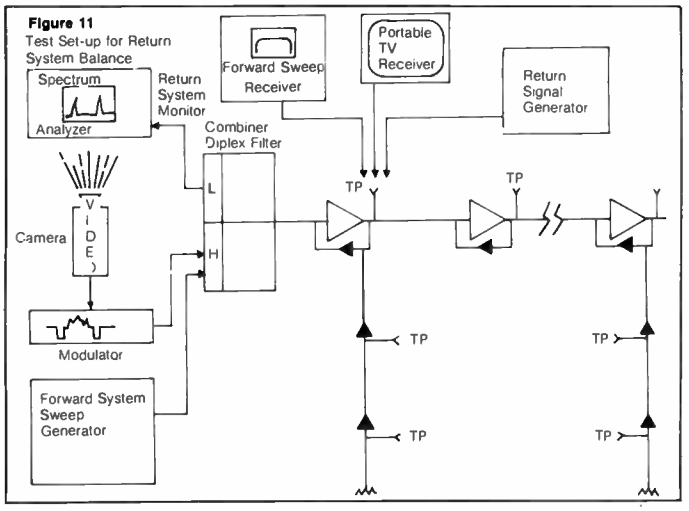



**Figure 11**
Test Set-up for Return System Balance

**Balancing the return system**

Early in the implementation of two-way systems, the balancing of a forward and return system was completed as two separate steps. The forward system would be balanced first and become operational; then the return system would be implemented as a separate procedure. The return system set-up requires two technicians, two sets of test equipment, two-way radios for communication and two sets of transportation. As operators gained experience, procedures and equipment were developed so that both the forward and return systems could be implemented and balanced at the same time using only one field technician. Figure 11 shows the test equipment necessary for the single-man set-up of a return system.

A system should be set-up in an outgoing manner starting with the amplifier closest to the headend and proceeding outward until terminations. The objective is to set-up a unity gain return system. Before proceeding with return sytem set-up, a reference level would be established on the spectrum analyzer at the headend. The test signal generator should be input to the combiner/diplex filter through a 30 dB attenuator. Once the spectrum analyzer reference level is achieved, the controls on the signal generator must not be changed. The technician should then proceed to the first amplifier, remove the 30 dB padding from the signal generator and insert the signal output into the 30 dB test point at the input of the return amplifier. The gain and slope of the return amplifier should be adjusted so that the signal levels received at the headend match the reference established on a spectrum analyzer. The spectrum analyzer is viewed on the portable TV receiver, which is to be connected to an unused port on the chassis or connected to the input test point of the amplifier. The technician should then proceed to the first line extender off of the first trunk amplifier balanced, and in the same manner, continue until all amplifiers in the system are sequentially balanced. This set-up procedure is a very cursory explanation of the method used.

Test equipment manufacturers are presently developing specialized sweep systems which will enable the reduction of the components shown in figure 12. This specialized test equipment will enable the sweeping of both the forward and return systems simultaneously and display the response at the technicians' remote location. CED

*Jay Staiger is product manager for Magnavox CATV Systems Inc., a division of North American Philips Corp., and is responsible for new product planning and sales proposals for all distribution products. Staiger joined Magnavox in 1979, with 10 years' experience in the cable television industry. He was educated at Penn. State University; holds a degree in electrical engineering; is a member of the SCTE; and, as a radio amateur, is a member of The American Radio Relay League.*



*continued from page 46*

stay with standard channel assignments, if at all possible.

**The objective**

Our initial goal was to develop a technology that improves distortion and noise performance within the confines of the existing amplifier packages and to maintain the standard size of the hybrid amplifier. The paramount criterion is that it be cost-effective.

After months of carefully documented research, Magnavox CATV Systems, together with its sister company, North American Philips, developed a significant technological breakthrough that met the objective. This breakthrough is called Power Doubling™.

This alternative technology is uniquely cost-effective because of its ability to do one or more of the following:

1. Eliminate multiple hub requirements.
   a. No duplicate headend processors.
   b. No duplicate tower antennas.
   c. Reduced microwave interconnect expense reduced.
2. Eliminate HRC requirements.
3. Perform in place of feedforward techniques.
4. Reduce the number of amplifiers of the CATV distribution system bill-of-materials.
5. Reduce bandwidth expansion costs in existing plant.

Depending on franchise requirement specifications, power doubling can be used to achieve one or more of the listed savings and achieve system topology when a high performance amplifier is applied.

The heart of the power doubling system is the postamplifier with improved distortion parameters. The system utilizes precise impedance matching, optimized frequency response flatness and superior thermal design that permits a much higher output from the single hybrid package. Combined, all these factors provide a minimum 6 dB improvement in composite triple beat and cross mod specifications when compared to a conventional hybrid system.

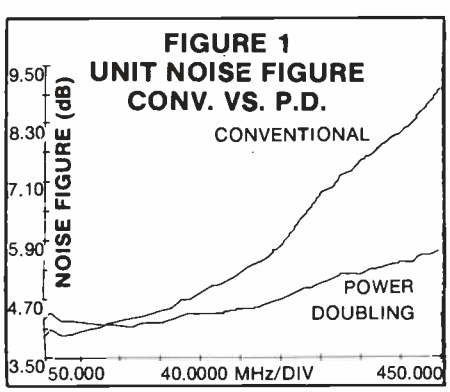
To achieve excellent noise performance, a low noise preamplifier has been introduced to the system. This preamplifier allows the Magnavox power doubling product to have at least a 2 dB better noise figure than that available with other hybrids.

The two components that comprise the power doubling system, the low noise preamplifier and the power doubler postamplifier, are configured so that the system can be packaged for use with Magnavox's present product line. This makes it extremely cost-effective and provides the operator with equipment for an advanced system architecture at an affordable price.

The previously stated improvements will be the minimum achievable. Some of the data accumulated indicate that, typically, greater improvements can be expected. The following text and illustrations will show greater than 3 dB improvement in noise figure and approximateiy 7.5 dB improvement in distortion.

**Test results**

Testing completed on the initial product proves the performance is as expected. Figure 1 is a graph of noise figure vs. frequency and is plotted from 50 MHz to 450 MHz. It indicates an improvement in the worst case noise figure at 450 MHz of 3.3 dB.



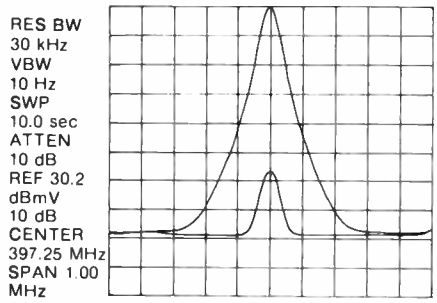



**Figure 2a**
**Unit C/CTB - conventional**

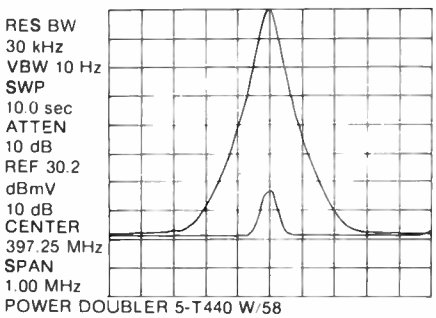



**Figure 2b**
**Unit C/CTB - power doubling**

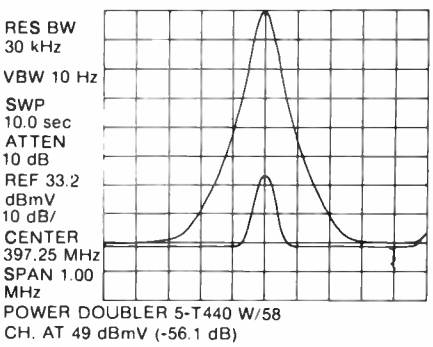



**Figure 2c**
**Unit C/CTB - power doubling**
**At 3 dB Higher Output**

Test results for composite triple beat also show the expected results. Comparing Figure 2a with Figure 2b shows a 7.5 dB improvement in composite triple beat. Figure 2a is the conventional hybrid and measures -55.6 dB carrier-to-composite triple beat ratio. This figure illustrates a spectrum analyzer display with a CW carrier superimposed over the composite triple beat distortion. Figure 2b is a display of the carrier-to-composite triple beat ratio of the power doubling amplifier and measures a 63.1 dB carrier-to-composite triple beat ratio. Take note that the CW carrier levels for both Figure 2a and 2b are equal, but the distortion is 7.5 dB lower in the power doubling case.

To confirm this measurement and also to prove that the third order performance is behaving as expected on a 2 dB of distortion for 1 dB of output level change, the output level of the power doubling amplifier has been increased by 3 dB and is shown in Figure 2c. Take note that the carrier-to-composite triple beat ratio measures -56.1 dB and is still .5 dB better than the conventional hybrid amplifier.

Summarizing the distortion test results, we can say that the amplifier has double the power output (a 3 dB increase is equal to twice the power) when compared to the conventional hybrid for approximately the same level of distortion.

## Compression point

For the purpose of this discussion, the compression point is defined as the output level of the CATV amplifier where the change in distortion (not composite triple beat distortion) deviates from a 2 dB in composite beat for 1 dB of output level change to a 3 dB of composite beat for 1 dB of output level change. Refer to Figure 3 for a comparison of the compression points for conventional power doubling and feedforward amplifiers. Figure 3a is the conventional hybrid and shows a compression point of 49 dBmV. Figure 3b shows a power doubling amplifier having a 52 dBmV compression point or a 3 dB improvement over the conventional hybrid compression point.

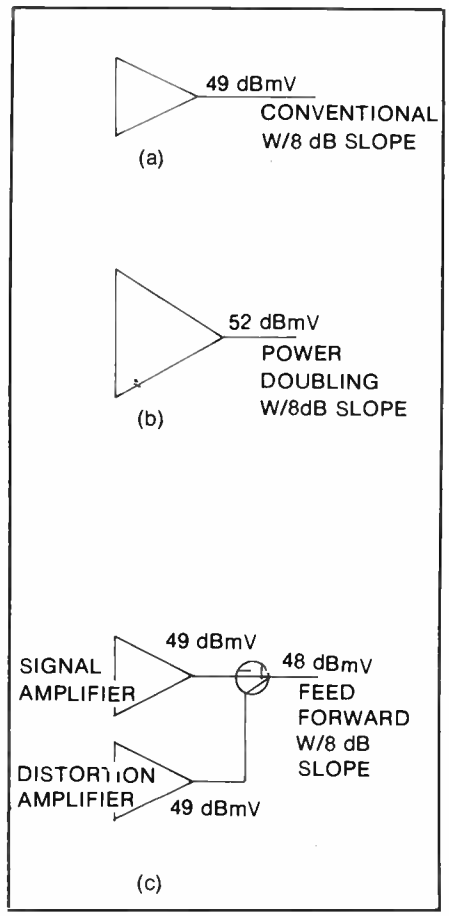



**Figure 3**

Comparing feedforward technology to power doubling technology, you will note that there is a 4 dB better compression point for the power doubler, the feedforward having 48 dBmV vs. 52 dBmV of power doubler. Also note that a standard conventional hybrid has a 1 dB better compression point. The reason for the lower compression point of the feedforward amplifier is the fact that the signal output from the hybrid I.C. amplifier must pass through the combiner where the distortion cancellation takes place. The output combiner, for this illustration, is assumed to have 1 dB of insertion loss and results in a 1 dB degradation in the compression point.

During the system design planning process, when the engineer calculates the amplifier operating levels and the resulting system performance, the compression point of the amplifier must be considered. For a standard CATV hybrid loaded to 450 MHz, the output level should not exceed 50 dBmV. Likewise, there are system designs utilizing feedforward technology that are limited to 49 dBmV maximum operational output level. The power doubling amplifier however, since it does have the improved compression point, can operate up to approximately 53 dBmV. In CATV systems with up to approximately 20 amplifiers in cascade, the power doubling bridger amplifier and line extender amplifiers will be able to operate at higher levels, thus reducing the number of amplifiers required when compared to feedforward technology.

## Longer cascades and extended trunk reach

As stated previously, the increase in dynamic range of the power doubling amplifier is 5 dB. That is the combination of the improvement in noise figure and the improvement in output levels.

Improved Dynamic Range =
Δ Noise Figure + Δ CTB/2
5 dB = Δ 2 + Δ 6/2

This 5 dB increase in dynamic range will yield the improvements in cascadability that are shown in Figure 4. Three columns are shown.

The first column indicates a conventional system at approximately 10 amplifier maximum cascade. The second column shows a power doubling amplifier at 26 dB gain and results in an approximately 20 amplifier maximum cascade. The third column depicts a power doubling amplifier at 22 dB gain and indicates an approximate 30 amplifier cascade. At the

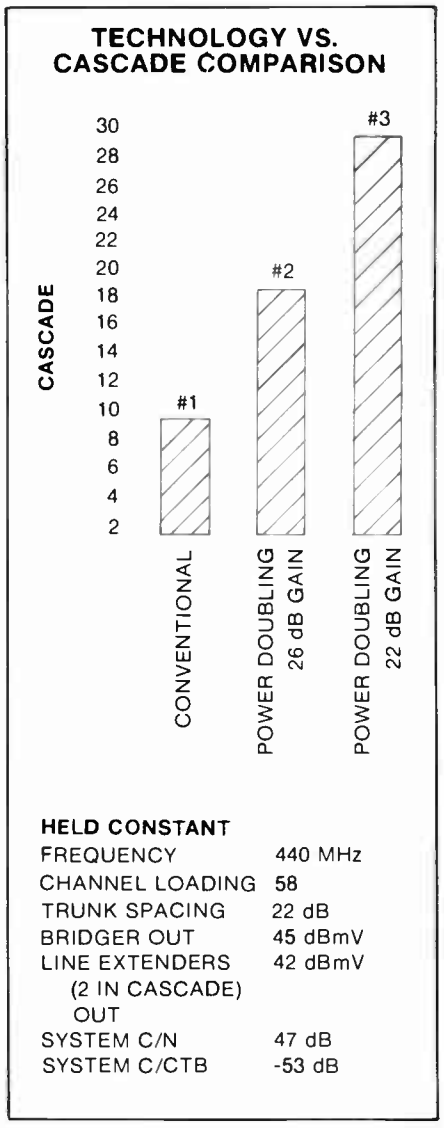



**Figure 4**
**Technology vs. cascade comparison**

end of each of these cascades, the resulting system performance, in terms of carrier-to-noise and carrier-to-composite triple beat, are identical. In other words, the power doubling column, at 22 dB gain, will meet a 47 dB carrier-to-noise and 53 dB carrier-to-composite triple beat at the end of 30 trunk amplifiers, plus one bridger and two line extenders in cascade. This is an improvement of three times the system reach as compared to conventional systems.

As a result of the improved cascadability with power doubling , the cable TV operator can take advantage by reducing the number of hubs necessary to build a given CATV system. Also, when critical specifications need to be met, power doubling can be used in lieu of feedforward technology. For example, if the specifications in Figure 4 were to be met at 29 amplifiers in cascade, a conventional system could not be used. Therefore, the choice would be either feed-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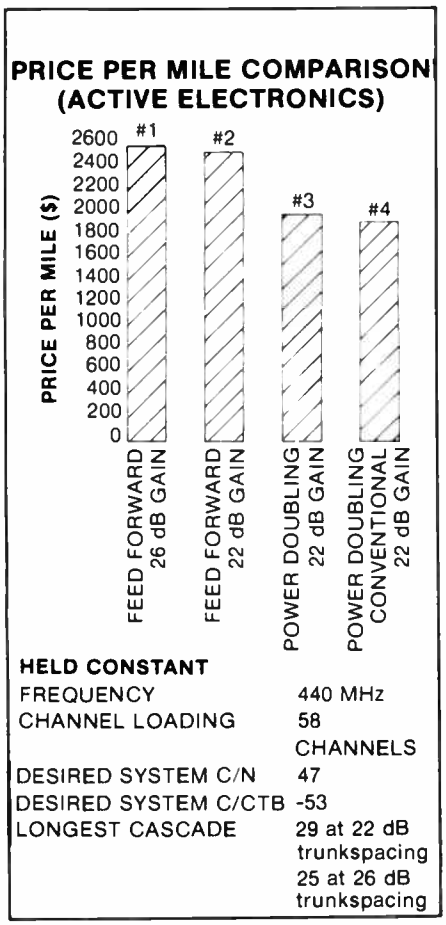


**Figure 5 Price per mile comparison (active electronics)**

forward or power doubling to meet these specs.

### Cost-effectiveness

In order to prove the cost-effectiveness in systems where conventional amplifiers could not fulfill the specification requirements, a series of study designs were performed. A sample area was selected, consisting of approximately 25 miles of CATV distribution system. The performance specs given in Figure 5 are held constant in each of the designs. The results of the study designs are plotted in Figure 5. Take note that the feedforward technology, shown by columns 1 and 2, priced out at approximately $2,500 per mile. Columns 3 and 4, which are the power doubling design, priced out at approximately $1,900 per mile or approximately $600 less than feedforward.

To define further, it was determined that this system required approximately 20 amplifiers in cascade at 22 dB trunk spacing. As shown in Figure 5, the conventional technology can only meet those specifications up to ten amplifiers in cascade. Therefore, the conclusion was that either feedforward or power doubling was required. Because the specifications could be met by both power doubling and feedforward, the decision was purely economical. Based on economics of the study designs, the choice would obviously be power doubling at $600 less per mile. Furthermore, this savings should be put into perspective. State-of-the-art CATV distribution systems now being proposed are usually, at minimum, a dual subscriber system. In a dual-cable subscriber system, this $600 per mile savings would have to be doubled for a total of $1,200 per mile in savings. If this were a 1,000-mile system, the total initial cost savings would be $1.2 million.

A cost savings can be illustrated in a different manner. For example, if the same system requiring a total of 30 amplifiers in cascade could be designed with conventional equipment and two hubs, the additional cost would result from the addition of one hub and all the associated equipment. If power doubling could be used to eliminate one of those hubs, the expense of an additional 58-channel headend, tower and antennas, earth station equipment, real estate, two-way microwave connection between hubs and the associated ongoing operating costs would be eliminated.

### Eliminating the harmonically related signal requirement

Harmonically related carrier (HRC) systems have been applied in expanded bandwidth systems to improve the subjective picture quality of the TV signals.

Some people believe that there are sufficient technical reasons why HRC headends should not be used. Other people believe that the problems created through the use of HRC are outweighed by the subjective improvements. In a situation where the technical disadvantages are perceived, the power doubling amplifier can be used to substitute for the HRC benefit. In either case, the HRC headend is somewhat more expensive than headends applying standard frequency assignments. In these situations, the power doubling concept can be used to save the additional cost for the HRC headend.

It is generally felt that an HRC improvement is approximately equivalent to 6 dB of carrier-to-composite triple beat. For example, if a system was designed for a 53 dB carrier-to-composite triple beat ratio with standard frequency assignments, that same system with HRC could be designed for a 47 dB carrier-to-composite triple beat ratio or a 6 dB reduction in the spec. This would yield the same picture quality for both the standard channel assignments and the HRC channel assignments.

Since the power doubling amplifier improves the distortion of a conventional amplifier by 6 dB, this improvement can be directly applied and compared to the 6 dB improvement of the HRC system. Therefore, a standard headend could be installed, along with power doubling amplifier systems, resulting in the same distribution system design architecture and bill-of-materials, but eliminating the need for harmonically related signals.

**Drop-in bandwidth expansion**

Another major benefit of a power doubling product is its ability to be applied for existing system bandwidth upgrades. Because of the significantly increased dynamic range of the product and because it will be available with operational gains up to 27 dB, a 270 MHz distribution system can be upgraded to 450 MHz with 60-channel loading. This can be accomplished by directly dropping in the power doubling modules at existing trunk amplifier locations. There is no need to move trunk amplifier locations. As indicated previously, one of the goals for this product was that it be housed identically to the existing Magnavox amplifier. This means that existing Magnavox systems need only substitute trunk modules and bridger modules. Housings, connector chassis and return modules can remain unchanged (if 270 MHz is to be expanded to 440 MHz, the model series 5-MC-2 chassis must be installed in the existing equipment).

With the conventional equipment, an upgrade from 270 to 450 MHz would require the complete redesign and respacing of the entire CATV distribution network. This would be more costly than the original initial build. The drop-in capability of power doubling provides a significant cost savings.

**Summary**

Power doubling provides a net 5 dB improvement in dynamic range. This is a result of a minimum of 2 dB better noise figure and 6 dB better distortion performance. Savings in CATV distribution systems design can be realized by reduction in actives, reduction in the number of hubs and elimination of the need for feedforward technology. Improved technical performance can be realized by eliminating the need for harmonically related carrier systems or by just applying the increased dynamic range for purposes of having sufficient head room on the subjective performance of the TV picture signal.

It should be noted that every CATV distribution system has its own unique features and design requirements. Magnavox's Systems Engineering Department can provide specific case analyses to determine benefits as they may apply.

**By Jay Stalger**

Communications Engineering Digest

# TECH II

CED's feature supplement and Product Profile

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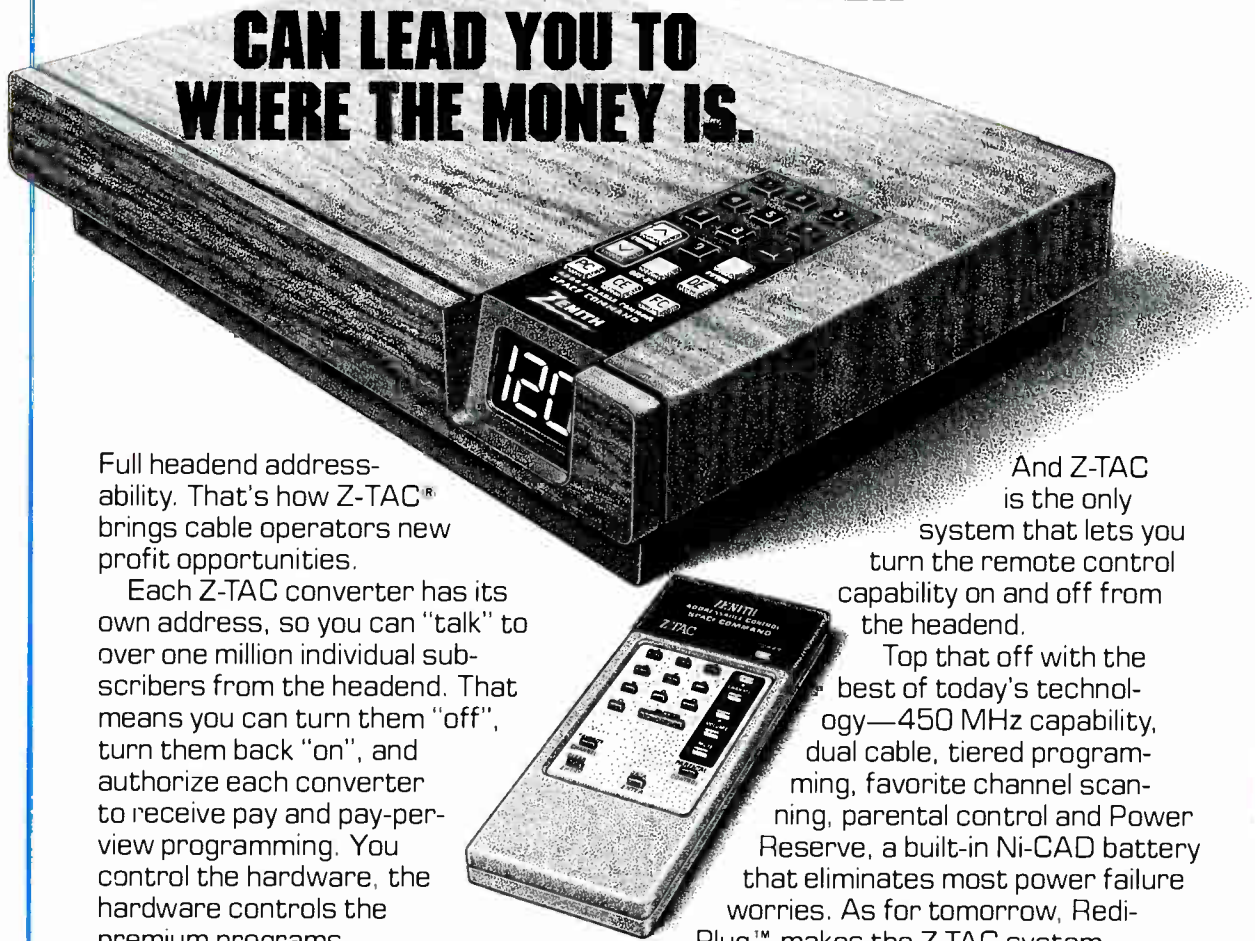


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## FROM THE LEADER IN BASEBAND TECHNOLOGY

# Text service topology growing more complex as user sites multiply

**By Gary Hoffman**
Sales Engineer
Texscan MSI

As ever more uses are found for alphanumeric delivery of information over cable channels, the operator's task of tying together remote character generator sites and the headend has become more complex. But, as difficult as the challenge sometimes seems, engineers have been resourceful in coming up with ways to get the job done.

The following set of questions reflects the sorts of problems confronting cable operators operating data channels in today's CATV environment:

- "Our new headend is on a mountain top feeding five hub sites. How can I control the character generator from the office and feed it valley-floor weather readings?"
- "How can we control the character generator at each of 15 cable systems from the MSO headquarters in another state?"
- "My franchise requires me to provide eight agencies with access to the character generator channels. How can I do this and retain control over these channels?"

This article will examine the various techniques employed to solve such problems and serves as basic background for operators new to data communications.

A character generator or CG is a handy device for displaying alphanumeric and graphic symbols or characters on a TV screen. In common use in cable systems, these are automated data display channels delivering news, weather readings, want ads, program listings and access information to cable subscribers on a cable channel.

Viewed in terms of a communications model, a CG is merely a black box for converting a data stream (newswires, keyboard input, weather sensors) to a video signal fit to be modulated to RF frequencies. (See Figure 1.) The remoting requirement occurs when the data stream is delivered at one place and the video is required at another—often miles apart.

The most common situation in cable television applications requiring remoting is where the headend and office are separate. The simplest solution is called the **video feed**, illustrated in Figure 2. The character generator is installed in the office, and its outout is fed via a coax cable or microwave return path to the headend. If the cable distance is short (under 1,000 feet), the signal can remain at baseband video. For longer distances, the video must be modulated at the office to an intermediate frequency or a VHF channel and amplified as required. If a dedicated reverse cable is used, the channel selected may be the actual cable channel dedicated to the character generator (this is also called a **remote modulator** situation). If a two-way cable is used, the IF or RF signal returning to the headend is usually in the sub-low band and must be processed at the headend to the proper cable channel.

### Keyboard remoting

This same problem also can be solved by transporting data instead of video to the headend, where both the character generator and modulator are located, (Figure 3). The simplest version of the **data feed** is called **keyboard remoting**. With the remote keyboard located at the office, its data output is transported to the headend over twisted pair or coaxial cable by means of a data modem. Since this data is a one-way stream, a simplex modem could be used; however, dup-

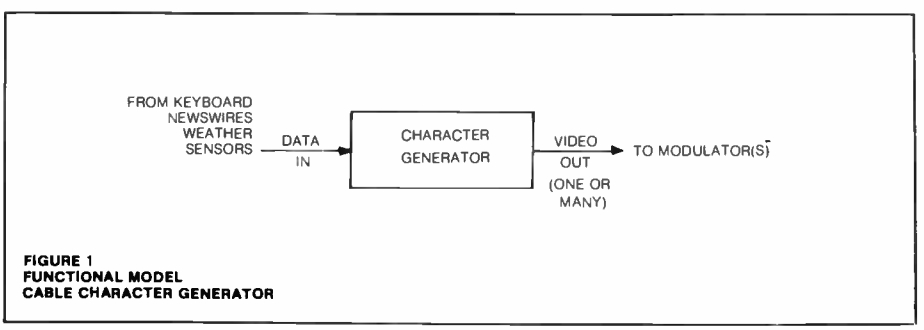



**FIGURE 1**
**FUNCTIONAL MODEL**
**CABLE CHARACTER GENERATOR**

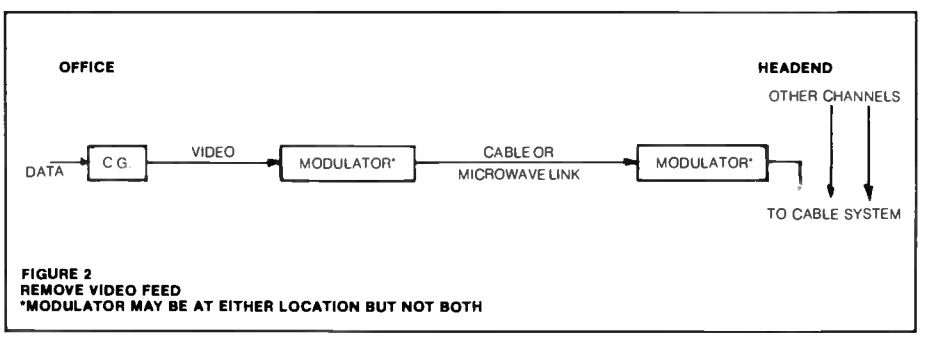
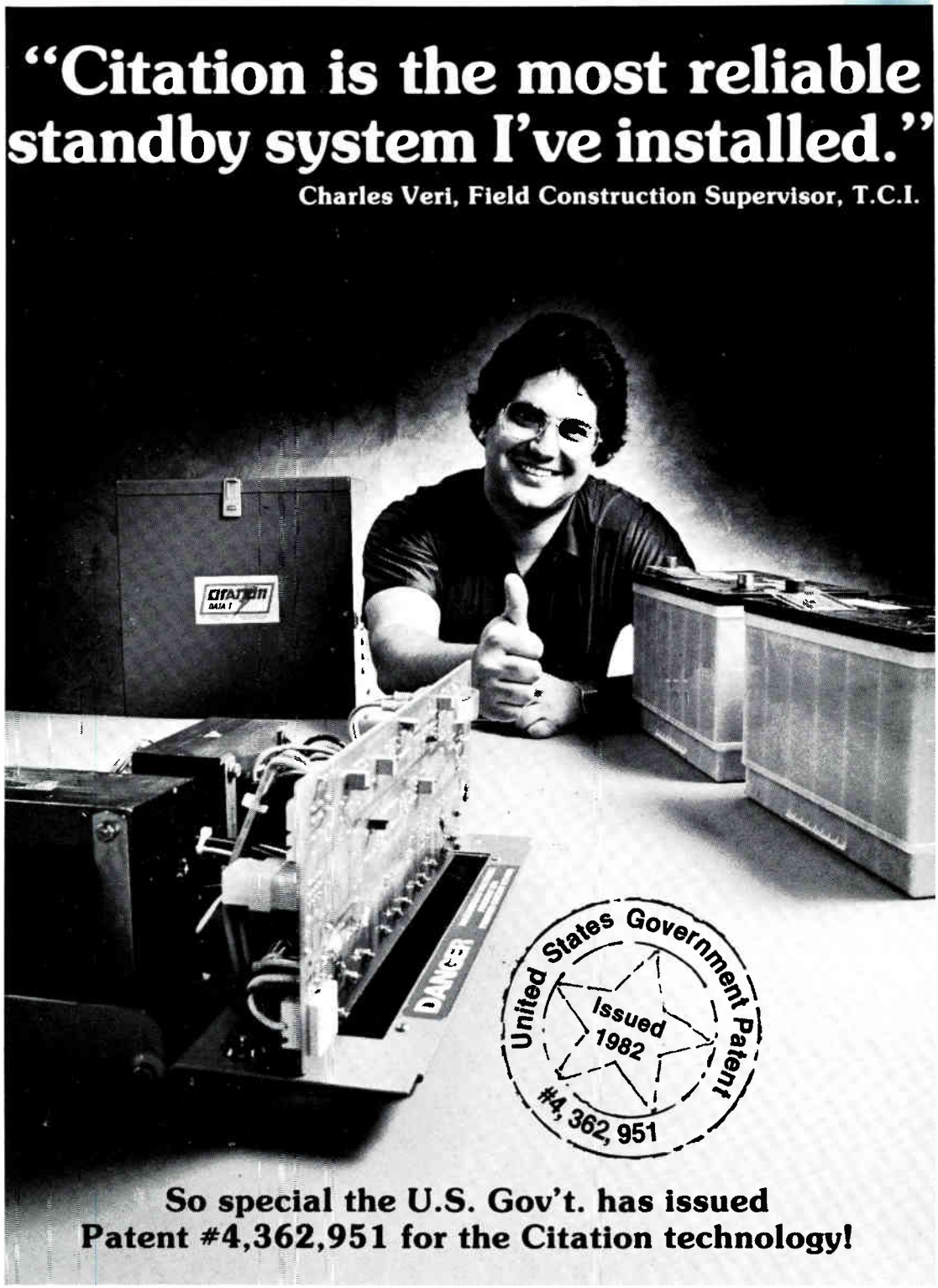



**FIGURE 2**
**REMOVE VIDEO FEED**
***MODULATOR MAY BE AT EITHER LOCATION BUT NOT BOTH**

# "Citation is the most reliable standby system I've installed."

**Charles Veri, Field Construction Supervisor, T.C.I.**




**So special the U.S. Gov't. has issued Patent #4,362,951 for the Citation technology!**

And Charles should know. He's installed hundreds of Citations in the last year and a half with no recalls or problems. The Citation has stood by him and now he's standing by it.

The Citation is neat—small, compact, easy to install and service. The hinged door unit smartly swings out for easy access. Battery life is extended with cycle charging (Patented).

Electronically regulated stand-by output maintains constant voltage. And automatic kick-in after line shorting saves trips up the pole! It's ready and steady! Citation. For peace of mind on your cable system.

## CITED FOR RELIABILITY

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**Control Technology, Inc.**

**Call Toll-Free 1-800-527-1263 1881 State St., Garland, TX 75042 In TX 214-272 5544**

lex modems are most commonly available. Telephone line modems are available for use in dial-up or dedicated (leased) line applications. Coax cable modems modulate an RF carrier or the vertical interval of a video signal. (Weather sensors with a stand-alone interpretation circuit also can be remoted like a keyboard. These systems output a data stream that can feed a modem for carriage to the character generator at the headend.)

To use the remote keyboard, the operator must have visual access to the cable channel carrying the character generator's edit channel. This is called "on-line" editing because keyboard entries are seen "on the air." Unless this channel is fed back to the office on a private channel, subscribers will be able to see all keyboard operations. (Some cable operators report this to be no drawback; subscribers call in to correct misspelled words and names.)

**Master edit approaches**

The **remote edit** or master edit configuration (Figure 4) solves this on-line editing problem. Here the remote keyboard is replaced by a simple character generator with its own keyboard. Keyboard entries are viewed on a local video monitor before the data is transmitted to the character generator at the headend. The displays of the on-air character generator remain undisturbed during the edit process. Most remote edit systems use the duplex feature of the data modems to provide full two-way interaction between the editing unit and display unit.

**Batch transfer** is a variation of remote edit using a more sophisticated character generator as the editing system (Figure 5). With batch transfer, pages and instruction menus are composed in the editing system (and perhaps stored or retrieved from disk to tape) and then transferred in a batch to the character generator at the headend. This way, the communications link is not used continuously during editing but rather only for short batch transmissions. With a batch transfer system, an operator can control headend character generators in distant states over long-distance telephone lines and keep the tolls to a minimum.

Another variation of the master edit configuration involves the **continuous transfer** or automatic transfer of data to one or several remote sites using dedicated telephone or coax cables. Here the master edit unit receives all external data inputs, continuously transferring them over a higher speed data link to all other character generators in the network. Pages from its own memories may also be added to the data stream at preset times. This method allows remote character generators at separate headends or hubs to display similar information, thus eliminating the need for inter-hub video channels for the data channels.

Another application related to this discussion arises when cable systems must allow **remote access** to their channels from government or other agencies (Figure 6). Giving city hall its own character generator won't work, because, first, the character generator may be too complex for non-technical city employees; second, the cable operator loses control of the channel; and third, the video signal must still be transported back to the headend. A more elegant solution is to place a simple computer terminal (complete with its own screen) at the access agency's location and let the operator "call in" to communicate with the character generator. Various security methods restrict each terminal's access only to its designated block of pages while retaining full system control for the cable operator. Access may be given to the text only on these pages or to the text plus the attributes of colors, character sizes and page times.

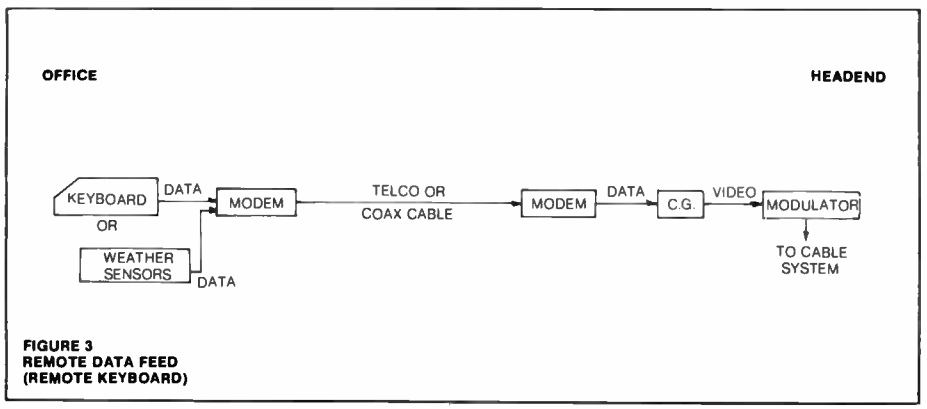


**FIGURE 3**
**REMOTE DATA FEED**
**(REMOTE KEYBOARD)**

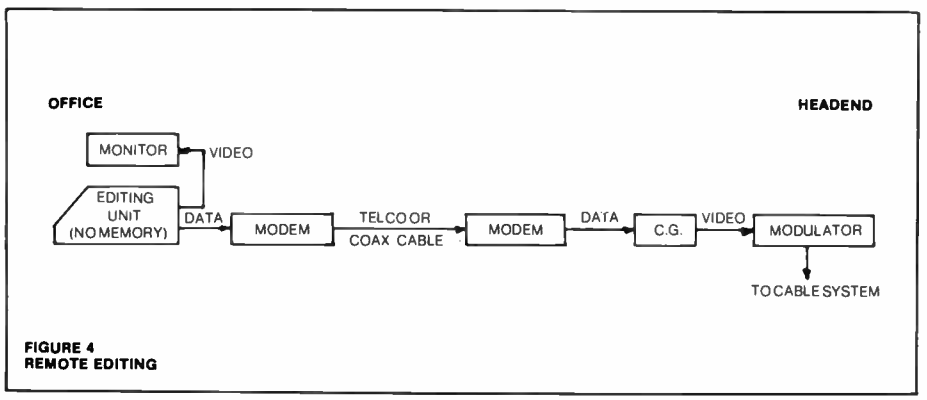


**FIGURE 4**
**REMOTE EDITING**

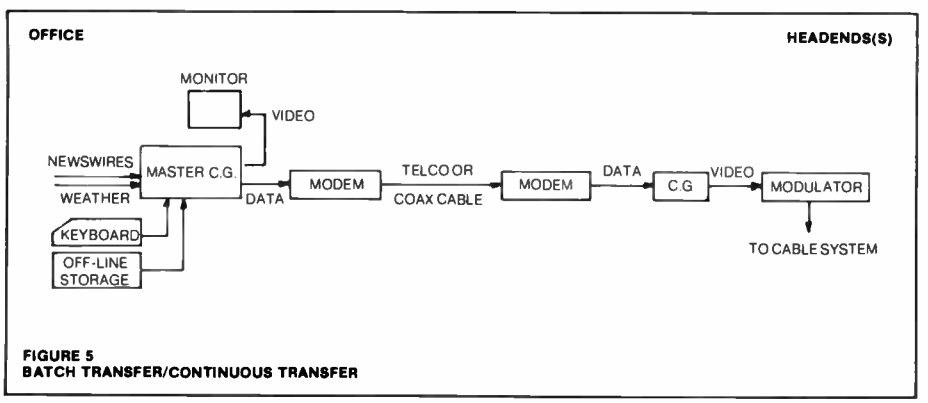


**FIGURE 5**
**BATCH TRANSFER/CONTINUOUS TRANSFER**

**New complexities**

The solutions to remoting problems outlined above become more complex when multiple origination sites or multiple headends are added to the equation. Most character generator manufacturers will solve these complex problems using variations of the solutions presented here. Because the communications link is so important, it deserves further discussion.

Telephone lines are most commonly used for carrying data between major components of a character generator system. The reason for this is that most data is at a slow baud rate, 300 to 1,200 baud, requiring only low-cost modems. Also, telephone lines are readily avail-

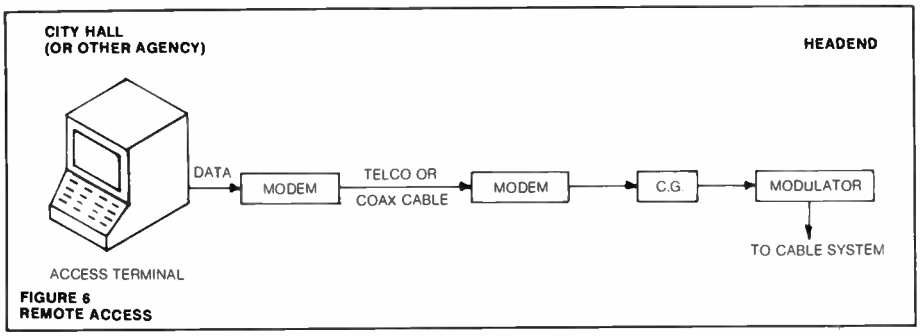


**FIGURE 6**
**REMOTE ACCESS**

able and reach to most locations in the world. And such slow speed lines are relatively inexpensive. Data modems for telephone lines cost between $50.00 and $1,500 but are coming down in price and size, and some character generator manufacturers even build them in as standard items into their equipment.

Using the dial-up telephone network also provides automatic selection among several data sources, such as keyboards or access terminals, which contend to send data to one destination. Like many suitors for the fair maiden's hand, only one will get the ring and the others will get a busy signal. Conversely, one master unit can access several headend sites one at a time, even at long distances, using the dial-up network, paying only for the time used on line.

For constant access from one point to another or to multiple points, the telephone company also leases dedicated lines for local or long distance service. Leased lines have commonly brought newswires and weather forecast services to headend character generators, but the high cost of dedicated telephone line service has caused the wire services to seek lower cost means of distribution. Recently, satellite-delivered news services have begun to replace the telephone line service.

Likewise, many cable operators are looking at ways to use their own cable network instead of the telephone network to provide the communications link among the elements of their character generator system. Costs of data modems for coaxial applications have been generally higher than those for telephone line service, on the order of $1,000 to $2,000 per site, but have begun to fall in recent months as more manufacturers have entered the field. In most cable applications, the data must usually move in the upstream direction, requiring two-way amplifiers or a dedicated trunk, at least for the data path.

Other alternatives available to the cable operator include the use of data channels on CARS band microwave or on a fiber optic trunk. Such data channels may be either RF subcarriers to the video carrier or data encoded in the vertical interval of the video signal itself. Presently, equipment for such a channel costs roughly $1,000 at both the transmitting and the receiving ends. We can expect these costs to come down as data signals become more common on cable systems.

The requirement to remote a character generator from the headend can be met with a number of solutions that involve a communications link between the remote site and the headend. The traditional telephone line link is being replaced by newer technology. Prices for both character generator equipment and supporting data link equipment can be expected to fall in the future. CED

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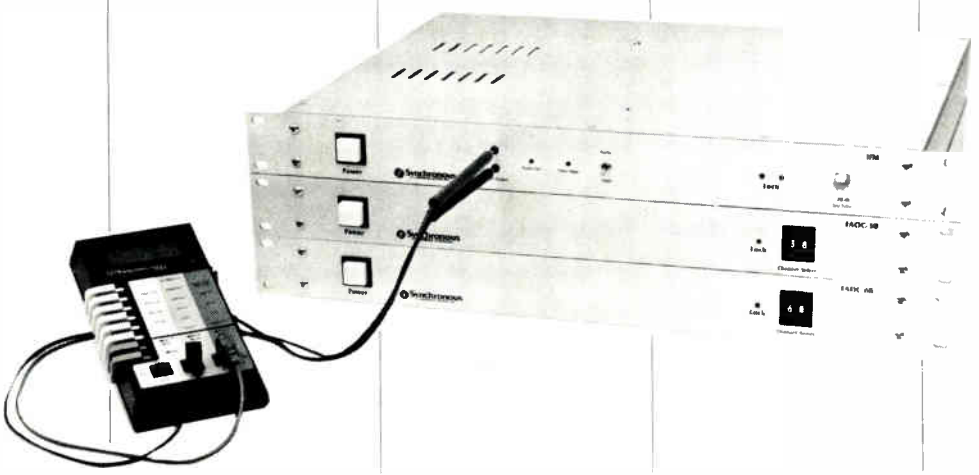

Our new IF modulator has 5 new design concepts that make our modulator the best.

**1** We developed two new ultra low noise voltage controlled oscillators and phase locked them to the same 6.000 MHz crystal reference oscillator. The results are, the audio carrier (41.25 MHz) and the video carrier (45.75 MHz) are very stable and the difference between them is 4.5 MHz ± 50 Hz.

**2** The audio carrier is phase modulated at 41.25 MHz resulting in a very linear audio modulator that can be deviated ±100 KHz at a 100 KHz rate. Of course, if you don't have a need for stereo audio right now, our audio modulator works real great at ±25 KHz deviation.

**3** Because we put our new modulator in our standard 1¾" chassis, we decided to let you use your own digital voltmeter to set the audio deviation and video modulation depth.

**4** We developed a new 38 channel Frequency Agile Up Converter that takes the IF output of our new modulator and converts it to any channel from 54 to 300 MHz.

**5** Our new modulator also works well with our other fine frequency agile output converters, including our FAOC-68 (54-450 MHz) FAOC-MIDSPLIT (5-200 MHz) and FAOC-60T (5-400 MHz).

Combine the FAOC-68 or FAOC-38 Frequency Agile Output Converter with our new IF modulator, and you can take baseband sound and video signals from Satellite Receivers, Video Tape Recorders, Demodulators, or other signal sources to any of the following assignments: Standard VHF, Midband, Superband, Hyperband, IRC channels, FM-1, FM-2, FM-3, A-1, and A-2. HRC channel assignments are available when you combine the IFM modulator with the FAOC-38/HRC Frequency Agile Output Converter.

## SPECIFICATIONS:

IFM TV IF MODULATOR

| | |
|---|---|
| Input Level | 1 volt p-p for 87% modulation |
| Diff. Gain | 5%, max. modulation at 87.5% |
| Diff. Phase | 1%, max. modulation at 87.5% |
| Harmonic Dist. | 1% max. with 25 KHz dev. at 1 KHz |
| FM Hum and Noise | <60 dB with 25 KHz dev. at 1 KHz |

FAOC-38 FREQUENCY AGILE OUTPUT CONVERTER

| | |
|---|---|
| Output Frequency Range | 54 to 300 MHz |
| Output Level | +65 dBmV max. |
| Input Frequency | TV IF |
| Input Level | +20 to +40 dBmV |
| Spurious Outputs | >60 dB below the video carrier |

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UPS address — ComSonics Lane at Port Republic Road

# The new generation of character generators: a study in cost-effective versatility

Alphanumeric programming, once an afterthought in cable system channel loading operations, has suddenly become an important part of CATV services.

Not only are there text channels devoted to finance, weather, national news and system programming guides, but the once lowly character generator has become a major programming tool for city government officials, local newspapers, institutions of all sorts and, perhaps most importantly, local cable operators inserting advertising and information in teletext and videotex services from national sources.

This month's *CED Product Profile* is devoted to the complex new world of character generators and the manufacturers who produce them. We wish to thank the American Newspaper Publishers Association and especially Kathleen Criner at the organization's Newspaper Center for providing us their compilation for character generator specs, much of which we used in putting together the Product Profile. It's a sign of the times that such an exhaustive listing of technical specifications would be considered worth the time of people at the ANPA.

**Beston Electronics Inc.**
15315 South 169 Highway
P.O. Box 937
Olathe, Kan. 66061
(913) 764-1900

In 1974, a joint venture between a private individual, Rod Herring, and a broadcast products manufacturer, Beston, was initiated specifically for the purpose of developing products that would bring character generator technology to all cable operators, including those operators with limited capital.

The company, Beston Electronics Inc., formed in the venture, introduced the Marquee 800, also known as the CG-800, in 1978. According to the company, this product uses Heathkit weather sensors as a cost-effective design. Technological advances, which occurred after the CG-800's introduction, were incorporated into the product to make it more reliable and less expensive.

One of the products on which the company is currently working is the Data Graphics™ character generator. Scheduled for release the fourth quarter of this year, Data Graphics is being designed to provide a resolution character display of 27 nanoseconds and to expand to a complete animation and graphics system.

**Chyron Corp.**
265 Spagnoli Road
Melville, N.Y. 11747
(516) 249-3296

Chyron Corp. manufactures electronics graphics equipment for the broadcast and video production industries. It markets its products to the international as well as domestic market. One of the company's first products to apply digital computer technology to titling and graphics generation was the Chyron IV®. Other products the company currently manufactures include: the RGU-2 compact and rugged graphics generator for studio and mobile applications; and the cassette cleaner and evaluator for inspecting, cleaning and re-packing videotape. In April 1982, at the NAB convention, the company also introduced the "Multimode Graphics Module," the

"Digifex" digital video effects generator, and the VP-1 high-resolution graphics unit

Being a relatively small company, Chyron prides itself on its sound financial standing and commitment to research and development. Last year, the company spent 9½ percent of its revenue on product development.

### Computer Video Systems Inc.

3678 West 2150 South
Salt Lake City, Utah 84120
(800) 453-8822

Conceived of as an electronic communications equipment manufacturer in 1979, Computer Video Systems Inc. has since narrowed its focus to the point where its primary business is the design, manufacture and marketing of the COMPUVID line of data display systems for cable TV and other related industries. As an ancillary service, the company also offers its electronic equipment design and manufacturing expertise to other companies in the communications field, who then carry the equipment under their own respective private labels.

The company attributes its ability to maintain a growing and well-recognized position in the electronics communications field to its commitment to research and development and to the success of its marketing and service organization, which operates throughout the U.S. and Canada.

Plans for the company's future include expansion of the COMPUVID product line, extension of its marketing efforts to new industries that could use the company's products and establishment of a marketing program in foreign countries.

### Metro Data

1190 Burnett Avenue
Suite F
Concord, Calif. 94520
(415) 827-9900

Metro Data was formed in 1970. In 1973, it applied for patents relating to the development of alpha numeric character generator technology. The company's "Instant Tele Digest" uses a computer to store, sort and organize information according to predetermined categories. This information is then displayed on channels one to 24. The company developed its first microprocessor based character generator to fill the void between single channel minimal page capacity systems and large, expensive systems. In 1980, Metro Data moved its base of operations to the San Francisco bay area. Since then, the company has developed computer-to-computer communications systems, microcomputer weather systems, security sensors and expander Ram equipment.

**The Microvision 7000**

### Mycro-Tek Products Division

820 West Second Street
Wichita, Kan. 67203
(316) 265-5277

Two former Boeing Aircraft Co. employees, Stan Brannan and Larry Runyan, founded Mycro-Tek in August 1974 with the intention of establishing a manufacturing company whose computerized end-product would incorporate the microprocessor technology first being introduced at that time. In order to pursue this objective, the company underwent three phases of development: consulting, OEM manufacturing and finally, manufacturing and marketing its own end-product.

Late in 1976, Mycro-Tek designed and programmed its Mycro-Comp online front-end system for the small- to medium-sized newspaper market. Not long thereafter, in 1978, the company entered the commercial printing and in-plant typesetting markets.

The company was acquired in February 1980 by Allied Corp. and, in 1980, was consolidated with another Allied subsidiary, Mergenthaler Linotype, a digital typesetting manufacturer.

### Quanta Corp.

2440 South Progress Drive
Salt Lake City, Utah 84119
(801) 974-0992

Quanta Corp., formerly known as Systems Concepts, first started developing microprocessor technology for character generation applications in 1974. Approximately five years later, the company introduced Nanolog™, a patented process, which the company claims was not only responsible for bringing the price of broadcast quality production titlers under $15,000 but also for delivering effective average 20 nanosecond resolution display. In 1981 and 1982, the company successively unveiled Quantavision™, a multichannel system designed for display of automated information and classified information on cable TV; Quantanews™, a computer-assisted newsroom that organizes housekeeping tasks while also providing storage retrieval and information management of incoming wire services; Q-8, a font load character generator for teleproduction use with true 26 nanosecond base resolution; and Microgen™, a relatively inexpensive character generator.

The company presently serves all major markets for graphic titling, as well as the international market, with accented fonts in 15 foreign languages. The decision to change its name from Systems Concepts to Quanta Corp. was prompted by the realization that the company would become more easily identified with its products, many of whose names begin with the prefix Quanta. Quanta Corp. sales and distribution offices are located throughout the world and a corporate European office is maintained in Amsterdam.

### 3M

3M Center
St. Paul, Minn. 55144
(612) 733-1110

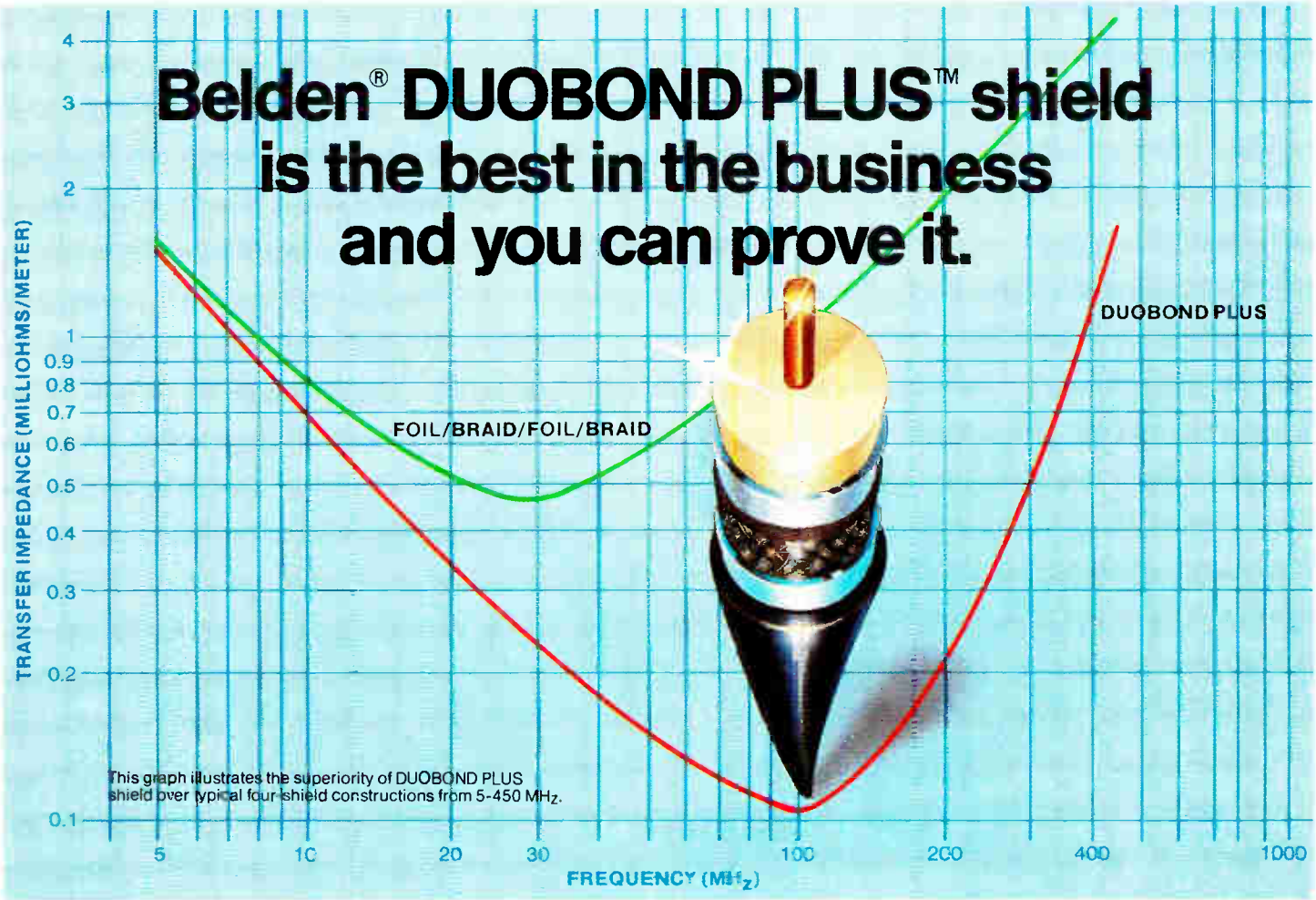
3M is composed of four business sectors: the industrial and consumer section, the electronics and information technologies sector, the graphics technology sector and the life sciences group. 3M's products for the cable TV industry extend into at least three of these groups. The company breaks down its cable products into the following subsets: construction and maintenance products, baseband video equipment, video and audio recording tapes, communications networks and advertising products and services. Within the baseband video equipment subset lies 3M's character generators and related equipment. The company's newest character generator is the D-8880 graphics system, which can be used for titling and graphics production and is designed around microprocessor technology.

A marketing program and business management group support the efforts

**3M D-8800 graphics system**

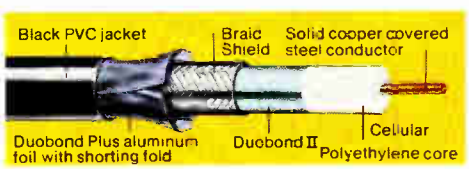
*continued on page 90*

# Belden® DUOBOND PLUS™ shield is the best in the business and you can prove it.




This graph illustrates the superiority of DUOBOND PLUS shield over typical four-shield constructions from 5-450 $MH_z$.

New DUOBOND PLUS drop cable shield can keep performance up and costs down in your CATV operations. Using a unique foil/braid/foil configuration, DUOBOND PLUS shield delivers greater shielding effectiveness than typical 4-shield constructions. It's also smaller in diameter, easier to terminate, lighter weight and more flexible.




**Greater shield effectiveness.**
As the transfer impedance data above shows, DUOBOND PLUS shield offers far superior shield performance to even the foil/braid/foil cables on the market today. The key to this effectiveness is the use of our unique shorting fold in our outer foil shield. This shorting fold along the longitudinal edge effectively reduces slot radiation normally experienced with traditional overlapping foils.

This protection from signal ingress and egress helps you meet the current FCC requirements limiting radiation from your CATV system. Try it in your toughest interference locations. You'll find that DUOBOND PLUS shield offers the kind of performance you—and your customers—demand from a CATV drop cable.

**Easy termination.**
Unlike foil/braid/foil/braid cable constructions, the DUOBOND PLUS cable shield does not require expensive oversized connectors. The cable is made to standard industry size to use any popular, commercially available connectors (RG 59, .242" O.D./ RG 6, .275" O.D.). Also, the inner foil of the DUOBOND PLUS shield is bonded right to the cable core. That means there's no chance for foil pushback and the signal leakage that frequently results from pushback.

DUOBOND PLUS shield features a unique shorting fold in the outer shield. This fold gives metal-to-metal contact for reduced slot radiation effect.

DUOBOND PLUS shield offers better shielding than this bulkier, more expensive foil/braid/foil/braid cable. The larger cable also requires special, non-standard connectors.

Cables with the DUOBOND PLUS shield are available in RG 59, RG 6 and RG 11 constructions—messengered, non-messengered and flooded versions. And all cables with DUOBOND PLUS shields are 100% sweep tested from 4 to 450 $MH_z$ with a minimum return loss of 23 db for RG 59 and 26 db for RG 6. Call Belden for assistance in selecting the cable that's best for you. You'll see that DUOBOND PLUS shield can keep profit and performance up—and costs down—in your CATV cable operations.

**Electronic Wire and Cable,** Attn: CATV Sales Dept., P.O. Box 1980, Richmond, Indiana 47374. Phone: 317-983-5200.

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**Belden,** Electronic Wire and Cable
P.O. Box 1980, Richmond, IN 47374. ATTN: CATV Sales Dept.

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☐ Have a salesman call. ☐ By phone. ☐ In person. ☐ Best time to call ☐ A.M. ☐ P.M.

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TITLE _____

COMPANY _____

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CITY _____ STATE _____ ZIP _____

PHONE _____

8-14-1D



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# Product Profile

| Co. Name Product | No. Serial Services Simultaneously | No. Background Character Colors | Matrix/ Nanosecond Display | Change Text Colors by: | No. Character Sizes/Fonts | Change Character Size by: | No. Characters Per Line |
|---|---|---|---|---|---|---|---|
| **Beston** | | | | | | | |
| **Marquee CG-800** | 2 | 4/1 | N/A | none | 1 | none | 32 |
| **Chyron** | | | | | | | |
| **RGU-2** | N/A | 64/64 | 27ns | character | unlimited | character | 1/62 |
| **Chyron IV** | N/A | 512/512 | 27ns | character | unlimited | character | 1/62 |
| **Computer Video Systems** | | | | | | | |
| **CDD-30** | 3 | 8/8 | 16x16; 70ns | line | 16 | line | 8/32 |
| **Metrodata** | | | | | | | |
| **110** | 4 | 16/8 | M15x15; 55ns | line | ULC only | line | 1/32 |
| **120** | 5 | 16/8 | M15x15; 55ns | line | ULC only | line | 1/32 |
| **Mycro-Tek** | | | | | | | |
| **Microvision 7000** | 4 | 12/12 | M64x40; 40ns | line | 2/6 | line, word and character | 1/32 |
| **Quanta** | | | | | | | |
| **Micro-Gen** | none | 10/10 | 30ns | word | 2 font widths | line | 24/32 |
| **Quanta 7A** | none | 8/8 | 20ns | line | 20 | line | 8/32 |
| **Teledac** | | | | | | | |
| **T-1300** | varies | 5/1 | 7x9 | line | 1, accents | none | 28 |
| **Telpar** | | | | | | | |
| **CTI-180** | none | 8/8 | 9x11 | character | 2 | character | 16/32 |
| **Texscan MSI** | | | | | | | |
| **Spectragen III** | 4 | 32/32 | M16x32; 70ns | line and word | 64 sizes; up to 8 fonts | line | 1/40 |
| **Spectragen II** | 6 | 32/32 | M16x20; 82ns | line and word | 8 sizes, 2 fonts | line | 1/32 |
| **Flexicaster II** | 6 | 32/32 | M16x20; 82ns | line and word | 8 sizes, 2 fonts | line | 1/32 |
| **3M** | | | | | | | |
| **D8800** | none | 8/8 | variable; 35ns | line, word or character | 6 | line, word or character | 1/99 |
| **Thomson/CSF** | | | | | | | |
| **Vidifont IVA** | 6-7 | 8/8 | N/A | character | varies | character | 59 |
| **Vidifont V** | none | 4096, 16 per display | N/A | character | unlimited (1/256 seamlines) | character | varies |
| **Video Data Systems** | | | | | | | |
| **GC832** | N/A | 3/2 | 10x14; 135ns | N/A | 1 | N/A | 8/20 |
| **MCG2500 Message Generator** | N/A | 8/2 | 16x20; 86ns | line | 6 | line | 16/32 |
| **Microsystem I MCP2000** | 6 | 8/2 | 16x20; 86ns | line | 4 | line | 16/32 |
| **Wilk Power & Video** | | | | | | | |
| **Wilk 330** | varies | 6/6 | M16x16 | line | 2 | line | 25 |
| **Wilk 3500** | varies | 8/2 | M16x16 | line | 2 | line | 31 |

| No. Lines Per Display Page, Min./Max. | No. Channels Controlled By Basic System | Resident Storage | Storage Expandable To: | Text Editing Interface | Backup Provisions | Graphics Available |
|---|---|---|---|---|---|---|
| 16 | 1 | 16 | 100 and up | none | battery back-up | none |
| 1/18 | 1 | 2 | N/A | none | none | font & logo (create) camera |
| 1/18 | 1 | 2 | N/A | none | none | font & logo, full screen graphics |
| 4/16 | 1 | 16 | 452 | none | built-in battery & charger | none |
| 1/13 | 1 | 16K, 39 pps | varies | serial | battery | 28 semigraphic characters |
| 1/13 | 1 | 32K, 78 pps | varies | serial | battery | 28 semigraphic characters |
| 8/16 | 1 | 120 | varies | 2-way error check, serial/auto format | battery | logo of PI font, 38 characters |
| 4/16 | 2 | 16 pps x 12 lines | 112K/200 pps | none | internal battery | limited |
| 4/16 | 1 | varies | 112K/200 pps | none | internal battery | limited |
| 16 | 1 per unit | 44 | 255 | RS 232 | standby power, memory protection device | limited |
| 8/16 | 1 | 16 | 64 | RS232, serial, direct/remote | battery | limited |
| 1/26 | 1 | 150 | none | serial | battery | 32 semigraphic characters |
| 1/21 | 1 | 116 | 812 | serial | battery | 32 semigraphic characters |
| 1/21 | 15 | 116 | 1740 and up | serial | battery | 32 semigraphic characters |
| font dependent | 4 | 350 | varies | none | all storage on disc | use digitizer to compose your own |
| 16 | 2 | 2,000 | 4,000 | none | none | freehand graphic tablet |
| varies | 1 | 100 | 600 | none | none | camera load, bill pad, geometric font |
| 8/20 | 1 | 8 | 16 | N/A | none | none |
| 8/14 | 1 | 32 | 32 | N/A | internal battery | semigraphic |
| 10/20 | 1 | 32 | 255 | N/A | storage on cassette | semigraphic |
| 8 | 1 | 62 | 128 | RS 232, serial | none | none |
| 10 | 1 or 2 | 60 | 128 | RS 232, serial | standby power | none |

# Mycro-Vision™ 7000 builds better video displays with more character.

**Video Display Information Systems from a world leader in technology**

Performance. Versatility. Reliability. Economy.

The *Mycro-Vision*™ 7000 display system has all these qualities. It's built by Mycro-Tek, a company with roots deep in the communications field. Through experience, we've developed the enviable expertise it takes to design better, more readable and more attractive fonts and to put them into a reliable character generator. And, it can be expanded as your business grows.

We're known, too, as a part of Allied Corporation, a company dedicated to technological advancement in new industries.

**Network-like displays draw viewers and subscribers**

Your viewers, of course, expect more quality and sophistication than ever when watching alpha-numeric programming. The *Mycro-Vision* 7000's high resolution, attractive fonts and special characters can help your localized programming stimulate interest and draw viewers. Features like real time sequencing provide limitless possibilities for program scheduling and unattended operation.

With its sharp resolution, beautiful palette of colors and array of enhancements, the *Mycro-Vision* 7000 has what you need to make your displays and classifieds as readable, interesting and attractive as your viewers expect them to be.

**A versatile system expands your business potential**

As you grow, you may choose to add the *Mycro-Comp*® 1100 Text Management and Class Ad System.


Together with *Mycro-Vision* 7000, it automates functions that can greatly enhance the productivity of an expanding operation:

- Offline editing
- Nonvolatile storage
- File management
- Telecommunications error checking
- Fast text editing using easily stored and recalled formats
- Classified ad billing and reporting
- Telecommunications from a host system to remote character generators

**The *Mycro-Vision* 7000 is ready to make you money...efficiently**

The revenue generating potentials of classified and display advertising in this industry are almost unlimited. But it's going to take efficiency to make them profitable. We're the first manufacturer to offer character generation plus total ad handling capabilities, all in one system. That's efficiency.

It's up to you to make your local programming as profitable as it can be. The *Mycro-Vision* 7000's high resolution and multiple font capability allow you to easily create professional, eye-catching advertising to mix with other programming. High viewer interest goes hand in hand with your profits!

Let the *Mycro-Vision* 7000 handle the details as you ensure your share of the growing local markets.

## Mycro-Tek

An ALLIED Company

See us at the NCTA Show.
Booth #1306.

**I want to know more about the *Mycro-Vision* 7000. Please call me.**

My operation is: Cable_____ LPTV_____ Broadcast_____ Other_____

Name_____ Phone_____

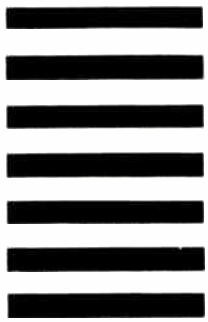
Company_____ Address_____

City_____ State_____ Zip_____

Mycro-Tek / P.O. Box 47068 / Wichita, Kansas 67201 / 800-835-2055 / In Kansas call 316-265-5277

6/CED

NO POSTAGE
NECESSARY
IF MAILED
IN THE
UNITED STATES



**BUSINESS REPLY CARD**
FIRST CLASS PERMIT NO. 4095 EASTCHESTER, NY

POSTAGE WILL BE PAID BY ADDRESSEE

G + Z Systems, Inc.
187 Main Street
Eastchester, NY 10707
Phone: (914) 961-1613

Call to know why you should own your own computer

G+Z Systems

The computer company
that knows *your* business

187 Main Street
Eastchester, NY 10707
(914) 961-1613

# CABLEFILE/83

*Order Today!*

**YES!**

☐ **Type of Business (Choose letter from left)**

I would like to reserve ___ copy(ies) of both volumes of CableFile/83 at the special offer price of $ 109 95 (including postage and handling) Enclose payment with your order and save $5 00 off the already low price, you pay only $ 104 95

Name _____
Title _____
Company _____
Street _____
City _____
State/Zip _____
Phone ( ) _____
Signature _____

Please charge my ☐Visa ☐Mastercard
Acct # _____
Exp date _____

**OR** ☐ Check enclosed ☐ Bill me

Date ordered _____

C6CD3

CABLEFILE/83

**Titsch Communications, Inc.**
**P.O. Box 5727 TA**
**Denver, Colorado 80217-9929**

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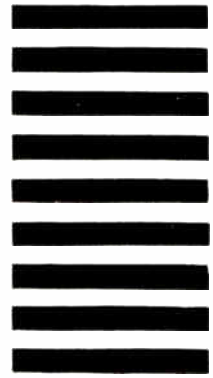
IF MAILED
IN THE
UNITED STATES



**BUSINESS REPLY CARD**
FIRST CLASS PERMIT NO. 422 DENVER, COLORADO

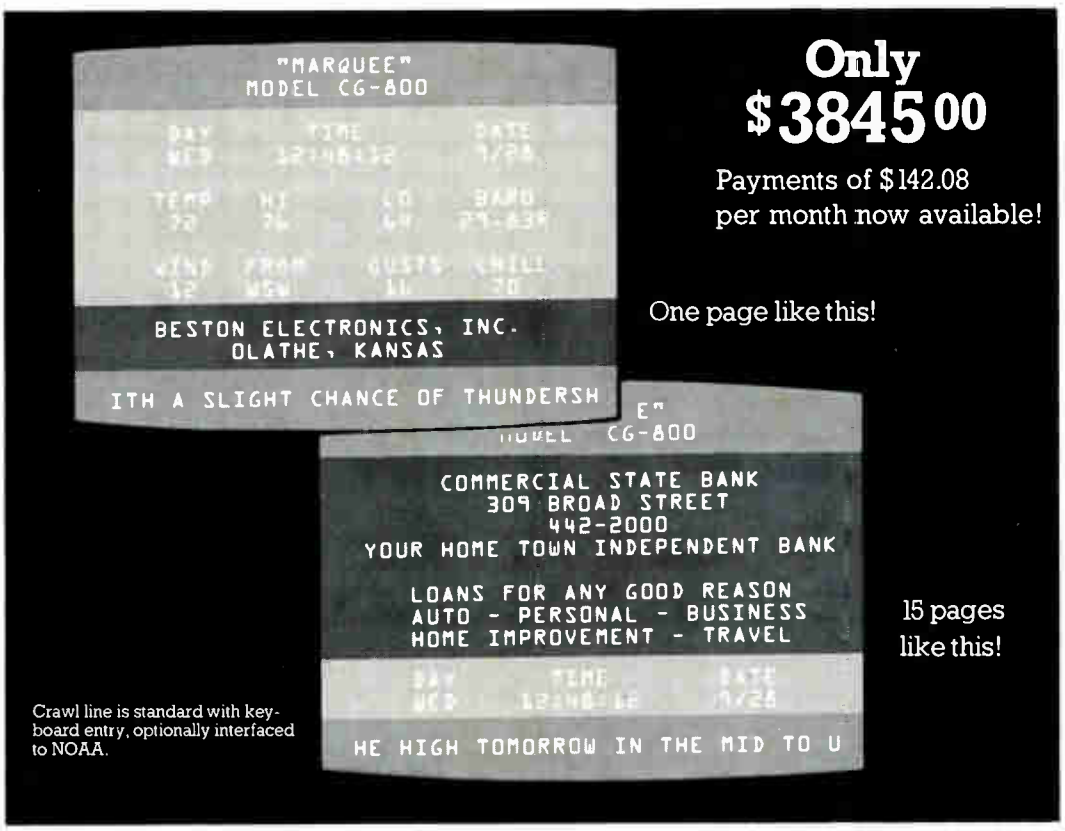
POSTAGE WILL BE PAID BY ADDRESSEE

CED

**Titsch Communications, Inc.**
**P.O. Box 5727 TA**
**Denver, Colorado 80217-9929**

CED

# Everyone talks about the weather, but over 1000 systems depend on the CG-800.




Why?

Because the quality was designed in, in the first place.

You might pay less, and you can certainly pay more, but you can't buy a more dependable, day-in-day-out, year-in-year-out, weather system than the Marquee CG-800. That's why more customers re-order the CG-800 than any other. It'll do everything you need. And keep on doing it for a long time to come.

Anyone can talk about the weather. If you want to do something about it, call Beston, for weather you can count on.

BESTON

(913) 764-1900 • P.O. Box 937 • Olathe, Kansas 66061

**SEE US AT BOOTH NO. 2404 • NCTA**

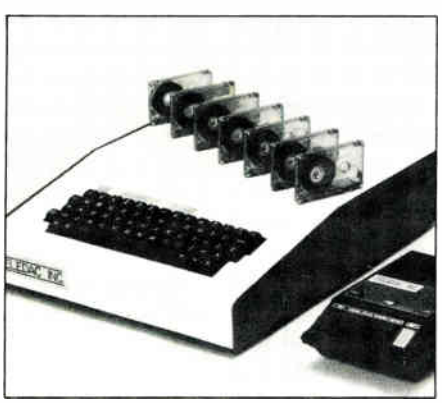
*continued from page 82*

of 3M's four business groups. In addition, an overseas sales force of approximately 6,500 sells the company's products in more than 100 countries. Company headquarters are located in St. Paul, Minn.

### Teledac Inc.
1575 Taschereau Blvd.
Longueuil, Quebec
Canada, J4K 2X8
(514) 651-3716

On June 1, 1978, the year of its incorporation, Teledac Inc. introduced its first character generator at the Canadian CCTA Convention. At the time, Teledac's president, Martin Chouinard, and vice president, Jean-Louis Chouinard, cable owners themselves, were particularly attuned to the need of small- and meduim-sized cable systems for an affordable character generator. Teledac's first product was designed to address this specific need.

Ever since then, the Canadian company has introduced a new system each year. These systems are based on flexible softwares and have been used by the Montreal Stock Exchange for stock exchange display on cable and as multichannel data display systems. The company's most recent character generator is the T-1300 series, which features both basic and optional software. Throughout the years, Teledac has maintained its original commitment to the small- and medium-sized cable operator. The company currently markets its products in Canada, the U.S. and South America.



**Teledac T-1300 character generator**

### Telpar Inc.
Cable Text Instrument Division
4132 Billy Mitchell Road
P.O. Box 796
Addison, Texas 75001
(214) 233-6631

In 1980, Fred Dupuy, the previous owner of several small cable TV systems in west Texas, founded Cable Text. Dupuy formed the company with the idea of producing low-cost text generators for the cable industry. In November 1980, however, Dupuy sold the company to Telpar Inc., a manufacturer of computers and terminals for the OEM market. The principal motive behind the sale was to acquire strong financing for the company's new products. Cable Text currently exists as the Cable Text Instrument Division of Telpar, with Fred Dupuy as its vice president of marketing. The division's newest product is the CTI-180 character text generator.

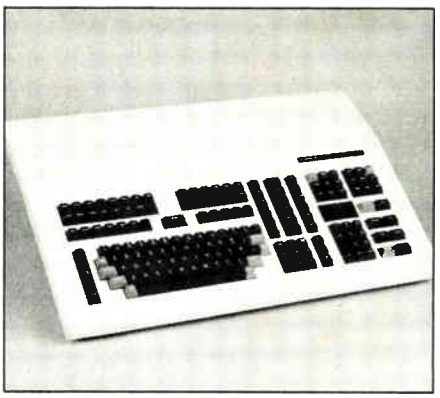
### Texscan MSI
3855 South 500 West
Suite S
Salt Lake City, Utah 84115
(801) 262-8475

MSI, Marketing Systems Inc., was founded in 1970. Shortly thereafter, the company began manufacturing alphanumeric digital display systems for the CATV industry. In early 1972, MSI was acquired by Com Tel Inc. During the eight years that MSI was a part of Com Tel, its product line was updated and expanded and its standard screen display was created. In 1980, in an effort to increase its offerings to the CATV industry, Texscan Corp. purchased the MSI division of Com Tel Inc. Since then, MSI has been operating as a division of Texscan and now is commonly referred to as Texscan MSI. The division's product line also has been upgraded. The Flexicaster Memory Controller System is MSI's most recent microprocessor based, automated information display.

### Thomson-CSF Broadcast Inc.
37 Brownhouse Road
Stamford, Conn. 06902
(203) 965-7000

In 1970, CBS Laboratories, a division of CBS, introduced its first Vidifont character generator, the Vidifont 1. This system used an electronic device to produce proportionally spaced characters and was designed specifically for television applications. Seven years later, when CBS was divesting itself of its hardware manufacturing properties, the professional products department of CBS Laboratories that produced Vidifont 1 became part of Thomson-CSF Broadcast Inc.

Since that acquisition, Thomson-CSF Broadcast has continued to develop the Vidifont character generator line, with the Vidifont Graphic 5 being its newest product. Presently, the company's primary markets for its Vidifont products are the TV, radio and broadcasting industries. Cable TV and the government comprise its secondary markets. The company's future plans, according to a company official, are to continue its efforts to improve



**Thomson-CSF Vidifont V**

the generation and manipulation of electronically generated graphics. Distributors of Vidifont products are located throughout the U.S.

### Video Data Systems
205 Oser Avenue
Hauppauge, N.Y. 11787
(516) 231-4400

Founded nearly 10 years ago by William Leventer and Steve Seiden as a division of Sterling Television Presentation, Video Data Systems has since grown into a $4 million company. The company's original intention was to break into the cable industry with the introduction of character generators. Over the years, it has updated its product line. In addition to the expansion of its character generator line, the company prides itself on its vertical interval transmission modem. Areas which particularly interest the company now are the computerized control of ad revenue and the potential use of cable in business communications.

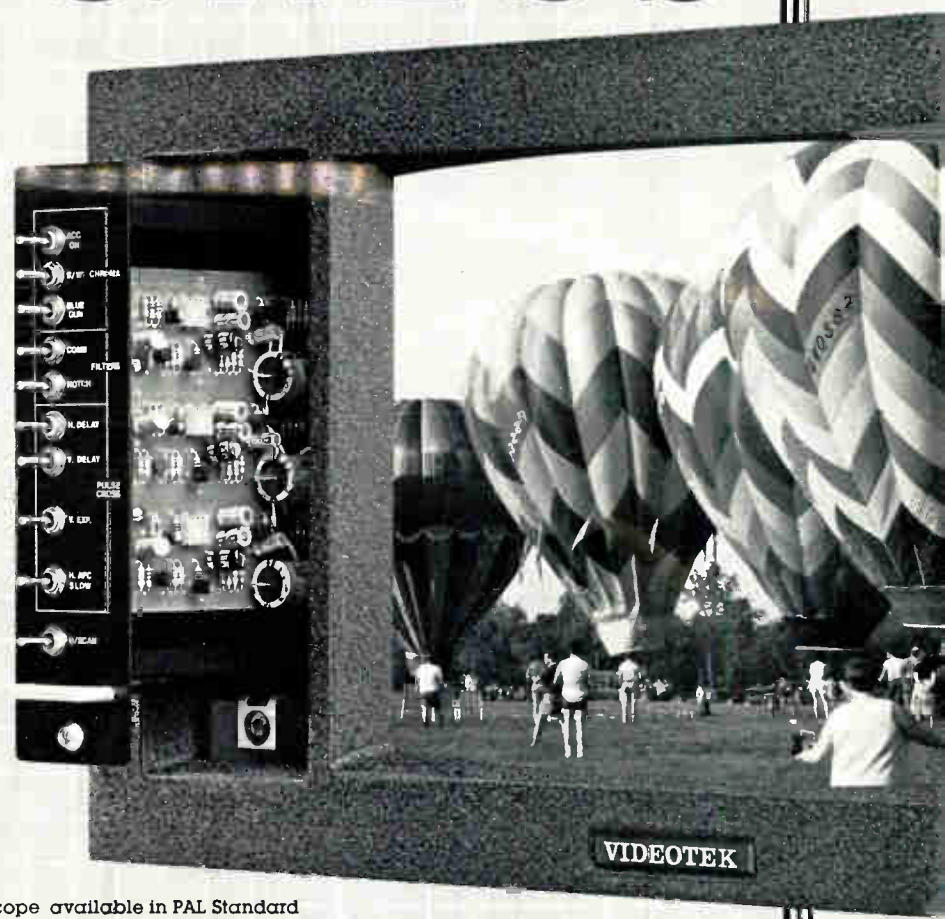
### Wilk Power and Video Inc.
16255 Ventura Blvd.
Suite 1001
Encino, Calif. 91436
(800) 828-7641

After purchasing Kelcee Communications, Toronto, Canada, this past February, George Newman renamed the company Source Communications. Since the name Source Communications is trademarked in the U.S., the U.S. division of Source Communications was forced to adopt another name. The name selected was Wilk Power and Video Inc., for the company's chief engineer, Raymond Wilk. In addition to character generators, Wilk Power and Video manufactures production titlers, audio video distribution equipment, audio video routing switchers and standby power supplies. The company markets these products to both the cable and broadcasting industries. According to a company spokesman, the company is planning to announce full color video graphics by the Western show.

# PROGRESS

## ...the new High Resolution Studio12A

Videotek's commitment to progress has resulted in the most versatile RGB/NTSC 12" broadcast color monitor on the market today. The Studio 12A employs an advanced fine-pitch CRT for 43% better resolution; Set-up Controls are now secured in an easy-access Slide-out Drawer; and Switchable Comb Filter, Notch Filter, and Analog RGB Inputs have been added to an already-impressive list of standard features found on monitors costing twice as much: High Voltage Regulation, A-B Split Screen, Selective H-AFC, ACC Defeat, Preset Controls, Pulse Cross, Underscan, and more.




TSM-5A Waveform Monitor / VSM-5A Vectorscope available in PAL Standard


## ...the TSM-5A Waveform Monitor & VSM-5A Vectorscope

New developments in the TSM-5A include: 30% less power consumption for increased efficiency and reliability; Dynamic Focus for critical waveform analysis; and a refined CRT for improved geometry and sensitivity.

Now that's Progress...

# BY·DESIGN

125 N. York Street, Pottstown, PA 19464, (215) 327-2292, TWX: 710-653-0125
9625 N. 21st Drive, Phoenix, AZ 85021, (602) 997-7523, TWX: 910-951-0621

VIDEOTEK INC.

# People News

■ **TOCOM Inc.** has appointed **John Fullingim** product manager for its 55 PLUS addressable systems and terminals. He will be in charge of coordination of new product development and marketing for the 55 PLUS line. Fullingim joins TOCOM from Control Data Corp. where he was account executive for the station business systems division. Prior to his work at Control Data, he was President of Matrix Systems, Inc.

■ **C-COR Electronics Inc.** has appointed **John Stehman** corporate planning manager. In this newly created position, Stehman will be responsible for the sales and marketing of C-COR's data products to the data, interconnect and "office-of the future" markets, as well as to LAN systems. He also will be in charge of the planning for the development of new data products and markets.

Stehman brings to C-COR 15 years of experience in the data communications field. Prior to joining C-COR, he was product line planning manager for Gould SEL, computer systems division and product marketing manager for Paradyne Corp.

■ **Scientific-Atlanta Inc.** has promoted **John Levergood** to senior vice president. As such, Levergood will be a group executive of the company's communications products organization. An engineering graduate of Temple University, Levergood joined Scientific-Atlanta in 1971 as regional accounts manager and has held various marketing and management positions in S-A's communications business. According to the company, he has played a key role in the growth of its cable-satellite business.

■ **Doyle Thompson**, director of engineering for The Weather Channel, has been elected president of the **Society of Broadcast & Communications Engineers**. Thompson, who has more than 30 years of experience in radio and television, presently directs all engineering operations at The Weather Channel. While accepting the presidency for the Society, Thompson expressed an interest in pursuing a number of goals: to act on the Engineering Certification Program and thereby establish good credentials and elevate public perception of the profession; to promote the Society through active participation in the FCC and related organizations; to continue working on The Harold Ennis Scholarship Fund; to double the Society's membership base, and to publish a new journal, to be known as *SIGNAL* magazine, in addition to the society's other existing publications.

■ **Warner Amex** recently announced four changes in its staff; three of these changes occurred within Warner Amex Cable Communications and the third occurred at Warner Amex QUBE, Columbus, Ohio.

At Warner Amex Cable Communications, **Bruce Hoban** became director of research. Formerly associated wth the Cable Television Advertising Bureau as its vice president, director of research, Hoban now takes over the task of developing research strategies for Warner Amex's advertising and sales at the local level. In order to execute this task, Hoban will work closely with the company's local advertising and sales staff and their clients. Among other accomplishments,

# BRAD CABLE ELECTRONICS
# WE DO OUR JOB WELL,
# SO YOU CAN DO YOURS BETTER

## BRAD CABLE ELECTRONICS: FOREMOST IN BUYING, SELLING & REPAIRING CONVERTERS

At Brad Cable Electronics, we understand how important top-notch converters are to you and your customers. We're converter specialists, and we're proud of our reputation for quality and service. Our 65,000-sq.-ft. facility houses over 100,000 refurbished converters available for immediate delivery, and tens of thousands of factory-fresh parts.


## PROMPT NATIONWIDE DELIVERY

We also understand the importance of prompt and efficient turnaround. Our full fleet of delivery trucks help assure fast pick-up and delivery of your urgent orders.

## SKILLED TECHNICIANS & QUALITY REPAIRS

Over 150 skilled technicians utilize modern proprietary test equipment manufactured by Brad to repair all makes and models of converters. Where applicable, our service procedures include:

- Aligning each unit to external crystal sources
- Complete RF sweep for gain and response
- AFC alignment
- Complete operational check of control head
- Full 24-hour burn-in
- Cleaning and safely repackaging in reusable containers

No unit leaves our facility until it is completely tested and approved by our Quality Control department, and all repairs are covered by our 90-day limited warranty. If any failure occurs because of workmanship or parts, Brad will fix it FREE.

Call 1-800-382-BRAD and talk to the converter specialists
1023 State Street P.O. Box 739 Schenectady, NY 12301
(518) 382-8000

**BRAD**
CABLE ELECTRONICS INC.

THE CONVERTER MARKETPLACE™

he is credited with having played an active role in the development and analysis of the recently released Cable Audience Methodology Study (CAMS).

Warner Amex Cable Communications also appointed **Harry Sheraw**, Arkansas group manager, in charge of the Warner Amex systems serving Fayetteville, Russelville, Clarksville, Bonneville and Paris, Arkansas. With Warner since 1976, Sheraw most recently served as director of general accounting for Warner Amex's national division in Columbus, Ohio. Before joining Warner, he was an auditor for General Telephone Electronics.

Another change at Warner Amex Cable Communications was the appointment of **Charles Saparito** to group general manager. A former project engineer in Warner Amex's national division, Saparito now will supervise the operations of all three systems, which presently serve more than 17,000 subscribers. Saparito began his career as a technician in the Warren, Pa., Warner Amex system some 26 years ago. Since then, he has served as chief technician, regional engineer for the mid-Atlantic region and in various positions at the company's national division.

At Warner Amex QUBE in Columbus, Ohio, **Frederick Beilstein** was appointed president and general manager. Beilstein formerly was the vice president of finance for Warner Amex Cable Communications, with responsibility for all the financial functions of the company's cable operations as well as for its accounting and control activities in the field. He also assisted in capital resource planning and acted as the liasion with senior management on construction control issues. As president and general manager of Warner Amex QUBE, Belstein is completely responsible for the operation of the QUBE two-way interactive service.

Prior to Warner Amex, Beilstein held various financial management positions with Container Transport International Inc. and other financial and accounting positions with the Hewitt-Robins Division of Litton Industries and with IBM Corp.

■ As a permanent memorial to **Lawrence Thielen**, who died this past April 4, an endowed fund to support the **Lawrence R. Thielen Memorial Fellowship in Electrical Engineering** has been established at Stanford University. The fellowship will provide financial support for the tuition and living expenses of a student in Stanford's department of electrical engineering. Donations to the fellowship fund should be sent to Nancy Bruno,office of development, Stanford University, Stanford, Calif. 94305.

Thielen was born Jan. 12, 1927, 1927 in Huron, S.D. During his lifetime, he was recognized as a pioneer in the replacement of tube-type microwave amplifiers and oscillators with solid-state components and also as the lead founder of Avantek Inc.

■ **Times Fiber Communications Inc.** (TFC) has appointed **Neal Katz** manufacturing systems coordinator. As such, Katz will be responsible for computerizing the company's manufacturing management systems. Katz comes to TFC from TRW Greenfield-Geometric.

▪ **CWY Electronics** has added two members to its sales staff.

**Jerry Lasecki** will serve the Michigan area and designated accounts in the Eastern U.S. A former sales representative for Oak Communications, Lasecki now will carry out traditional sales representation duties for CWY Electronics

**G.L. Wright** also joins CWY Electronics from Oak Communications. At Oak, he served as group leader, field service engineering. In his new position, Wright is a sales representative in the metro Chicago and southern Wisconsin areas and also is in charge of designated accounts in the Western U.S.

# The aerial lift your company needs at a price you can afford . A FULL-FEATURED TELSTA FOR UNDER $20,000*

Not a stripped down model, but a fully equipped Telsta van-mounted aerial lift like the one pictured here. It's a Telsta A-28C with APU (Aerial Lift Power Unit).

The APU is an outboard-mounted heavy-duty industrial grade engine/generator which powers the three-way boom movement and provides 1200 watts of 110V AC power for your tools. Unlike other lifts, the boom can be operated with the truck engine off, thus eliminating overheating, conserving fuel and reducing battery drain.


APU is mounted outside of van to give you more working room inside. Parts are readily available for this quality-built generator.

And, of course, it has all the quality and durability that makes Telsta the most wanted aerial lift in the industry as it has been for three decades. Along with the best user support program available from any aerial lift manufacturer.

**See us at booth 4342 at the NCTA Show.**

*Price is based on A-28C gravity leveling with metal basket, APU power source mounted on a 1983 Ford E-350 9600 GVW, 138" wheelbase. F.O.B. Telsta plant. Utility truck-mounted package available at slightly higher price.

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COMPANY
APPARATUS DIVISION
MOPECO/PUREGAS/TELSTA
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Phone 303/427-3700
Facilities in San Lorenzo, CA, Frederick, MD and Lithonia, GA

# Classifieds

## BUSINESS DIRECTORY/EMPLOYMENT OPPORTUNITIES

### CHIEF TECH

Colony Communications, Inc., a major New England based MSO is expanding into the LA area. If you are a Chief or a Lead Tech looking for a new challenge, please call us. To be considered you must have a minimum of 5 years cable field experience, with working knowledge of headend and distribution systems. Strong supervisory and interpersonal skills desired with formal electronics training a plus. Prefer 2nd Class FCC and bilingual abilities. System will be state-of-the-art, 168 channels with 2-way capabilities and 250 miles of plant servicing the harbor area of L.A. from Wilmington, CA. Excellent salary, company paid benefits and vehicle provided. Please send resume, in confidence, to:

**Daniel V. Donohue**
**Director of Employee Relations**
**P.O. Box 969**
**Providence, Rhode Island 02901**
**(401) 277-7116**
**EOE**

BRAD CABLE ELECTRONICS INC. THE CONVERTER MARKETPLACE

### CATV SERVICE REPS

**BRAD CABLE** is interested in working with a select few CATV distributors and rep groups across the country. We would like these groups to represent **BRAD quality converter service** along with reconditioned sale converters. If interested call:

**Ben Rhodes**
1023 State Street
Schenectady, New York 12301
**518-382-8000 or 1-800-382-BRAD**
**THE CONVERTER MARKETPLACE™**

### CATV TECHNICIAN

**Excellent growth opportunity and chance to be part of a team.**

Modern System - New Build
Southwestern sunbelt area at large lake with recreational facilities.

- 3 to 5 years cable experience, headend and construction preferred.
- Second Class FCC license preferred.

**Please send resume to:**
**MCT Cablevision**
**Rt. 2, Box 122AA**
**Flint, TX 75762**
**Attn: Jim Hanlon**

### ENGINEER

Televents, Inc. is seeking an engineer to serve in the Walnut Creek, CA office. Some travel involved. Duties to include:

1. Oversee and assist in proof of performance tests.
2. Oversee and do some system layout and design.
3. Instruct and aid in technical training program.
4. Design and FCC filings on microwave system.

**Write to: Tom Mitchell**
**Televents, Inc.**
**2855 Mitchell Dr. Ste. 250**
**Walnut Creek, CA 94598**

cable

### CATV REGIONAL ENGINEER

### VAIL, COLORADO

Heritage is a rapidly growing MSO with cable systems in 13 states. We are in need for an Engineer to take charge of construction, rebuild, design, multiple unit residential installation and microwave duties primarily in Vail, but with responsibilities in other Colorado areas. The Engineer will analyze problems, then plan, organize and execute appropriate cost-effective solutions. This position reports to the Engineering VP in our home office.

If interested in joining a dynamic organization, please send your resume to:

**J. German**
**Heritage Communications, Inc.**
**2195 Ingersoll Avenue**
**Des Moines, IA 50312**
**An Equal Opportunity Employer m/f**

Heritage COMMUNICATIONS

### CONTRACT INSTALLERS

Residential and post wire personnel needed for work nationally. Immediate openings in Las Vegas for high caliber, honest, dependable individuals. Must be experienced and furnish late model clean truck and tools. References required. Send resume to:

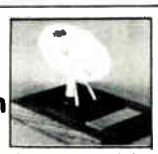
**Cable Video Systems**
**P.O. Box 503**
**Middletown, OH 45042**

## BUSINESS DIRECTORY/PROFESSIONAL SERVICES

***—Converter Repairs—***
***Jerrold Specialists***
***Quality Workmanship***
***Fast Turnaround***

CTS

**Cable Television Services**
**120 Erbbe N.E.**
**Albuquerque, NM 87123**
**(505) 292-7766**



**Personalized Earth Station Awards**

Delight acquaintances in the cable industry with this personalized gift. Engraved brass nameplate on a genuine walnut base. This attractive piece is available in desk and wall models. Please inquire about quantity discounts and custom work.

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**1424 Lake St.**
**Evanston, Illinois 60201**
**312/864-2299**

**Baker Scott & Co.**

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# ara Associated Recruiters Agency, Inc.

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To Work With
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**TECHNICIANS • MARKETING**
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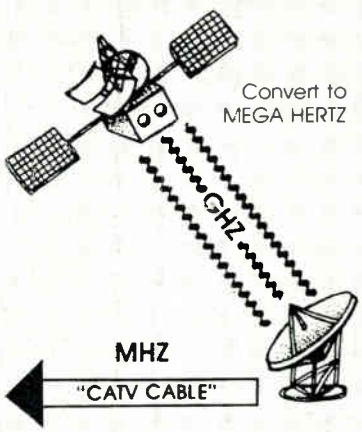


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### Advertisers Index

# Product News

### ATI GLS-800 equipment package

Automaticn Techniques Inc. has entered the home TVRO market with an equipment package called the GLS-800, "Great Little System," series.

The package includes ATI produced and technically matched dish, feedhorn, low noise amplifier, downconverter receiver and remote control. Designed for ease of installation and operation, the system features single cable control. One cable connecting receiver to downconverter carries all power and control. In addition, the package contains a GLR-808 receiver that offers crystal synthesized tuning for stability and automatic polarity control that locks the probe for each channel while correcting for skew.

Other components of the package include: a digital indicator that displays channel selections on the contemporary-styled front; a tunable IF filter on the rear panel that allows terrestrial interference rejection; a LB-808 remote control infrared wireless unit that provides full function operation; an LNA/polarizer, featuring an updated design with direct-coupled input to eliminate waveguide transition loss; and a feedhorn to optimize the dish signal.

The dish included in the package is one-piece spun aluminum built to rigid tolerances to insure consistently high gain. It is available in 6-, 7½- and 9-foot sizes with sturdy polar mount and single-pole support facilities.

For more information, contact Automation Techniques Inc., 1550 North 105th East Avenue, Tulsa, Okla. 74116, (918) 836-2584.

### Microdyne multiple-feed system

Microdyne Corp. has introduced a multiple-feed satellite system that not only can receive signals from up to five adjacent satellites on the same parabolic reflector but also, when installed on the antenna, can receive programming from adjacent satellites at approximately one-fifth the cost of a new dish.

According to the company, in a TVRO system designed with adequate margins, the unit can provide quality pictures on all feeds. Designated the MSF-16 system, the unit can retrofit with existing Microdyne AFC antennas, requiring only the replacement of the spars and brackets of the feed support hardware. Antennas purchased from other manufacturers also can be modified for use with the system.

For more information, contact Microdyne Corp., 491 Oak Rd., Ocala, Fla. 32672, (301) 622-5100.

### Tektronix expands logic analyzer line

The design automation division of Tektronix Inc. has added the Sony/Tektronix 318 and 338 logic analyzers to its 300 series of "ultra-portable" logic analyzers. Both analyzers offer state and timing with serial state and character analysis as on option.

The 318, priced at $5,300, provides 16 parallel channels of data acquisition at up to 50 MHz. The 338, priced at $5,800, delivers 32 channels at up to 20 MHz. Both the 318 and 338 provide glitch capture and three levels of triggering. Developed by Sony and Tektronix in a collaborative effort, the 318 and 338 weigh only 11 pounds each.

One of the most important features intrinsic to both systems is a menu-driven interface. This easy-to-use interface reduces the frequency of user errors and presents all the necessary parameters for acquisition set-up, trigger definition, data display and external communications in a series of prompt fields on the CRT display. For complex software acquisitions, there are three word recognizers that can be linked together in a three-level sequence.

The 318 and 338 both offer serial state and character analysis priced at 1,200, as an option to the standard parallel state and timing features. In the serial mode, both synchronous and asynchronous data acquisitions can be executed at baud rates from 50 bps to 19.2 kbps, while word length is selectable from 5 to 9 bits with odd, even, or no parity. Captured data can be displayed in hex, binary, octal, ASCII or EBCDIC. According to the company, these features make the 318 and 338 ideal candidates for first-line data communications service applications such as testing line links, analyzing protocols and data checking in local area networks. This option also includes RS-232 external communications and non-volatile memory.

For more information, contact Tektronix, (800) 547-1512.

*Ditch Witch 2300 diesel trencher*

### Ditch Witch diesel engine trencher

Ditch Witch now is making its model 2300 trencher available with a 30-HP-class diesel engine and with a gasoline engine. The 2300 is a four-wheel-drive riding trencher that can dig to depths of 5 feet and widths to 16 inches, depending on the boom and chain set up. A hydraulic blade is standard.

An optional front-mounted utility backhoe also is available for the machine.

For more information, contact The Charles Machine Works Inc., P.O. Box 66, Perry, Okla. 73077, (405) 336-4402.

### Artel plug-in fiberoptic modules

According to Artel Communications Corp., its T-2000L and R-2000L plug-in fiberoptic modules allow wideband transmission and multiple subcarriers up to four miles, without requiring the use of either amplifiers or repeaters.

Designed to plug directly into the SL-2000 card frame, the T-2000L and R-2000L permit audio to be transmitted with the baseband video on prediplexed standard subcarriers or through the use of single or dual Artel subcarrier modules.

In addition, a test switch on each module allows on-line measurement of data and carrier on the SL-2000 front meter. Alarm outputs are provided to automatically detect loss of carrier and intrusion. Other features of the system include: self-test metering, alarm outputs and signal indicators.

For more information, contact Artel Communications Corp., P.O. Box 100, West Side Station, Worcester, Mass. 01602, (617) 752-5690.

### Cable Security enclosure systems

Cable Security Systems has introduced two enclosure or enclosure-related products. One of these products is an anti-theft pedestal, called Pedloc; the other is a locking system, appropriately named Lockout.

*Comband™ Update #1: Live Demo At NCTA.*

# Comband Is Coming On.


On June 12th in Houston, you'll see cable history in the making.

A live demonstration of General Electric's revolutionary new Comband™ cable expansion system.

We introduced the concept in November. Now you'll see it firsthand, the bandwidth compression system that can up to double your cable channel capacity without adding cable. Two video programs are compressed and transmitted through one channel and then separated back into two programs, each with high quality audio and video signals.

This live demonstration is an important, vital step toward making the fully addressable Comband System available to cable operators in 1984.

So don't miss the GE display at the June NCTA Show in Houston. We'll even give you a customized, on-the-spot computer analysis of what the Comband System can do for your own upgrade plans in the very near future.

NCTA, June 12 through 15 in Houston. Watch Comband come on strong.

*For more information, call Ron Polomsky, GE Video Products Division, (804) 483-5480.*

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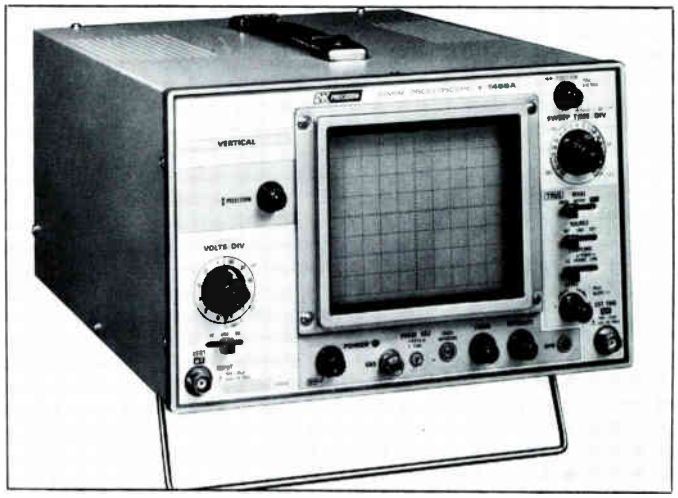
Pedloc was designed by the company for use as a distribution pedestal for subscriber drops. Manufactured out of 16 gauge steel with welded seams and an anti-retrieval stake, Pedloc contains an "easy access" disc for feeder and drop cable and the company's patented shrouded locking system. The unit can accommodate up to two taps or a total of eight subscriber drops and up to .625 feeder cable.

Cable Security Systems' Lockout began as an idea for converting an ordinary pedestal into a high-security underground enclosure without incurring too much time or expense in the process. According to the company, the final product does just that. The locking system consists of a patented lock, pin and shroud and can fit all standard utility pedestals. By mounting the locking pin between the two feeders and under the trap, Lockout can prevent illegals from uprooting the pedestal. The system, as a result, gives cable operators the security they need. The unit also can be used to secure standby power supplies.

For more information, contact Cable Security Systems, (205) 887-7088.



*B&K Precision oscilloscope*

**B&K Precision single-trace oscilloscope**

The B&K-Precision Test Instrument Product Group of Dynascan Corp. has introduced a 10 MHz, single-trace oscilloscope that can be used in a variety of design and troubleshooting applications. Given the model number 1466A, this unit can measure dc voltage as well as peak-to-peak voltage, time, frequency, pulse width, relative voltage and relative period.

The unit features 2 mV/div vertical sensitivity to 10 MHz with selectable 1 mV/div sensitivity to 7 MHz and five-inches rectangular CRT with internal graticule. The user can select from 19 calibrated sweep time ranges (0.5 s/div to 0.5 $\mu$s/div), with each sweep time range being fully adjustable between calibrated ranges. A video sync separator circuit with selectable frame or line triggering is used to observe composite video waveforms. An auto sweep feature provides sweep without trigger input and automatically reverts to triggered sweep operation once adequate trigger is applied. Other features include a 10X sweep magnification, X-Y operation, Z axis input (TTL Compatible), a probe adjust calibrator and a front panel adjustable trace rotation.

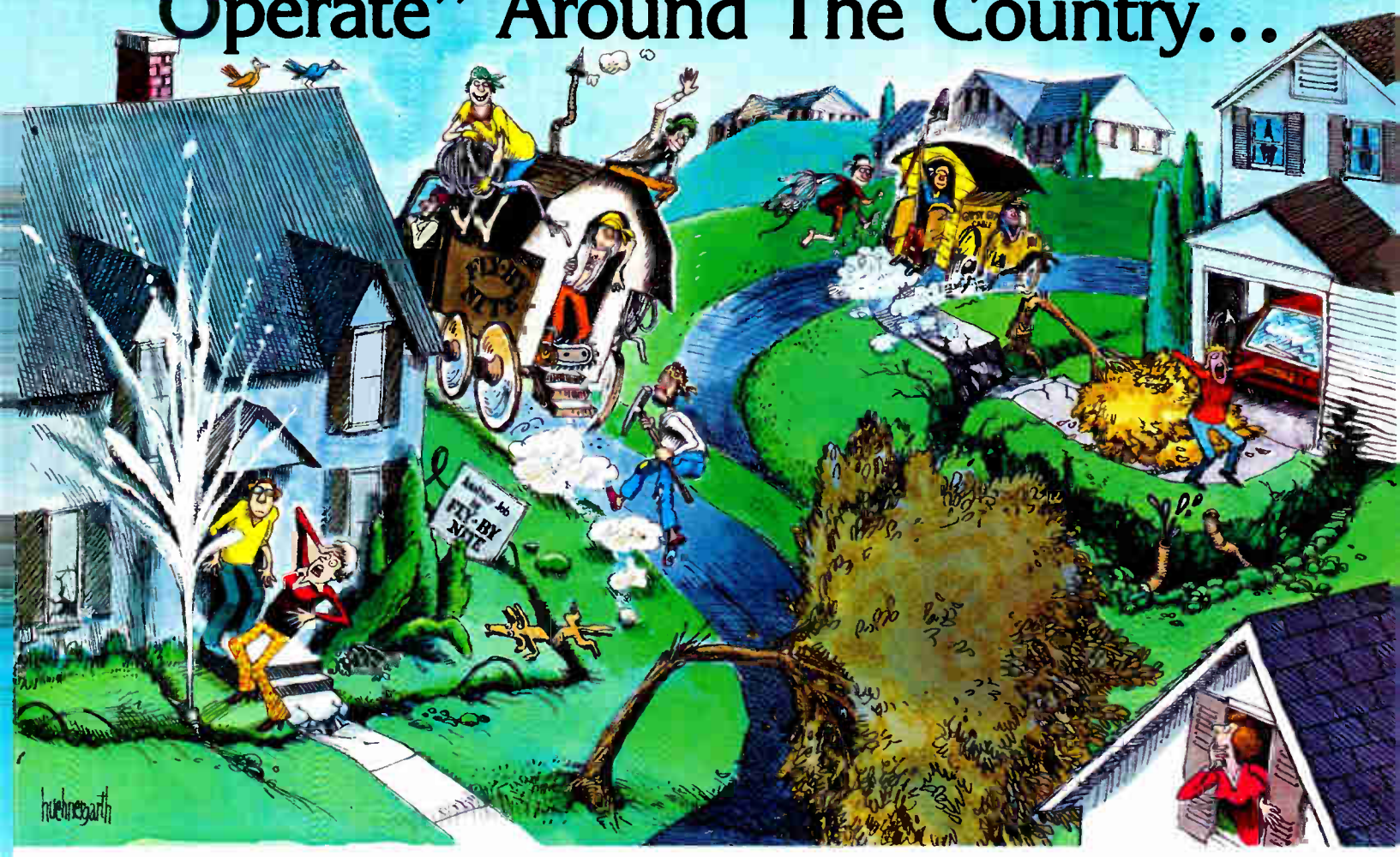
The model 1466A is sold exclusively through B&K-Precision distributors and costs $475.00. Included in the package are one 10:1/direct probe, spare fuses, instruction manual, schematic diagram and parts list.

For more information, contact B&K Precision Test Instrument Product Group, 6460 W. Cortland St., Chicago, Ill. 60635, (800) 641-4627.

**Channel Master 6174 and 6274 earth stations**

Due to recent engineering and production advances that have made it possible for Channel Master to produce a double mount more economically than originally expected, Channel Master

# While Many Cable Contractors "Operate" Around The Country...




# Few Provide The Technical Skills And Experience You Really Need.

A scenario such as this is anything but funny, especially when it becomes reality to a System Manager or his Director of Marketing. The fact is, many people in our industry have actually experienced this sort of nightmare.

Unfortunately, not all construction companies have the strength and experience necessary to support their good intentions. And, without a proven "track record," your decision to contract these companies is usually based on an assortment of promises and a "slick" color brochure.

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now is able to offer its 10-foot non-motorized satellite earth station for $2,995 retail.

Once installed and aligned, the model 6174 double monopole 120 degree LNA manual sytem can provide full domestic satellite coverage through a single manual adjustment. The prime focus feed assembly (LNA, scaler feed and polarizer) and downconverter are supported above the fiberglass dish by lightweight aluminum struts. In addition, the earth station is an all-weather system that can withstand hurricane force winds in excess of 100 mph.

A motorized version of the system, the SATSCAN™, incorporates not only all of the above features but simple up and down buttons to aim the antenna as well. In addition, continuous three-digit LED readout, which the company claims is accurate to one-third of a degree, is offered. Available with a custom, easy-to-use satellite locator card and with a heavy duty actuator motor, the system features an electronics package that includes a 24-channel receiver. Push button tuning with automatic polarity switching and LED digital channel display are combined with a center/fine tuning meter and signal strength meter to provide improved reception. Additional features include channel scan, a built-in modulator and an optional remote control unit which simplifies channel selection and fine tuning processes.

Suggested retail for this SATSCAN version, model 6274, is $3,695.

For more information, contact Channel Master, (212) 289-6080.

**Intercept 500 MHz multitaps**

Intercept is offering a new series of 500 MHz two-, four- and eight-output multi-taps that collectively are referred to as the INT 500 series. Together, these multitaps cover the complete range of tap values. Each tap is of modular design, which permits the operator to remove the base plate and circuit board as a single unit without having to remove the center seize or the strand mounting.

Housings on all units are fabricated of corrosion-resistant aluminum alloy, while other components of the unit are constructed of stainless steel. In addition, moisture-sealing gaskets are used on the housing and all ports, with subscriber ports having a puncture-sealing rubber membrane. Connector ports are designed with large shoulders and equipped with anti-slip ribs to accommodate shrink sleeving.

Other features include: aerial or pedestal mounting, color-coded db value, high tap-to-tap isolation and full 5-500 MHz frequency range.

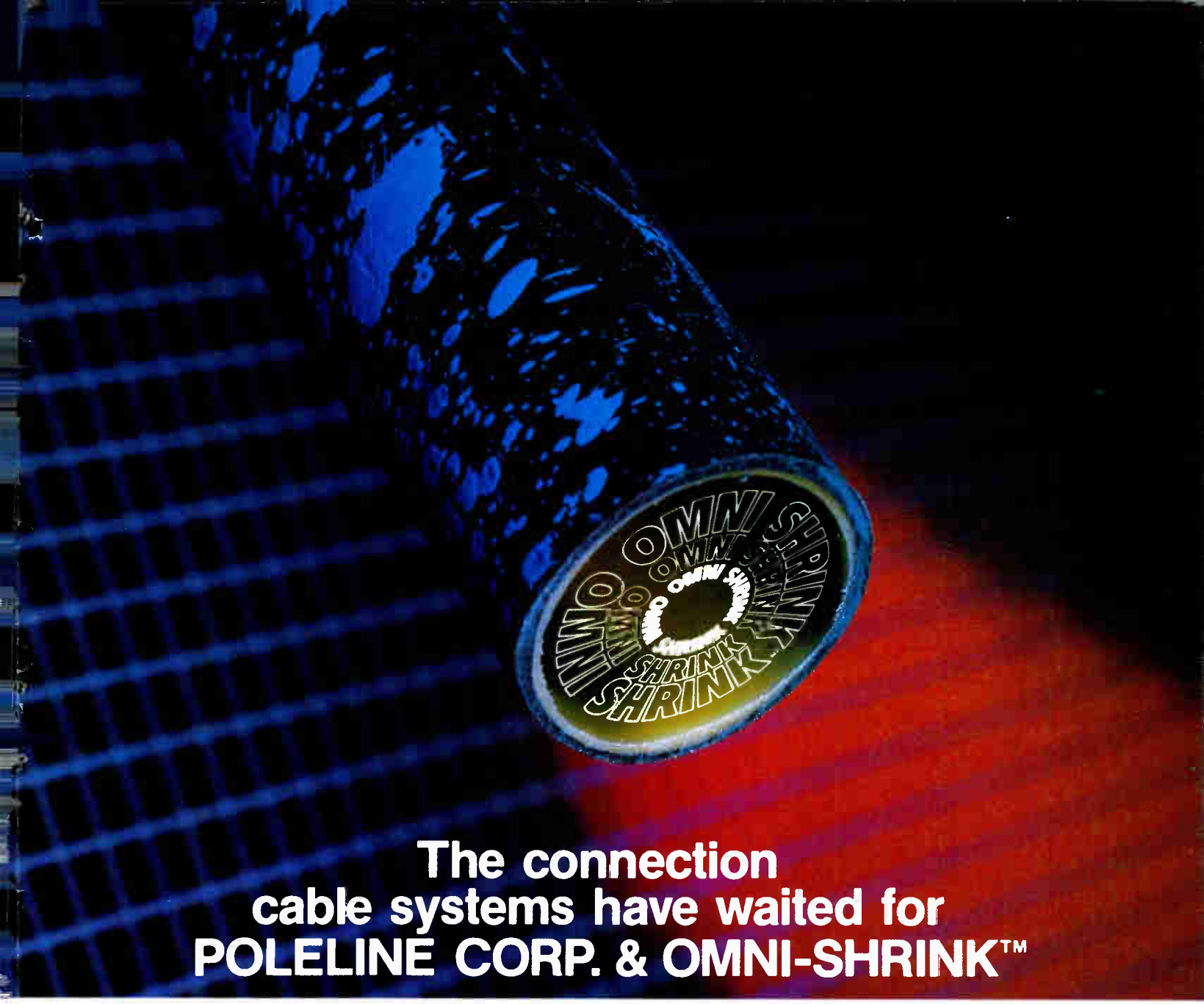
For more information, contact Intercept Corp., 220 Entin Rd., Clifton, N.J. 07014, (800) 526-0623.

**Solid state uplink**

Modulation Associates debuted their new solid state uplink at the NAB convention. Being the first of its kind, the uplink is composed of solid state features to ensure relatively inexpensive, broadcast quality radio transmission. Referred to as the SU 10 solid state uplink, it is a dual channel earth station transmitter that uses two 10-watt solid state high power amplifiers. The uplink has applications for two independent SCPC uplink channels or for stereo program channels. In its complete configuration, the SU 10 is available with audio processors, frequency agile modulators, a dual transponder upconverter, dual HPAs and a personal computer with full dial-up remote control capabilities.

The portable design of the SU 10 addresses the needs of the remote satellite radio user as well. The entire uplink is housed in a four-foot enclosed rack for shelter mounting at the antenna. This feature also permits any SAT terminal in state or regional networks to become a transmitting station for news collection or for regional program unlinking to the network.

For more information, contact Modulation Associates, 897 Independence Ave., Mountain View, Calif., 94043, (415) 962-8000.

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## Satcom 3R

| Signal | Day | Start/Stop | Alert Tone | Transponder |
|---|---|---|---|---|
| ASCN-The Learning Channel | Weekdays<br>Weekends | 6 a.m./4 p.m.<br>6 a.m./1 p.m. | 192°/# | 16 |
| ARTS | Daily | 9 p.m./12 a.m. | 311°/# (E,C,M)<br>519°/#(P) | 1 |
| Cable Health Network | | 24 hrs. | 361°/# | 17 |
| CBN | | 24 hrs. | None | 8 |
| Cinemax | | 24 hrs. | None | 20 (E,C)<br>23 (M,P) |
| CNN | | 24 hrs. | 024°/# | 14 |
| CNN Headline News | | 24 hrs. | 635°/#<br>541°/# | 15 |
| C-SPAN | | 24 hrs. | 195°/# | 19 |
| Daytime | Weekdays | 1 p.m./5 p.m. | 307°/# | 22 |
| ESPN | | 24 hrs. | 048°/# | 7 |
| Eternal World Television Network | Daily | 8 p.m./12 p.m. | 762°/# | 18 |
| HBO | Daily | 24 hrs. | None | 24 (E,C),<br>13 (M,P),<br>22 |
| HTN Plus | Daily | 4 p.m./4 a.m. | 207°/# | 16 |
| The Movie Channel | | 24 hrs. | None | 5 |

### Major Communications Satellites Serving North America

| Location: Degrees West Longitude | Satellite: Present | Satellite: Future |
|---|---|---|
| 66 | | Satcom 2R* (Mid 84) |
| 70 | | Southern Pacific-2 (Oct. 84)** |
| 74 | | Galaxy-2 (Mid 84) |
| 79 | | Advanced Westar-2** (Mid 83) |
| 83 | Satcom-4 | |
| 87 | Comstar-D3 | Telstar-2 (1984) |
| 91 | Westar-3 | Advanced Westar-1** |
| 94 | SBS-3** | |
| 95 | Comstar-D2 & D1 | Telstar-1 (Mid 83) |
| 97 | SBS-2* | |
| 99 | Westar-4 | |
| 100 | SBS-1* | |
| 103 | | GTE-1* (1984) |
| 104.5 | Anik D-1 | |
| 106 | | GTE-2* (1984) |
| 109 | Anik-B** & C3 | |
| 112.5 | Anik C-1 | |
| 114 | Anik A-3 | Anik D-2 (1984) |
| 116 | | Anik C-2 (Mid 83) |
| 117.5 | | |
| 119 | Satcom-2 | Southern Pacific-1 (Feb. 84)** |
| 123 | Westar-5 | |
| 123.5 | Westar 2 | |
| 127.5 | Comstar-D4 | Telstar-3 (1986) |
| 131 | Satcom-3R | |
| 135 | | Galaxy-1 (Mid 83) |
| 136 | Satcom-1 | |
| 139 | Satcom-1R | |
| 143 | Satcom 5 | |

*Ku Band
**Dual Ku/C Band

Orbital slots and launch dates often change without notice

| Signal | Day | Start/Stop | Alert Tone | Transponder |
|---|---|---|---|---|
| Modern Satellite Network | Weekdays | 10 a.m./1 p.m. | 243°/#<br>421°/# | 22 |
| MTV: Music Television | | 24 hrs. | None | 11 |
| National Jewish Television | Sundays | 1 p.m./4 p.m. | None | 16 |
| Nickelodeon | Daily | 8 p.m./9 p.m. | 311°/# (E,M,C)<br>519°/# (P) | 1 |
| PTL | | 24 hrs. | None | 2 |
| Reuters | Weekdays | 4 a.m./8 p.m. | None | 18 |
| Showtime | | 24 hrs. | 576°/# | 12 (E,C)<br>10 (M,P) |
| Spotlight | | 24 hrs. | None | 4 |
| USA Blackout Network | | O/V after 5 p.m. | 295°# | 22 |
| USA Cable Network | | 24 hrs. | 601°/# | 9 |
| WGN | | 24 hrs. | None | 3 |
| WTBS | | 24 hrs. | None | 6 |
| The Weather Channel | | 24 hrs. | None | 21 |

## Satcom 4

| | | | | |
|---|---|---|---|---|
| BizNet | Weekdays | 7 a.m./2 p.m. | None | 15 |
| Bravo | Daily | 8 p.m./6 a.m. | None | 6 |
| Eros | Thurs-Sat | 11 p.m./2 a.m. | None | 1 |
| FNN: Financial News Network | Weekdays | 10 a.m./5 p.m. | 975°/#<br>738°/# | 2 |
| GalaVision | Weekdays<br>Weekends | 4 p.m./4 a.m.<br>1 p.m./4 a.m. | None | 23 |
| Genesis Network | | 24 hrs. | None | 12 |
| National Christian Network | Daily | 6 a.m./8 p.m. | 073°/# | 7 |
| SIN | Daily | 24 hrs. | 819°/# | 1 |
| SPN | | 24 hrs. | 429°/# | 3 |
| Trinity Broadcasting Network | | 24 hrs. | None | 17 |
| The Playboy Channel | | 8 p.m./6 a.m. | None | 7 |

## Westar 5

| | | | | |
|---|---|---|---|---|
| ARTS | Daily | 9 p.m./12 p.m. | None | 12D |
| BET | Daily | 8 p.m./2 a.m. | 406°/# | 12X |
| Daytime | Daily | 1 p.m./9p.m. | 307°/# | 12D |
| Satellite News Channel | | 24 hrs. | None | 4X, 6D<br>7X, 8X,<br>9X |
| SelecTV | | 24 hrs | None | 11X |
| Spotlight | | 24 hrs | None | 11D |
| The American Network | Daily | 5 p.m./5 a.m. | None | 10X |
| The Disney Channel | Daily | 7 a.m./11 p.m. | None | 6X(E,C)<br>5X(M,P) |
| The Nashville Network | Daily | 9 a.m./3 a.m. | none | 9D |
| WOR | | 24 hrs. | None | 2D |

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Whether you're adding one pay channel, 15 pay channels, or 15 tiers of service with 120 channels, Eagle's Descrambler can handle it all. Select only what you need. In the future, channels can be added to the headend scrambler with our simple plug-in module. The headend unit integrates with all manufacturer's modulators and processors and is compatible with all Standard/HRC/ICC configurations.

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