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Communications Engineering Digest/The Magazine of Broadband Technology December 1980

New Format

- Rural Cable Design
- M/A-COM Profile


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# Contents



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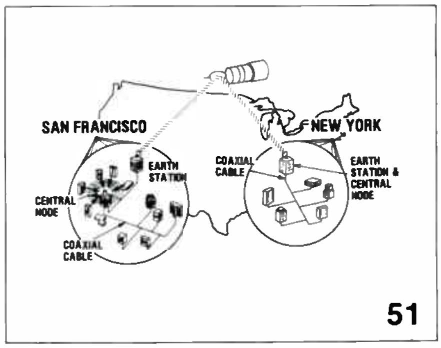


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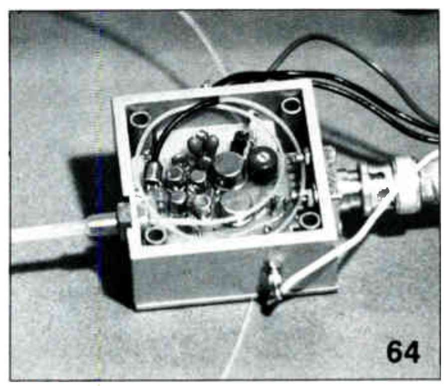

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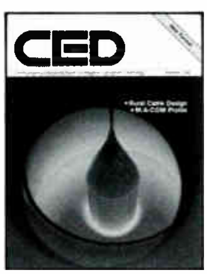

## About the Cover

Most of it begins here, with the growth of a single-crystal-silicone ingot. Wafers are formed from the ingots in high-temperature diffusion to achieve maximum-microwave-frequency operation. The photo was supplied by M/A-COM, Inc.


**CED** (USPS 300-510) is published monthly on behalf of all parties, including the Society of Cable Television Engineers (SCTE), interested in the advances of broadband technologies by Titsch Publishing, Inc., 2500 Curtis Street (P.O. Box 5400 TA) Denver, Colorado 80217.



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## Conspicuous Silence

Judging from a conspicuous silence in New York, it seems that **Southern Satellite Systems** (SSS) **may have** the **race to provide second earth stations** all to itself. Last summer, SSS announced its plan to provide an additional dish to cable operators so they could access Westar III programming and, specifically, SSS' Satellite Programming Network. Shortly thereafter, Satellite Communications Network (SCN) entered the fray, touting its own program to provide another dish. However, these paraboloids would be pointed at Comstar D-2 to beef up the audience for the Las Vegas Entertainment Network and Cinemerica, both represented by SCN. SSS and SCN shared the target goal of installing 300 earth stations by the end of this year, but plans can go astray awfully quickly in this industry. So far, SSS is doing fairly well, **with commitments for 210 of** the **planned 300** earth stations. On the other side, SCN has run into major stumbling blocks. Spokesman Al Parinello has insisted that the plan hasn't been scuttled, but, to date, it is so far behind schedule that there must be some serious revamping going on.

## TeleCable Teledata Tale

**TeleCable** Corporation has formed an **alliance with** both **Radio Shack and CompuServe to provide interactive videotex** services to cable subscribers in the future. The project hinges on the development of a cable-compatible videotex terminal for home use. TeleCable personnel are working with Radio Shack to perfect a version of the company's recently introduced TRS-80 model and are planning on the availability of such a terminal **by the fall of 1981**. The complete videotex package has been labeled TeleCable's teledata system and will include services offered by CompuServe, a subsidiary of H&R Block. CompuServe has been providing computer services to business and government agencies for the last decade. TeleCable is confident that the partnership will prove successful and is including the interactive service in its new franchise proposals.

## Two Scrambled, Please

The Federal Communications Commission (FCC) has decided to **allow Wometco** to **buy WSNL-TV**, Channel 67, Smithtown, New York, and operate **it as a "satellite" of its STV station WWHT-TV**, Channel 68, Newark, New Jersey. Satellite stations are regular television stations complying with all of the FCC's technical rules, except they mainly rebroadcast the programming of the parent station. **WSNL-TV will rebroadcast** the conventional and STV programming of **WWHT and originate 4½ hours per week** of local programming. The grant was made under the "satellite exception" provision of the FCC's duopoly rules. Those rules say that no application will be granted which would result in any party owning, operating or controlling two commercial television stations whose predicted **Grade B contours overlap**. Exception can be made for what are primarily satellite operations. The commission made the exception this time so that the public would not be deprived service and stressed that a competing application could be filed at renewal time. For now, however, with the parent and satellite station, **Wometco** has at least a Grade B **coverage** for its STV operation **over most of New York City and Long Island**.

## Unofficial Lottery Alternatives

Just out of the Federal Communications Commission's **Office of Plans and Policy** (OPP) is a **"working paper" on "Frequency Spectrum Deregulation Alternatives."** There it is again, the word "deregulation" that flows freely from the Chairman's mouth. "Spectrum management" is another topic to which the Chairman refers quite frequently, especially in private radio and common carrier matters. But his preferred alternatives, lotteries and auctions, are not very popular. Neither were highly recommended in this paper. Instead, OPP **suggested alternatives** such as: **freer transferability of licenses; limiting** the use of **petitions to deny; allowing sharing** and **resale; more** technical **flexibility; giving users** a clear but limited **property right**; and **reducing** the number of separate **classes of allocations**. Notably present was the disclaimer that the "views expressed are those of the author, Doug Webbink, and do not necessarily represent those of the commission or its staff."

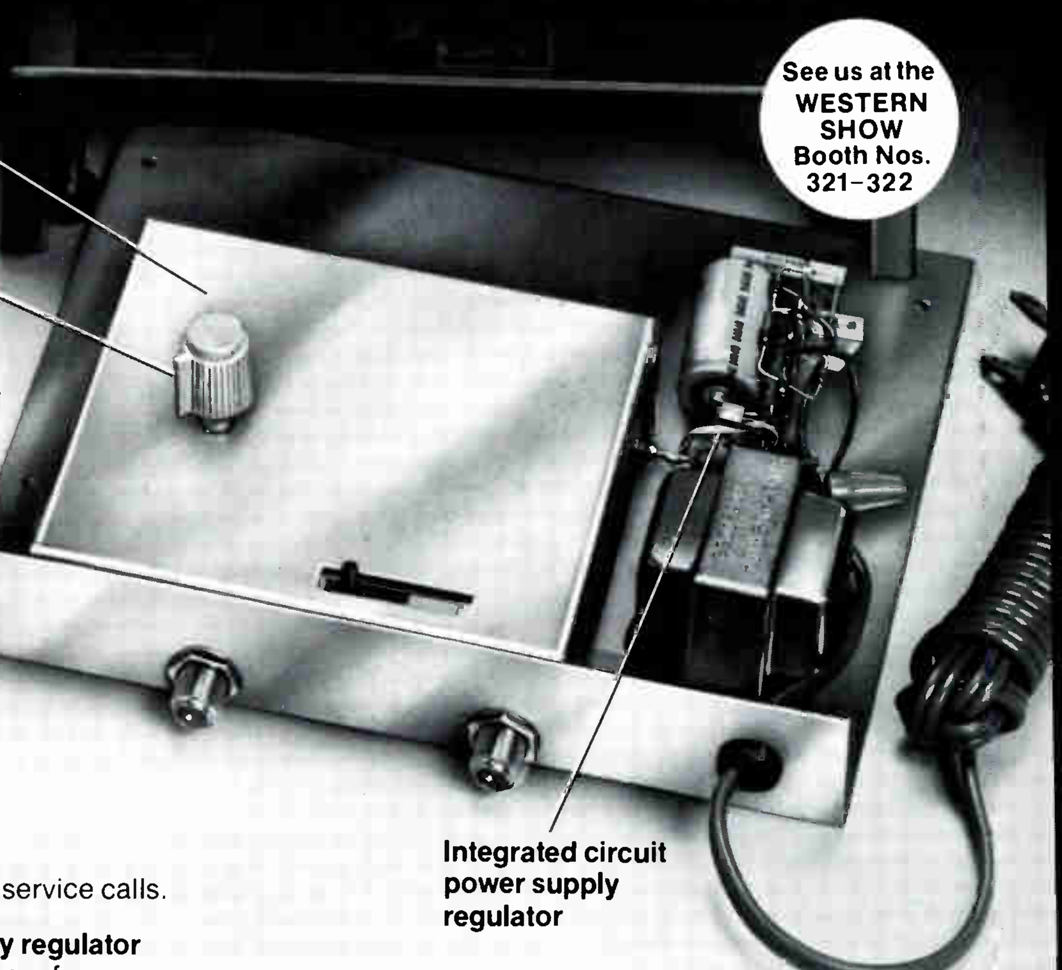
## 11 Satellites At Once

**Calvert Telecommunications** (Caltec), which serves cable subscribers in Baltimore County, Maryland, is anxiously **awaiting delivery** of the **first spherical reflector antenna** from United States Tower Company of Afton, Oklahoma. Caltec placed the initial order for the new line of antenna that has the **capability of receiving signals** from as many as **11 satellites simultaneously**. The model that Caltec will install has a dimension of 22½' by 36' and will be constructed from 12 7½' by 9' panels. With that configuration, the spherical reflector is anticipated to deliver a signal **quality equivalent to a six-meter paraboloid dish**, but with the added capability of bringing in transmissions from satellites orbiting anywhere from 70° to 140° in the geosynchronous arc. Jim Wright, engineering manager, says the antenna is planned for Caltec's north system outside of Baltimore. So far, his only concern is dealing with "the **unknowns of radiation patterns**" with the new antenna. But he's not anticipating any problems. The latest word from U.S. Tower is that the panels will be shipped December 10.

## Two-Way Privacy

The **prospect** for **implementation** of interactive two-way technology has triggered discussion of a **host of public policy** concerns in areas ranging from media **ownership** to **property rights** for the information transmitted. Not the least of the public policy questions that two-way raises is that of **privacy**. As FCC Chairman Charles Ferris recently pointed out, an interactive cable system that polls homes every few seconds to see what viewers are watching offers tremendous potential in terms of services that can be provided. But, he remarked, it also offers opportunity for abuse if subscribers' preferences are easily disclosed and used for illegitimate purposes. Ferris urged those responsible for developing goods and services for the new information society to think of the privacy consequences and to try to address them at an early stage. He urged engineers to design them away, program them away, and to do their engineering with this human interest goal in mind.

# ATTENTION, 12-CHANNEL SYSTEMS READY TO EXPAND:

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# Seminars

## DECEMBER

**5-6:** The **Council of Communication Societies** is holding its annual seminar at the Crystal City Marriott Hotel in Arlington, Virginia. Contact Dr. Vernon Root, (301) 953-7100.

**9-13:** The **NCTA Engineering Committee** will hold a business meeting before and a field trip after the Western Show in Anaheim, California.

**10-12: NCTA** is holding a meeting of the Subcommittee on Videotex/Teletext, during the Western Show in Anaheim, California.

**10-12: Integrated Computer Systems, Inc.**, is holding a workshop on "Fiber Optics Communications Systems" in Boston, Massachusetts. Contact Ruth Dordick, (800) 421-8166; (213) 450-2060.

**10-13:** The **California Community Television Association** is sponsoring the Western Cable Show to be held at the Disneyland Hotel in Anaheim, California. Contact Fran Ferriter, (415) 881-0211.

## JANUARY

**7-8: The U.S. Independent Telephone Association** will sponsor a roundtable seminar titled "Deregulation and Competition in a Changing Telecommunications World," at the airport Sheraton Inn in Atlanta, Georgia. Contact Robert Nachtweh, (202) 872-1200.

**12-16: Hughes Aircraft Company's** microwave communications products technical seminar will demonstrate detailed operation and maintenance procedures for AML systems. Tuition-free, the seminar will be held at Hughes' Torrance, California, facility. Contact the firm at (213) 517-6100.

**14:** The **New England Cable Television Association** is holding its winter meeting at the Sonesta Hotel in Boston, Massachusetts. Contact the association at (603) 224-3373.

**14-16: Integrated Computer Systems, Inc.**, is holding a workshop on "Fiber Optics Communications Systems" in San Francisco, California. Contact Ruth Dordick, (800) 421-8166; (213) 450-2060.

**19-20:** The **Society of Cable Television Engineers** will hold a seminar on "Digital Electronics and Cable TV" and "Preventive Maintenance" at the Cross Keys Inn, Baltimore, Maryland. Contact SCTE at (202) 293-7841.

**25: Conexpo '81** opens at the Astrodome in Houston, Texas. Contact Dan Fricker, (414) 636-7000.

**27-29:** A **Jerrold** Technical Seminar is meeting at the Princess Kaiulani Hotel in Honolulu, Hawaii. Contact Len Ecker, (215) 674-4800.

## FEBRUARY

**1-2: Information Gatekeepers, Inc.**, will sponsor a two-day marketing and technology conference on fiber optics and satellites in local broadband and computer networks at the Hyatt Regency Hotel, San Francisco, California. Contact Ellen Bond, (617) 739-2022.

**3-5:** A **Jerrold** Technical Seminar will be held in Long Beach, California. Contact Len Ecken, (215) 674-4800.

**4-6: Texas Cable Television Association** is holding its annual convention and trade show at the Convention Center in San Antonio, Texas. Contact W.D. Arnold, (214) 593-0335.

**9-10:** The **Society of Cable Television Engineers** will hold a

seminar on "Cable Plant Construction" and "System Test Requirements" at Stouffer's Indianapolis Inn, Indianapolis, Indiana. Contact SCTE at (202) 293-7841.
**10-11: Arizona Cable Television Association** is having its annual meeting at the Adams Hotel in Phoenix, Arizona. Contact the association at (602) 257-9338.
**18-20:** The **Arkansas Cable Television Association** is holding its annual meeting in Little Rock, Arkansas. Contact Tom Carroll, (501) 321-7730.
**24-26:** A **Jerrold** Technical Seminar will be held in Orlando, Florida. Contact Len Ecker, (215) 674-4800.

## MARCH

**2-4: Information Utilities '81** will focus on interactive cable and new technologies at the New York Hilton, New York, New York. Contact Jeffery Pemberton, (203) 227-8466.
**9-11: Arizona State University**, Tempe, Arizona, is holding a three-day intensive course on "Fiber Optical Communications." Contact Dr. Joseph Palais, (602) 965-3757.
**15-17: North Central Cable Television Association** is meeting at the Holiday Inn in Fargo, North Dakota. Contact Paul Keating, (701) 662-8141.
**16-17:** The annual spring engineering conference of the **Society of Cable Television Engineers** is being held at the Opryland Hotel in Nashville, Tennessee. Contact the association at (202) 293-7841.
**18-19:** The **Georgia Cable Television Association** will hold its annual convention at the Sheraton-Atlanta Hotel, Atlanta, Georgia. Contact Marian Smith, (912) 354-7531.
**24-26: Information Gatekeepers, Inc.**, is holding FOC '81 East at the Hyatt Regency Cambridge in Boston, Massachusetts. The event will include a fiber optics trade show, three short courses on fiber optics and a technical program on short-to-medium-range fiber optics applications. Contact the firm at (617) 739-2022.
**28-April 1: Illinois-Indiana Cable Television Association** is having its annual convention at the Hyatt Regency Hotel in Indianapolis, Indiana.

## APRIL

**12-15:** The **National Association of Broadcasters** is holding its 59th annual convention at the Convention Center in Las Vegas.
**13-14:** The **Society of Cable Television Engineers** will hold a seminar on "Digital Electronics and Cable TV" at Stouffer's Inn, Denver Airport, Denver, Colorado. Contact SCTE at (202) 293-7841.
**22-24: Integrated Computer Systems, Inc.**, is holding a workshop on "Fiber Optics Communications Systems" in Los Angeles, California. Contact Ruth Dordick, (800) 421-8166.

## MAY

**11-12:** The **Society of Cable Television Engineers** will hold a seminar on "System Test Requirements" and "Preventive Maintenance" at the Hilton Airport Inn, Kansas City, Missouri. Contact SCTE at (202) 293-7841.
**13-15: Integrated Computer Systems, Inc.**, is holding a workshop on "Fiber Optics Communications Systems" in Washington, D.C. Contact Ruth Dordick, (800) 421-8166; (213) 450-2060.
**20-22: Videotex '81**, an international conference and exhibition, will be held at the Royal York Hotel (Toronto, Ontario) and the Canadian National Exhibition grounds.
**29-June 1:** The **National Cable Television Association** is holding its 1981 convention in Los Angeles, California. Contact Rochelle Nezin, (202) 457-6700.

**Introducing Wavetek's 400MHz Sweep Recovery System.**

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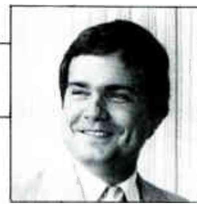
# Editorial

By Pat Gushman



## The New CED: "Hands on" the Future

Did you recognize us? Now into its sixth year of publication, **Communications Engineering Digest** sports a new look with this December issue. For the face-lift, congratulations are due, in part, to Assistant Art Director Brad Hamilton, the pilot of our creative efforts throughout this transition. To countless others on our staff, whose names are too numerous to mention here, we also owe a debt of thanks—for their suggestions, as well as occasional criticisms. And no uncertain amount of credit goes to Associate Managing Editor Brian Huggins, who, over the past several weeks, has worked closely with Brad, et al, in getting this magazine off the boards and into the hands of our readers. Hopefully, our thousands of subscribers will find the "new" **CED** not only attractive and easier to read; but, ultimately, we've set upon a course to make *your* magazine much more useful—much more suitable to *your* needs, to meet increasing demands for an accurate, timely source of information on developments affecting the technical sector of the ever-expanding cable television industry.

To paraphrase a popular beer commercial, this magazine is for all of you who keep those cable television services coming. For the techs in the field and engineering vice presidents of the largest MSOs, for those who design the systems as well as those who build them, we are working to make **CED** as at-home in the field as in the executive suite, as comfortable atop the drafting table as on the test bench. This means carefully combining reportage on the high-technology aspects of this business with the "hands-on" type of information that is crucial to the continued expansion of the various and diverse applications of broadband communications.

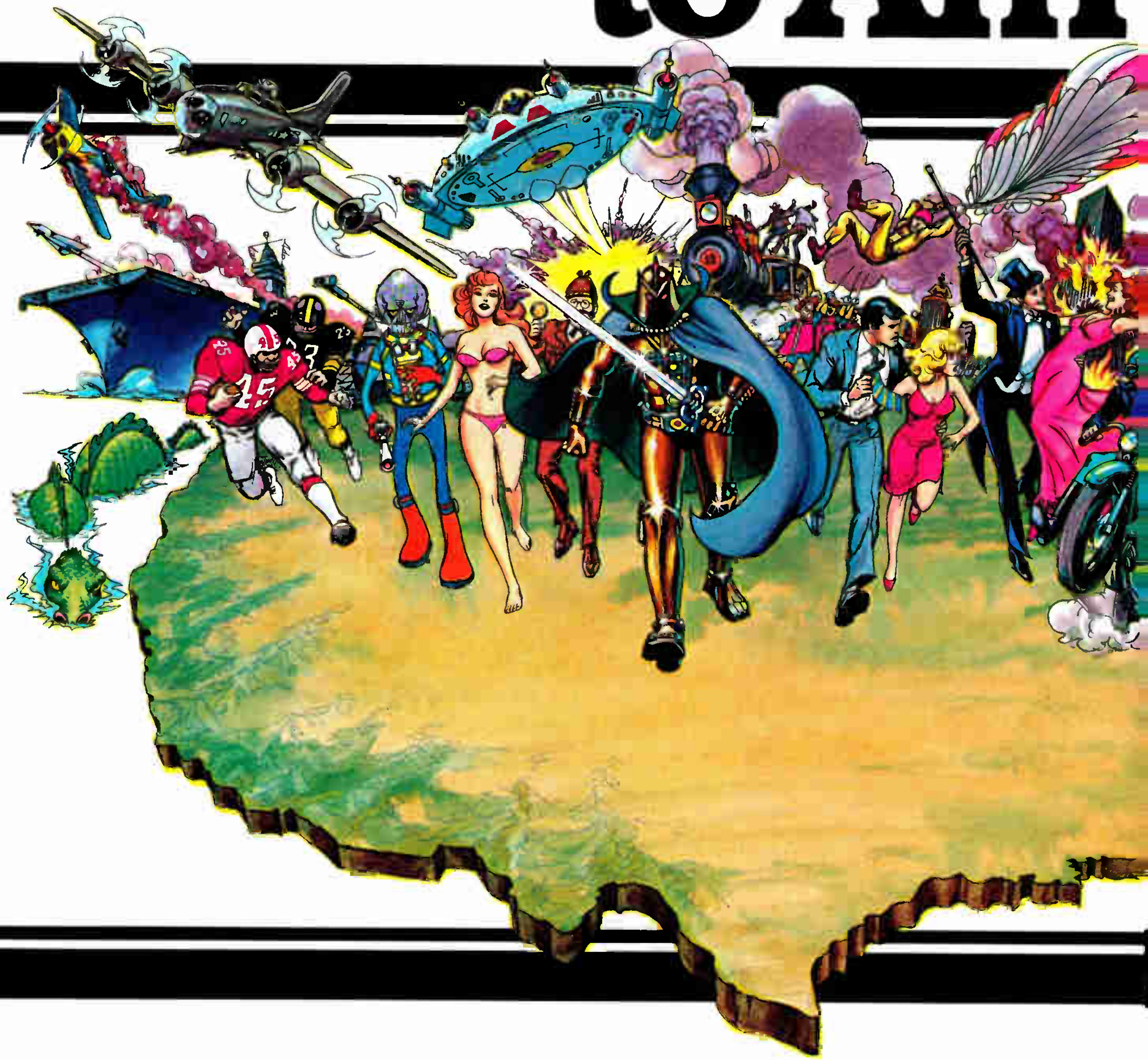
That is the challenge which faces **CED** in the months and years ahead. And to the advertisers supporting us in this effort, we extend our thanks.

The difficult challenges facing the broadband telecommunications industry not only bring with them new opportunities for engineers and technicians, but they bring new responsibilities, as well. In working with a technology which has the potential to deliver a seemingly endless number of services to homes and businesses, system engineering at once becomes social engineering—not only capable of altering certain behavioral patterns, but, in fact, spawning an entirely new cultural system. The myriad of non-entertainment services coming on stream in the next few years have the potential of virtually eclipsing the entertainment offerings which have been the revenue base for the cable television industry throughout the first 30 years of its existence. Furthermore, data transmission, information retrieval, security, etc. will have yet another impact, in that they will markedly change the way the industry has done business for three decades. No longer will systems be able to operate in a solitary fashion, as so-called *de facto* monopolies in one isolated community after another. To be sure, there will be increasing competition from other media, with other technologies, which will raise the marketplace expectations of system performance.

Perhaps even more importantly, the broadband telecommunications systems of the '80s will become part of the vast, complex communications network serving business and consumer needs in half the country by decade's end. The telephone company has talked of the "integrity" of its network for years. And when cable system after cable system become linked together via satellite and microwave, "network integrity" will become an important part of the cable television vernacular, too. When that happens, telephone and cable television will become truly competitive. As the battle is joined, **CED** will chronicle it—reporting developments on all fronts.

Pat Gushman

# We're taking to Am

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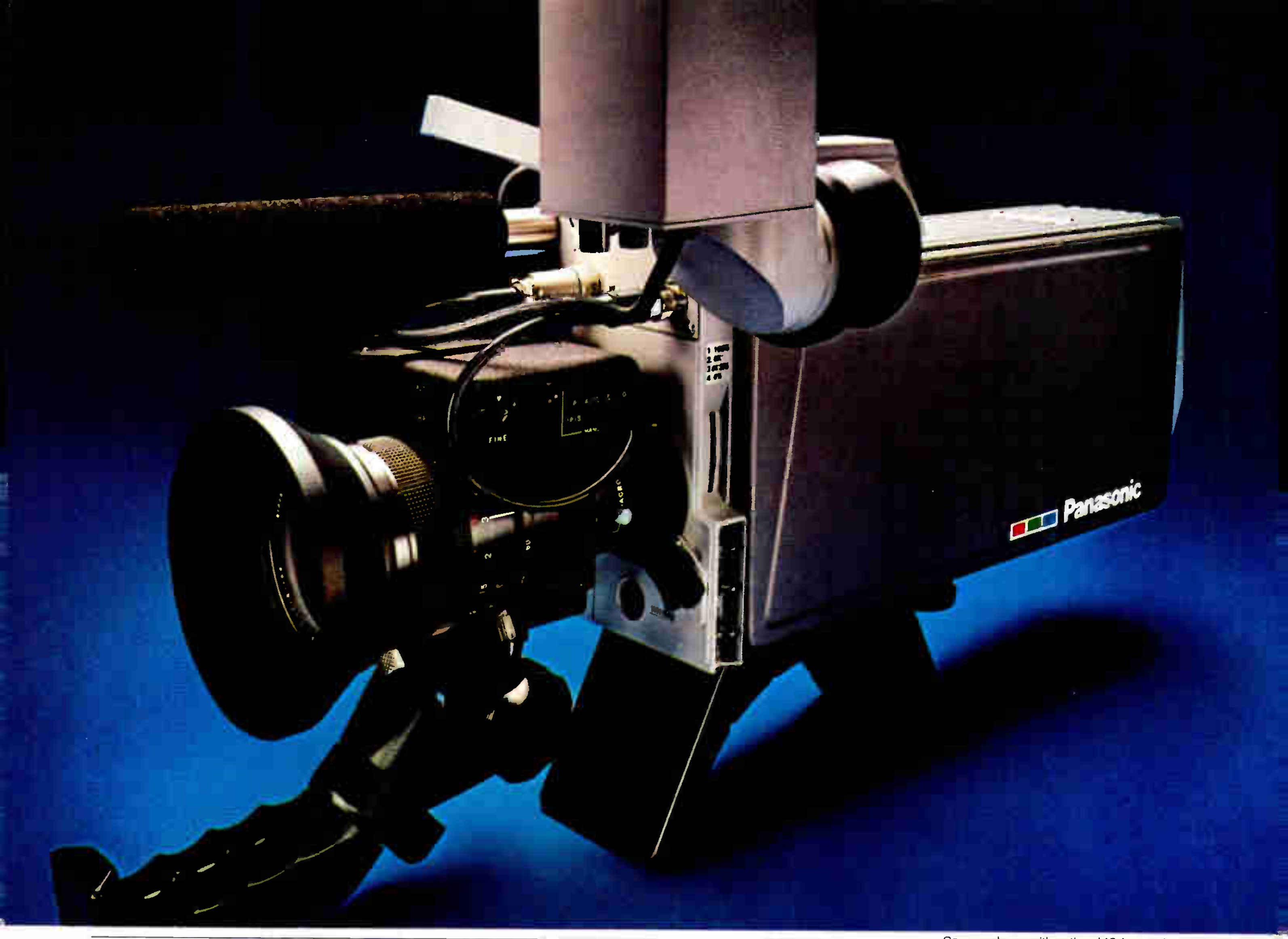
In a cable television marketplace cluttered with confusing claims, *The Movie Channel* stands out with a very simple concept: All movies, nothing but movies, 24 hours a day. America is going to love it.

All the research tells us that this is the kind of programming that subscribers everywhere want most. Only *The Movie Channel* brings it to them, around-the-clock, and in the widest variety: the smash hits, the classics, the foreign films, and special film festivals. They'll all be there, no matter what time of day or night subscribers want to see them.

Programming that attracts and holds subscribers is important to your profit picture. Let us show you how *The Movie Channel* can help your system, and your profits. Call your local Field Representative. And bring the movies to your part of America.

THE MOVIE CHANNEL

**We're taking the movies to America.**




Camera shown with optional 12:1 zoom lens.

# Introducing 4,551 reasons to buy the Panasonic AK-750B three-tube Plumbicon® camera.

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For the field, the AK-750B is a fully self-contained camera with timing and phase adjustments built in, but weighing in at only 16 lbs. (not including lens). And it's just as light on power, using only 23 watts. The camera comes with a C-mount adapter. And it can interface with an EFP system because it accepts single-cable external sync.

The AK-750B can also be used as a studio camera with our optional Remote Control Unit and 4.5" CRT viewfinder.

Optional studio configuration.

But whether you're indoors or out, the AK-750B performs superbly with a S/N ratio of 50dB, and horizontal resolution is 500 lines at center (recommended illumination of 200 footcandles at f/4). There's even a +6dB gain for minimum illumination of just 15 footcandles at f/1.8.

The AK-750B. Because only Panasonic gives you so many reasons to buy a three-tube Plumbicon camera.

*Panasonic recommended price, but actual price will be set by dealers.

*Plumbicon* is a registered trademark of N.V. Philips of Holland for TV camera tubes.

For more information, write: Panasonic Company, Video Systems Division, One Panasonic Way, Secaucus, N.J. 07094. In Canada, Panasonic Video Systems Department, Mississauga, Ontario.

**Panasonic.**
VIDEO SYSTEMS DIVISION

## FCC Sets Standards Limiting Periscope Antennas

WASHINGTON, D.C.—In an effort to establish similar technical standards for both Cable Television Relay Service (CARS) and Television Broadcast Auxiliary Service equipment, the Federal Communications Commission (FCC) has issued its Second Report and Order amending Parts 74 and 78 of its Rules and Regulations. Although most of the requirements are directed toward conforming the broadcast standards, there will be restrictions on the CARS equipment as well.

The FCC action dates back to December 1977 when the FCC proposed expanding the CARS band from 12.7-12.95 GHz to 12.7-13.20 GHz with co-equal sharing of the entire band with TV Auxiliary Broadcast stations. The allocation was adopted May 17, 1979, and further actions have attempted to reduce the likelihood of harmful interference to existing or proposed facilities using the spectrum.

"Most of the CARS equipment already complies," said Mel Murray, spokesman for the FCC Office of Science and Technology. "The changes would come from our attempt to control the proliferation of periscope antennas."

In gathering input before the rulemaking, the FCC proposed that the radiation pattern of antenna systems conform to certain specified limits. In areas of congestion, the use of a more directive (category A) antenna would be required and in less congested areas a less directive (category B) antenna would be allowed. If a periscope-antenna system were employed, the FCC proposed that such a system must meet or exceed the standards for conventional antennas.

This proposal prompted opposition from several cable operators who argued that rural areas would never have the degree of frequency usage found in other areas and that the FCC requirements would be burdensome. They suggested that any interference problems resulting from the use of periscope antennas could be worked out during the coordination period.

As a compromise, spokesmen for Viacom International and Teleprompter Corporation suggested that the licensing of new periscope-antenna systems be prohibited except upon submission of specific information showing that no frequency congestion exists in the area of proposed transmission. Under this scheme, each authorization of such a system would expressly require conversion to a conventional antenna if such congestion occurred.

As stated in the new amendments, new periscope systems will be authorized "upon a certification that the radiation, in a horizontal plane, from an illuminating antenna and reflector combination meets or exceeds the antenna standards of this Section [category A and B antennas]." However, the regulations do allow the FCC to approve requests for the use of periscope-antenna systems "where a persuasive showing is made that no frequency conflicts exist in the area of proposed use." If an applicant for a new TV auxiliary broadcast or CARS station indicates that the use of such an existing system will cause interference to the new facility, the licensee must remedy the interference by using a category A or B antenna system.

Any fixed station licensee whose application was accepted prior to October 1, 1981, may continue to use its existing antenna system, subject to periodic renewal until October 1, 1991. After that date, all licensees will be required to conform to the new standards unless granted a waiver under the terms of the exception.

The regulations leave the choice of receiving antennas to the discretion of the individual licensee. However, licensees "will not be protected from interference which results from the use of antennas with poorer performance" than established in previous standards.

The case for using non-standard antennas in exceptional cases received support in documents filed by the CBS and NBC broadcast networks during the comment period. Both cited the World Trade Center in New York City as an example where the use of a category A antenna was prohibited. The separation between the main columns in the outer walls of the building is only 28 inches, making the use of a conventional system impossible. In responding to the specific case, the FCC stated that "We will individually entertain requests for exceptions where the applicant has clearly indicated in detail why an antenna system complying with the required standards cannot be installed."

Although most of the other amendments deal with TV Broadcast Auxiliary stations, changes in Part 78 deal specifically with CARS standards. In the area of power limitations, the regulations state that "with the exception of pickup stations, transmitter-peak-output power shall not be greater than necessary, and, in no event, shall exceed five watts on any channel." For CARS pickup stations, the upper limit for transmitter-peak-output power has been set at 1.5 watts.

Other amendments to Part 78 establish performance standards for the directional antennas required of fixed CARS stations as listed in the chart below. If a licensee can show an adequate need to serve a larger sector or more than one sector, the regulations allow for the authorization of greater beam width or multiple antennas. In order to receive such authorization, the applicant must specify the polarization of each transmitted signal.

The final changes center around CARS equipment and its installation. Any installation of CARS equipment must be made by a qualified engineer or under the immediate supervision of an operator who holds a valid first- or second-class radiotelephone operator license. However, simple repairs such as the replacement of tubes, fuses or other plug-in components may be made by an unskilled person.

**The FCC established the following performance standards for the directional antennas required of fixed CARS stations.**

| Frequency (in megahertz) | Category | Maximum beam-width to 3 dB (included angle in degrees) | Minimum radiation suppression at angle in degrees from centerline of main beam in decibels: 5 to 10 degrees | 10 to 15 degrees | 15 to 20 degrees | 20 to 30 degrees | 30 to 100 degrees | 100 to 140 degrees | 140 to 180 degrees |
|---|---|---|---|---|---|---|---|---|---|
| 12,700-13,200 | A | 1.0 | 23 dB | 28 dB | 35 dB | 39 dB | 41 dB | 42 dB | 50 dB |
| | B | 2.0 | 20 dB | 25 dB | 28 dB | 30 dB | 32 dB | 37 dB | 47 dB |

## NCTA Attacks CBS Plan For Teletext Standard

WASHINGTON, D.C.—Earlier this year, CBS, Inc., filed a rulemaking petition with the Federal Communications Commission (FCC) proposing that Antiope, the French teletext system, be adopted as the standard for teletext in this country. In a recent response to the CBS filing, the National Cable Television Association (NCTA) has categorically enumerated why the initiation of teletext rules based on this request would be premature.

The CBS filing centered around the need to adopt standards "which would allow television broadcast licensees to transmit teletext." However, the NCTA charged that since television broadcast licensees will be only one of many users of the new technology in years to come, any FCC regulations must fairly consider the needs of all communication-delivery systems.

While conceding that the public interest would best be served by the prompt adoption of standards by the federal government, the NCTA presents the case that several critical questions have yet to be answered. According to the association, the dangers of adopting rules now include: such standards would be outmoded prematurely; they would curtail future research and development; and present action could prejudice the development of teletext capabilities in other communications media, such as cable, which may require different standards. The NCTA also argued that accepting ill-considered standards could "adversely affect the public acceptance necessary for the creation of an economically viable national teletext system."

As an alternative, the NCTA suggests holding off on any adoption of standards until the Electronic Industries Association (EIA) completes a thorough study of optimal standards. However, the delay the EIA is experiencing in completing its efforts is one point that CBS included in its rulemaking petition. The EIA "has been very active and productive during the past year and a half of its existence, but is very much behind schedule," the petition stated.

The research project undertaken by the EIA was to have been completed by January 1, 1980. The NCTA cites the problems the research team has encountered as evidence that a quick decision is unwarranted.

"The issues surrounding the adoption of a single national teletext standard are very complex," the filing stated. "Initiation of a rulemaking proceeding cannot speed up that process."

Within the NCTA itself, the Engineering Committee has established a Teletext Standards Subcommittee, chaired by John Lopinto of Home Box Office. It was formed in part to work with the EIA in assuring that cable industry concerns are represented in the establishment of any national teletext standards. The subcommittee is composed of cable system operators, satellite users, television-receiver manufacturers, hardware manufacturers and representatives of software producers.

This information was provided to the FCC to assure the commission that work on developing teletext standards is proceeding and the findings of these groups "must be taken into consideration before the commission can adopt a truly meaningful national teletext standard which would serve the public interest, conveniences and necessity."

The filing added that, "no irreparable injury would result in denying the CBS petition at this time."

Beyond the political reasons for delay, the NCTA spelled out specific technical concerns. The CBS petition failed to take into account the interests of any nonbroadcasters and specifically ignored the peculiar adjacency of signals in a cable system. Since there is a relatively high amount of energy at the band edge of each channel, the NCTA reports, the teletext signal "may adversely affect adjacent video and/or aural channel performance. Accordingly, any new signals, such as those introduced by the insertion of teletext in the vertical blanking interval, could have a potentially deleterious effect upon other frequencies being carried within the same cable distribution system."

In addition, the bit rate (the speed that the machine-readable letters or digits are transmitted) proposed by CBS is 5.727272. The NCTA contends this may be incompatible with the cable system. The result of an improper bit rate would be an increase in the potential of interference within the host channel or any adjacent channels.

Other questions that have not been sufficiently answered in the CBS proposal are pulse-shape standards, the impact of the CBS bit rate on the upstream information of a cable system offering interactive service and the ancillary concern of signal leakage from whatever decoders are ultimately developed.

In concluding its opposition filing, the NCTA reminded the commission that although the cable industry is presently serving only about 20 percent of television households in the country, by 1985, when teletext is expected to play a major role in communications, that figure will have jumped to around 33 percent. Therefore, it is imperative that the cable television industry be included in any considerations of national teletext standards.

"While the cable television industry supports the concept of teletext and videotex services," the filing stated, "the industry cannot be shackled at this early juncture with a set of standards about which so little is known within the nonbroadcast environment."

Although CBS claims to have no proprietary interest in the Antiope system, a major teletext experiment is underway utilizing Antiope at a CBS affiliate, KNXT-TV, and a noncommercial station KCET-TV. Both are in Los Angeles.

## FCC Weighs Value Of First-Class License

WASHINGTON, D.C.—The Federal Communications Commission's (FCC) inquiry into the discontinuance of first-class radiotelephone operator licenses has created a flurry of response from the organizations which would be affected by that decision. Although there seems to be general agreement that the licensing examination in itself is not an effective measurement of technical competence, some groups are concerned about other ramifications of license elimination.

In a letter to the members of the Society of Cable Television Engineers (SCTE), Executive Director Judith Baer wrote that "numerous requirements for licensing and/or 'certification' are unfair to the individuals employed in this or any other industry." However, Baer expressed her concern that elimination of the first-class license on the federal level could create new problems.

"As the Federal Communications Commission walks away from regulation and standards, the state and local jurisdictions are walking right back in," Baer wrote.

*Judith Baer, executive director of the Society of Cable Television Engineers, warned that the elimination of the first-class license at the federal level could create new problems.*

Even though cable television systems are not licensed by the FCC, many cable operators in the past have based hiring decisions on whether an applicant possessed a first-class license. If the system is scrapped, both cable and broadcast engineers will be looking for new ways to screen applicants.

In comments filed in response to the FCC Notice of Inquiry on the elimination proposal, present holders of first-class licenses were, not surprisingly, in favor of retaining the licensing requirement by a 95-to-1 margin. Station managers and licensees were split 48-48 on the same question. Supporters of retention stated that they prefer to hire an operator who has "demonstrated some degree of technical knowledge and ability by passing a required examination." Predictably, large-market broadcasters tended to favor the licensing requirement while broadcasters in smaller markets leaned in the other direction.

Subsequent surveys by the Society for Broadcast Engineers (SBE) have produced the following figures: 66.6 percent of those responding favored retention of the licenses, with 23.8 percent opposed. Those in favor of keeping the first-class license reasoned that any examination system is better than no system at all. Those opposed cited the argument that the knowledge necessary to pass the examination is insufficient to guarantee that the license holder could actually operate and maintain transmit facilities.

In explaining the issue to SBE members, President Robert Jones stated that "the SBE officers and board members are quite concerned over what appears to be a degrading trend by the FCC of the engineering and technical profession. We question whether these efforts are really necessary or are merely self-serving."

One organization that is supporting the FCC proposal is the National Association of Broadcasters (NAB). In filings with the commission, the NAB concurred with the FCC conclusion that federal licensing procedures are not an adequate test of technical competence. If the license were eliminated, the NAB recommended the industry devise an alternative program where testing could be conducted at broadcast stations enabling applicants to work directly with transmitting equipment to exhibit their knowledge and technical competence.

The FCC action is an ongoing study of the viability of licensing requirements in broadcast and nonbroadcast areas. The commission has already abolished the third-class licensing requirements and is beginning a study on the need for the second-class phase as well. If the first- and second-class licenses go the way of the third, individuals performing technical functions at broadcast stations would only need the restricted radiotelephone operator permit.

## Siecor Supplies Optical Cable For New York Power Utility

HICKORY, NORTH CAROLINA—Siecor Optical Cables, Inc., has announced the installation of a major fiber optic system by Niagara Mohawk Power Corporation. Siecor claims the system is the longest high performance trunk system built in the United States by a company outside the telephone industry.

Siecor supplied 15 kilometers of eight all-dielectric ESR fiber cable (Extended Spectral Response) which will allow the system to operate in the 800 to 1300 nm region.

Presently, the system is using 850 nm sources and is designed for six kilometer repeater spacing. In the future, the system can use long wavelength sources to eliminate the need for repeaters. Within the cable, six fibers are dedicated to operation and two fibers are used for experimental purposes. Attenuation of the operational fibers is less than 2.2 dB/km at 1300 nm, and 3.7 dB/km at 850 nm; their bandwidth is greater than 400 MHz•km over the 800 to 1300 nm range.

Niagara Mohawk line crews have installed 2 kilometers in ducts and 12 kilometers aerially on poles carrying 34.5 kv sub-transmission lines.

In addition to the cable, Siecor provided installation and maintenance training; site supervision; program documentation; and splicing.

Harris Corporation of Melbourne, Florida supplied the electronics.

## Trade Shows Boost Sales

WASHINGTON, D.C.—Attendance at a major trade show is followed by the purchase of one or more items that were exhibited, according to a research report released by the Trade Show Bureau. A study of those who attended the 1978 National Computer Conference found that 11 months after the show, 69 percent had already made a purchase; within the following year, 81 percent of all attendees had bought something that was displayed at the show.

## Fiber To Link Canadian Telephone Systems

BURNABY, BRITISH COLUMBIA—A new fiber optic link between Vancouver and the mainland will be completed by 1981, according to officials of the British Columbia Telephone Company. The System will be just under three km long and will connect the central telephone office in Victoria to the new digital microwave terminal, recently installed at Smith Hill.

The installation is expected to cost $4 million. It will have a capacity of 1,344 voice channels and will be installed underground with several spare fibers for future expansion potential.

## Fiber Industry Set To Explode

MILBURN, NEW JERSEY—According to a new study by Probe Research, future fiber optic installations now being planned indicate a sharp change in direction of the fiber optic communications industry.

Planning for new installations indicate a quantum-level jump in size of fiber optic system procurement dollars. They show a dramatic change in function. The ascendancy of long-haul applications is generating a good deal of industry excitement. Further-more, long-wave length systems are now in the planning state, and will constitute a "next generation" with major impact.

## GTE Fiber Optics Division Formed

SAN CARLOS, CALIFORNIA—General Telephone & Electronics Corporation announced the formation of a new strategic business unit of its GTE Lenkurt subsidiary for fiber optics communications systems, and named Arthur R. Kraemer as vice president/general manager.

Herbert K. Krengel, president of GTE Lenkurt, told a news conference that the formation of GTE Lenkurt Fiber Optics Division "is an important step preparing the company to meet the competitive and technological challenges offered to a dynamic new telecommunication medium that is revolutionizing the way people's phone calls, television pictures and data messages are transmitted over the telephone network."

In making the announcement, Krengel also noted the new operation will initially be located at the company's headquarters in San Carlos, but will relocate in the near future to its own facilities in Mountain View, California.

Kraemer was previously business unit manager of the electro-optics group at GTE Sylvania Systems Group, Western Division, in Mountain View, California, where he directed all phases of laser radar and optical communications systems development.

## If It's Good Enough For Swine . . .

SEATTLE, WASHINGTON—Responding to claims from environmentalists and others about the possible effects of electromagnetic "smog" on humans and other living beings, researchers at Battelle's Pacific Northwest Laboratories have started a long-range experiment to build up a data base on the subject.

## Correction: Dish-Aiming Program for Programmable Calculator

The November issue of **CED** featured a calculator program for aiming satellite dishes. Unfortunately, step 060 was omitted from the chart. This month, **CED** reprints the entire calculator program.

The program, which will compute antennae azimuth and elevation angle to an accuracy of one-tenth of one degree, is based on the following equation.

$$A+180° = \text{Arc tan} \left(+/- \tan\lambda / \text{Sin}\,\varphi\right)$$

$$E = \tan^{-1}\left(\frac{(6.6362092\ \text{Cos}\lambda\ \text{Cos}\varphi)-1}{6.6362092\ \sqrt{1-\text{Cos}^2\lambda\ \text{Cos}^2\varphi}}\right)$$

Where:

A = Azimuth angle in degrees from true north.
E = Elevation angle in degrees.
$\lambda$ = Difference in longitude between the earth receive station and the satellite of interest.
$\varphi$ = The earth receive station's latitude in degrees.

To test the program, calculate the antennae azimuth and elevation angle using the following data: Satellite of Interest Longitude is 135° W; the Earth Receive Station Longitude is 121D 15M 45S W; and the Earth Receive Station Latitude is 38D 03M 44S N.

Key in **135** Push **A** Display should now read 135.
Key in **121.1545** Push **B** Display should read 121.2625...
Key in **38.0344** Push **C** Display should read 38.0622...
Push **D** Display should read 201.6, the antennae azimuth in degrees from true north.
Push **E** Display should read 43.6, the antennae azimuth angle in degrees.

Be careful: When entering degrees of longitude and latitude, place a decimal point after the degrees (i.e. 121.). Always use four places after the decimal point, placing a zero before all single-digit entries (.0344, not .344).

The program was developed by Steven Lowe, Sr., and Dr. Robert Sam Lackey.

| | | | | | |
|---|---|---|---|---|---|
| Off/On | 021 RCL | 044 + | 067 2 | 090 = | 113 RCL |
| LRN | 022 01 | 045 1 | 068 STO | 091 STO | 114 13 |
| | 023 - | 046 8 | 069 08 | 092 10 | 115 = |
| *001 Lbl | 024 RCL | 047 0 | 070 RCL | 093 RCL | 116 √x |
| 002 A | 025 02 | 048 = | 071 01 | 094 07 | 117 X |
| *003 DMS | 026 = | 049 STO | 072 - | 095 X | 118 RCL |
| 004 STO | *027 TAN | 050 06 | 073 RCL | 096 STO | 119 08 |
| 005 01 | 028 STO | 051 R/S | 074 02 | 097 11 | 120 = |
| 006 R/S | 029 04 | *052 Lbl | 075 = | 098 RCL | 121 STO |
| *007 Lbl | 030 RCL | 053 E | *076 COS | 099 09 | 122 14 |
| 008 B | 031 03 | 054 RCL | 077 STO | 100 $X^2$ | 123 RCL |
| *009 DMS | *032 SIN | 055 03 | 078 09 | 101 STO | 124 10 |
| 010 STO | 033 = | *056 COS | 079 RCL | 102 12 | 125 ÷ |
| 011 02 | 034 STO | 057 STO | 080 09 | 103 RCL | 126 RCL |
| 012 R/S | 035 05 | 058 07 | 081 X | 104 11 | 127 14 |
| *013 Lbl | 036 RCL | 059 6 | 082 RCL | 105 X | 128 = |
| 014 C | 037 04 | 060 • | 083 07 | 106 RCL | 129 INV |
| *015 DMS | 038 ÷ | 061 6 | 084 X | 107 12 | *130 TAN |
| 016 STO | 039 RCL | 062 3 | 085 RCL | 108 = | 131 STO |
| 017 03 | 040 05 | 063 6 | 086 08 | 109 STO | 132 15 |
| 018 R/S | 041 = | 064 2 | 087 = | 110 13 | 133 R/S |
| *019 Lbl | 042 INV | 065 0 | 088 - | 110 1 | |
| 020 D | *043 TAN | 066 9 | 089 1 | 112 - | LRN/Rst |

★ *Indicates second function of a key.*

The wide spread use of power transmission lines, microwave equipment (including microwave ovens), television sets, automobiles, telephone lines, and a thousand other devices have led to the widely-expressed concern that living in such a highly-charged electromagnetic environment could be harmful to health.

Battelle researchers are using two groups of 40 Hanford miniature swine, exposing one group to an electric field of 30 dV/m at 60 Hz for 20 hours per day, with four hours of relief for cage cleaning and feeding, and keeping the other group isolated in a nearby building with no electric field. The swine have so far been subjected to the radiation for periods ranging from six to 14 months without any obvious ill effects.

"All the animals have bred and delivered 140 offspring, and we have seen no apparent alteration in the growth and development of either the parents of the offspring," declared Dr. Richard D. Phillips, who manages the study. As reported in *Industrial Research & Development*, Phillips said that the team had detected no abnormalities in any of the piglets that were born within the electric fields.

Phillips emphasized that the study, sponsored by the Electric Power Research Institute, is in its early stages. By next spring, however, the Ballelle team expects to have usable data on the effects of electric fields on hematology, teratoloty, cytogenetics, pathology, behavior, and general growth and development.

## Satellites

### RCA Americom Revises Satellite Tariff

WASHINGTON, D.C.—In a recent filing with the Federal Communications Commission (FCC), RCA American Communications (RCA Americom) has proposed revisions of its satellite tariff to "assure the validity" of its second cable television network. The proposal would offer an additional transponder on the future Satcom IV to those present customers relegated to AT&T's Comstar D-2 satellite by the loss of Satcom III.

According to the latest RCA Americom plan, the replacement for Satcom III (Satcom IIIR) and Satcom IV will be launched by the end of 1981. Cable Net One customers currently transmitting programming from Satcom I will be moved to the Satcom III bird once it becomes operational. The next phase will be to move the Comstar D-2 customers, deemed Cable Net Two, to Satcom IV.

In the filing, RCA Americom cited the problems in establishing the second cable network as one of the considerations for its decision. Since only a small number of cable systems have an earth station pointed toward the Comstar D-2 bird, RCA acknowledged the difficulties Cable Net Two customers have had in establishing their services. When Satcom IV is operational, RCA Americom predicts that "each customer will develop his business rapidly" and is offering the option of an additional transponder so the customers "will have the facilities necessary for sustained growth and profitability."

Underlying the RCA Americom proposed tariff revision is an attempt to placate the Cable Net Two customers whose plans changed dramatically with the Satcom III disappearance. "Lastly," stated the filing, "due recognition is given to those customers who have borne the financial risks of uncertainty following the loss of the F-3 (Satcom III) satellite."

RCA Americom has requested that the tariff revision become effective January 20, 1981.

## SCTE News

### SCTE Schedules 1981 Technical Seminars

WASHINGTON, D.C.—The Society of Cable Television Engineers (SCTE) has lined up most of its technical meetings for next year. The SCTE meetings will be held at the airport hotel facilities of six cities.

SCTE's schedule will begin with two seminars January 19 and 20 in Baltimore, Maryland, at the Cross Keys Inn. The first, titled "Digital Electronics and Cable TV," will provide a basic understanding of digital technology and include demonstrations of current applications and an examination of potential growth in digital technology. The program, a new one for SCTE, will open with a four-hour course, "Introduction to Digital Electronics," taught by Joe Carr, who has written more than 30 books and 170 magazine articles on electronic technology.

After the introductory course, Doyle Haywood, of Wavetek/Mid-State, Cliff Schrock of CableBus and Jim Grabenstein of Microdyne Corporation will discuss their experience in "self-instruction" on digital electronics and their thoughts on how digital electronics will affect the cable industry.

The second day of the seminar will be devoted to specific applications of digital electronics, including converters and addressability, security and alarm systems, status monitoring, cabletext, electronic publishing and adapting existing STVROs to digital. The seminar will be repeated April 13 and 14 in Denver, Colorado, at Stouffer's Inn.

The second Baltimore seminar scheduled for January 19 and 20 is on "Preventive Maintenance." While the SCTE has discussed this topic before, this year SCTE has expanded its seminar to include an entire day on TVRO maintenance and distribution system requirements. The seminar will also discuss planning for optimum system operation, fault isolation, troubleshooting, automated program control, modulators, LNAs, antennas and transmission lines, and back-up systems. The seminar will be repeated May 11 and 12 in Kansas City, Missouri, and July 27 and 28 in Orlando, Florida.

The SCTE will also hold two concurrent seminars February 9 and 10 in Indianapolis, Indiana: "System Test Requirements" and "Cable Plant Construction." The first seminar will stress the importance of proper total system testing procedures, test data evaluation, and federal requirements. The second seminar will provide a comprehensive view of developments in technology, operations, training, management techniques and equipment.

"Systems Test Requirements" will be repeated May 11 and 12 in Kansas City, Missouri, and September 14 and 15 in Los Angeles, California. "Cable Plant Construction" will be presented again in Los Angeles, California, September 14 and 15.

Registration rates for next year's seminars will remain at the 1980 level for SCTE members but will be raised considerably for non-members.

The 1981 seminars will also feature hardbound reference books or textbooks. Currently, textbooks will be included in the package for the "Preventive Maintenance" and "Digital Electronics" seminars.

## CORRECTION

The National Cable Television Association Wrap-Up featured in the July issue of **CED** included a section describing a presentation made by Jim Palmer of C-COR. It was reported that Palmer had voiced severe criticism of some of the larger suppliers of 400 MHz equipment, and that one of his primary points concerned the high turnover of engineering personnel with respect to those manufacturers.

The article should have noted that the scope of Palmer's criticism was limited to manufacturers of 400 MHz hybrids and did not apply to manufacturers of other 400 MHz components. It was not a criticism of the management of these manufacturers but rather was a criticism of the availability of both 300- and 400-MHz hybrids. The reference to high turnover in personnel was cited as an aggravating factor in this problem, but was also characterized as an unavoidable fact of life within the environment of manufacturing and engineering in the West Coast's Silicon Valley.



# Rural CATV Designs: A Question of Cost

*The Rural Electrification Administration (REA) has brought its years of experience financing rural electrical and telephone systems to the cable industry. In the following article, William Grant, an REA communications consultant, discusses the advantages of a single-cable design for a rural cable system.*

This report presents a design approach for coaxial cable systems for rural CATV operations. Although the approach is not commonly encountered in urban CATV operations, it is by no means new or revolutionary. Perhaps before considering a different approach, one should ask, 'why is a design change needed?' Thousands of miles of plant have been built along the conventional design which is so fenerally used and widely accepted by the CATV industry. Presumably, all of this plant is delivering adequate service and performance.

The answer is simply economics. An examination of the two applications, urban and rural, will make this clear. Urban systems are limited in geographical area and serve a relatively dense and evenly distributed population. In urban systems, potential subscriber densities of 40 or more homes-per-mile of plant placed are typical. These situations present an attractive base of subscription revenues to support initial capital investments and annual maintenance costs. A rural application requires much more cable plant to reach a smaller potential revenue base and presents a less attractive profit potential. If stringent cost control methods are not applied or fully explored, many rural systems will not be economically viable.

Rural situations can have anywhere from 30 homes-per-mile of plant to as few as one or two homes-per-mile. There is, of

***"In both rural power and rural telephone service, remarkable successes were accomplished through innovation and modification of generally accepted urban techniques and hardware. Clearly, if rural CATV is to be feasible, it requires the strictest investigation and attention to cost reduction techniques that are consistent with usable transmission quality (in this case, salable television signals). Comfortable margins of engineering are an unaffordable luxury here. The CATV industry must reach out to the limits of the state of the art or concede defeat."***

course, a great deal of statistical data on rural power and telephone systems. A diligent study of this data will produce a reasonably accurate profile for use in cable designs. On a national average, the density of rural residences is 5.5 homes-per-mile of plant constructed. Over 95 percent of these rural homes can be served by distribution systems that extend 100,000 feet or 18.9 miles in length.

If one accepts without question construction costs as developed in existing urban CATV operations, one might simply dismiss as economically impractical some finite level of population density. The Rural Electrification Administration (REA), however, is not free to dismiss any rural area. The REA is charged with addressing rural telecommunications services. Although economic limitations exist, REA's technical designs must consider, and permit insofar as possible, the ultimate expansion of service to the rural population levels.

The economics of such applications are inhibitive, to say the least. In both rural power and rural telephone service, remarkable successes were accomplished through innovation and modification of generally accepted urban techniques and hardware. Clearly, if rural CATV is to be feasible, it requires the strictest investigation and attention to cost reduction techniques that are consistent with usable transmission quality (in this case, salable television signals). Comfortable margins of engineering are an unaffordable luxury here. The CATV industry must reach out to the limits of the state of the art or concede defeat.

## Urban CATV Designs

The urban designer is faced with evenly distributed, heavy service drop-tapping loads throughout the entire service area. This presents a different set of problems. If system transmission signals can be maintained at high levels, improved efficiency of the service drop taps can be achieved. These higher levels generally require higher output levels from all system amplifiers. This imposes a greater intermodulation distortion contribution from the amplifiers and can produce unacceptable transmission performance if the signals are passed through many amplifiers connected in cascade. Since the input signal levels to the amplifiers are also maintained at a relatively high level, the carrier-to-noise ratio will be very satisfactory.

A practical solution to the problem is to adopt two distinctly separate design philosophies—in effect, design two different subsystems—and incorporate them to produce a satisfactory overall transmission performance. In urban applications, a trunk subsystem is used to provide arterial or backbone distribution of signals throughout the service area. Since many trunk amplifiers are connected in cascade to reach the service area extremities, the cumulative noise contribution and intermodulation distortion accumulation through the trunk subsystem must be considered. In practice, the trunk plant is operated at lower, more conservative signal levels so that the noise contribution is acceptable at the system ends and the intermodulation distortion is better than just acceptable. In effect, the operating output levels are held quite low to reserve some rather high-intermod distortion contribution from the second level subsystem, which is called the feeder plant. The trunk amplifiers then are operated at conservative gain figures (22 or 24 dB, typically) and no subscriber taps are inserted into the trunk cable. Because of the low gain, the physical spacing is relatively close and often higher cost, lower loss cable is used in the trunk to further reduce the total number of amplifiers required.

The feeder subsystem demands frequent tapping for service drops. To improve the tapping efficiency, the feeder subsystem is operated at substantially higher transmission levels. This requires higher gain in each amplifier and imposes significantly higher intermod distortion contributions from each feeder amplifier. To limit higher-intermod contribution, the feeder subsystem imposes a limitation on the number of amplifiers that can be connected in cascade. The higher distortion is tolerable in overall system performance because of the conservative, intentionally limited intermod introduced by the trunk subsystem.

Limiting the cascade of feeder amplifiers means that additional arterial trunk plant may be required throughout the area; and not allowing taps in the trunk cable means that a parallel feeder cable must be placed to accommodate taps along trunk cable routes. The overall system performance then is the composit performance of low-signal level, low-intermod-distortion trunk followed by high-signal level, high-intermod-distortion feeder. Most of the noise power in overall transmission is produced in the trunk system because of many amplifiers in cascade and relatively low input-signal levels.

Feeder plant is usually less sophisticated than trunk plant, since feeder plant is distinctly limited in cascade and does not require automatic level or slope-corrective amplifiers. Since signal levels are high, lower cost, higher loss cable is used also.

If the ratio of feeder plant to trunk cable is high (typically four-to-one or better) and the feeder plant is less expensive, the design in a large urban system achieves significant cost economy. This is conditional on the majority of the feeder plant being "off route" and not simply paralleling the trunk route itself. It also depends upon a significant cost differential between trunk and feeder-type amplifiers.

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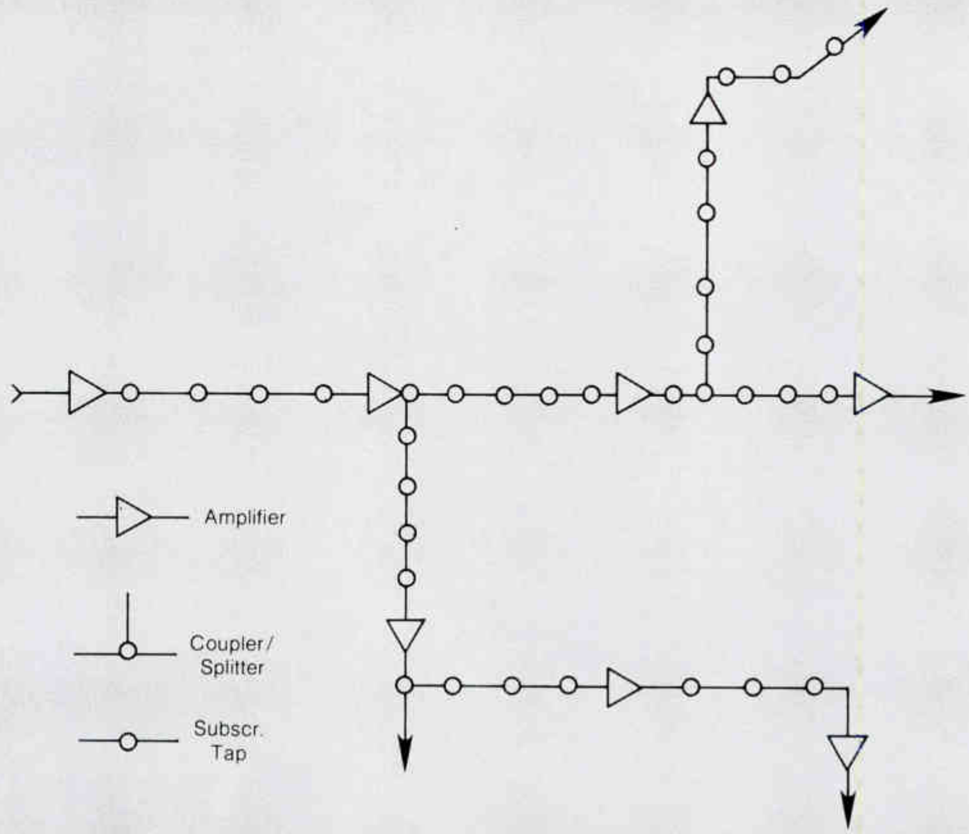



**Figure 1 Single-Channel Cable System**

## Rural CATV Designs

In most rural applications, the probability of developing advantageous trunk-to-feeder ratios is remote. Since the system extensions out into the rural areas are quite long (100 kft in the profile), the trunk would have to be extended out most of that distance. Feeder cable, which simply parallels the trunk itself to accommodate tapping for drops, is not cost-effective. In effect, in the outer, rural area, the trunk-to-feeder ratio will generally be an unattractive one to one.

In the "in-town" segments of most rural applications, the situation is not much more promising. The towns involved will rarely require more than ten or 15 miles of in-town plant combined with 100 miles of rural. Even if subscriber densities "in-town" favored trunk-plus-feeder designs, the overall ratio at best would present a marginal cost reduction opportunity. This slight edge would be offset substantially or entirely by the logistics of introducing several new units of equipment and requiring a greater variety in maintenance spares.

In the rural situation, the most cost-effective approach would be a single cable that is used both for signal distribution and service-drop access along its length. When this plant is operated somewhat above the low-distortion-signal levels of conventional trunk cable but below the high-distortion-signal levels of the feeder subsystem, the system is more cost-effective. Obviously, the major economy available through this approach is to eliminate a substantial amount of cable as well as the placement costs for that cable.

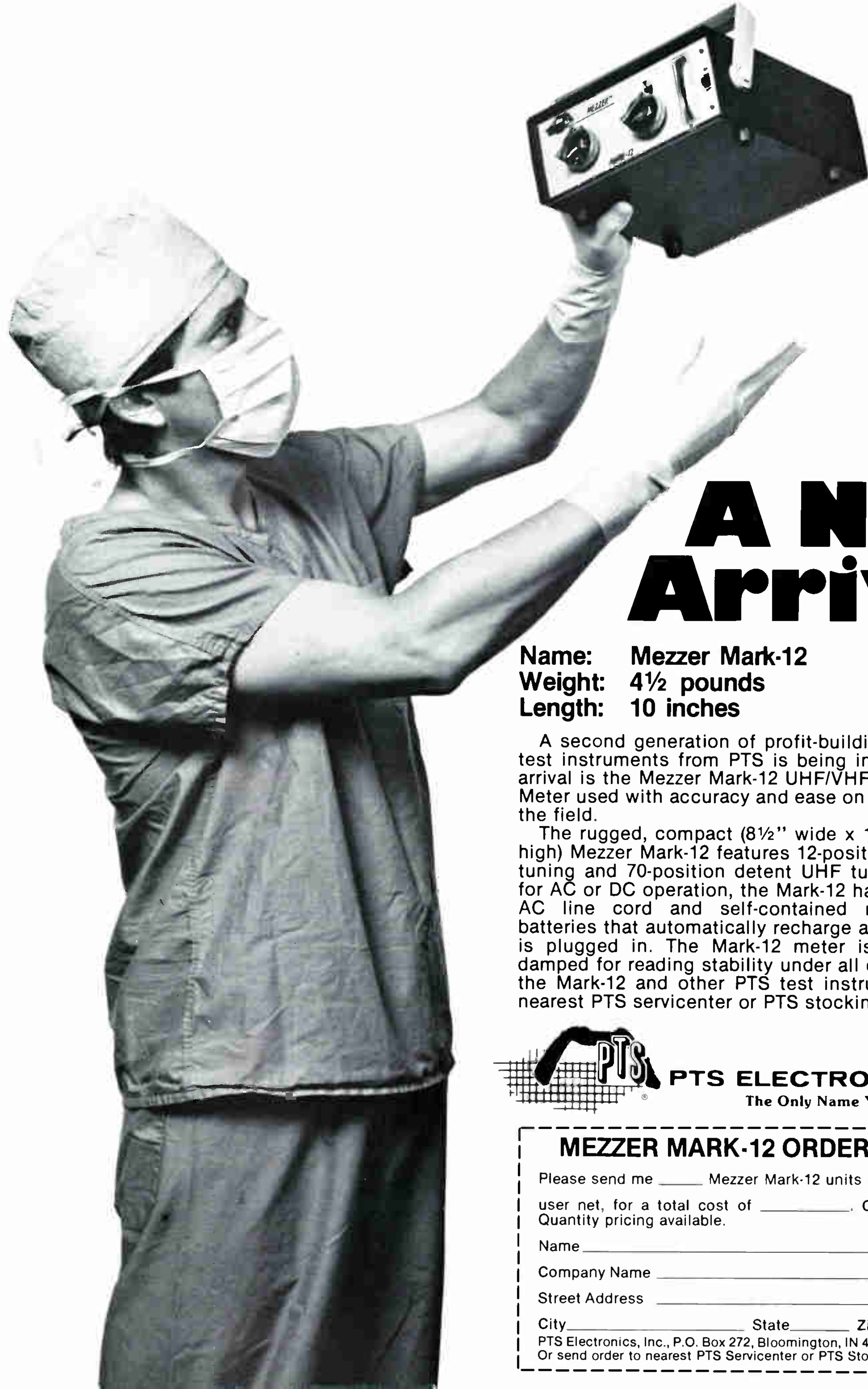
A CATV company might consider simply "lifting" its urban trunk design and applying it to rural situations on the basis that it is a highly refined and proven existing system. A closer examination of this points out a fallacy in such reasoning.

The trunk-plus-feeder design enabled the trunk subsystem to operate at reduced output levels and allowed some intermod distortion contribution from the feeder subsystem (which was connected in tandem and which the system transmissions had to pass through). If a long trunk of finite length (say, 25 amplifiers) were operated at conventional trunk design levels, the noise contribution which had accumulated at the end of the trunk would be very close to (or at) the overall system-specified noise level. The intermod distortion contribution at that same point, however, would be substantially better than the system specifications require. This is because, in urban applications, the design is intended to extend off the trunk into feeder plant, which introduces almost no noise but a very significant amount of intermod distortion.

In rural applications, no large groupings of subscriber drops are found. The trunk is noise-limited but by no means intermod-limited. The amplifier spacing could be increased by using higher gain amplifiers and higher output levels. This would increase the intermod distortion, but the increase is acceptable because the distortion was better than the specifi cations required. In effect, amplifier gain can be increased by redistributing the allowable intermod distortion along the entire trunk route. If the input levels are not changed, noise contribution will not change and overall system transmission performance at the last-subscriber premises would be the same as that produced through a trunk-plus-feeder transmission system. But the same number of amplifiers (say, 25 units) would now space out farther apart and overall system "reach," or practical length, would be improved by 20 percent or more. Since the same number of amplifiers were used in either case, the extended coverage imposed no cost penalty.

If, on the other hand, a company applies a feeder design only from a trunk-feeder system to a rural application, it would find the practical system length limited by the intermod distortion that is produced by high output signal levels through many amplifiers in cascade.

What must be considered in rural



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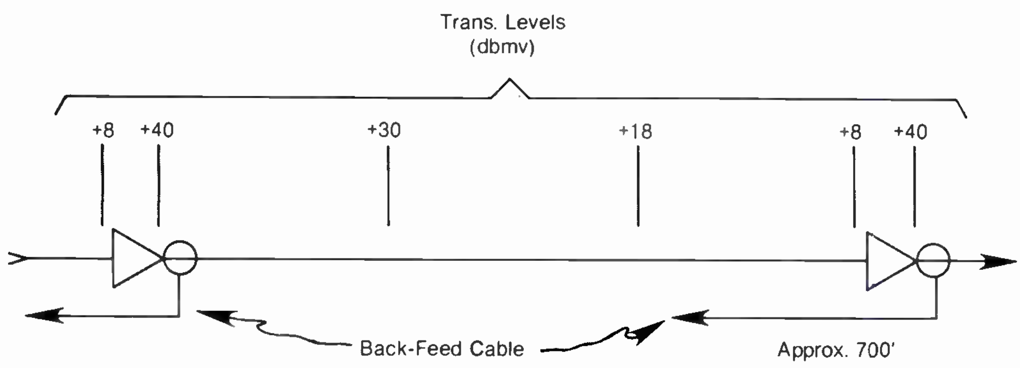


**Figure 2 Back-Feed Cable**

applications is a hybrid or composite design that combines features of both trunk and feeder concepts and is economically practical for the rural application. At the heart of the design is the single-cable concept.

## Transmission System Design

In a single-cable design, the transmission system is tapped for subscriber service drop access by inserting the tap devices into the single cable itself. One cable both distributes signals throughout the service area and feeds signal to subscriber service drops, as shown in Figure 1 on page 31. Introducing subscriber-tap devices into the same single cable causes additional transmission loss and requires more frequent reamplification of signal levels, but this loss is acceptable because of the cost saving achieved by using one cable instead of separate cables for transmission distribution and subscriber-drop access.

The single-cable design does require limited placement of parallel cable on portions of the cable route. This condition is imposed because the amplifiers are spaced as far apart as possible to produce the lowest system cost. If the input-signal levels to each amplifier were set at +8 dbmv as an optimum compromise between economy and system reach, the cable for some distance immediately preceeding each amplifier would not provide high enough signal levels to serve subscriber drops.

Assuming the minimum signal level at any service drop input is +10 dbmv, then, a signal level below +10 dbmv at any point along the cable route is insufficient even if all the signal energy were directed to the drop. In addition, tap devices for purposes of drop isolation introduce transmission loss to the service drop input.

The lowest practical tap device available is an 8 dB unit. This tap, inserted into the main cable, will introduce 8 dB of loss to the service drop connection port. Since the minimum acceptable drop input level is +10 dbmv and the tap itself introduces an additional 8 dB of loss, tapping the main cable at points where the transmission signal level is below +18 dbmv is not practical. This produces a section identified in Figure 2 as the "no-tap" zone. In the design example, which utilizes .500 inch o.d. size cable and requires a +8 dbmv input signal level at the amplifier, the no-tap zone is approximately 800 feet. This distance could be reduced to 700 feet, however, which would provide drop-service access points every 100 feet.

To accommodate service drops that might be required in these sections of the system, a technique called "back-feed cable" can be used. This requires inserting a directional coupler at the output of every amplifier, which provides a convenient feed point at a relatively high signal level. A second cable could be placed paralleling the main cable back along the route a sufficient distance to cover the 700-foot no-tap zone. During the system-layout phase, designers will have to judge which amplifier locations require directional couplers. The back-feed cable is necessary at the time of initial construction. If no homes will be served along the no-tap zone, some economy can be achieved by leaving out the coupler and back-feed cable. This is probably a good idea in a swampy area unsuitable for residences. If an area has no homes but is suitable for future development, designers should consider deferring cable placement until the service requirement develops and initial economy can be produced. Subsequent placement of short cable runs of this magnitude is neither difficult nor expensive.

The single-cable design includes and provides for the insertion loss of the directional coupler at every amplifier output. Thus, the system overall transmission performance is unimpaired whether the coupler and back-feed cable is placed initially, placed subsequently or is omitted entirely.

An alternative solution to back-feed cable could be reducing amplifier spacing to the point where signal levels in the main cable are high enough to permit tapping 100 feet or so ahead of the amplifier. This would increase drastically the number of amplifiers required and drive up the cost. The increased number of amplifiers and the consequent increase in system noise and intermod distortion would also reduce the attainable system length.

Reducing amplifier spacing instead of placing back-feed cable may be practical in the in-town portions of the system. Except for two, three or four cable routes that might pass through the town and extend into the rural areas, the cascade of amplifiers in the in-town plant will be limited, and the transmission quality penalty of a few additional amplifiers would be insignificant. The placement of short random sections of back-feed cable, on the other hand, could be more expensive than the additional amplifiers required. It could be argued that future subscriber growth is more likely in the in-town areas, further justifying the reserved gain provided by close spacing. Basically, the judgement is economic. Although close spacing is a less-cost effective usage of a single amplifier station, the alternative, back-feed cabling, will cost more.

If the in-town portion is large enough, the REA recommends parallel cable be used. On long-run cable routes that are intended to extend into the surrounding rural area, the penalty of inserting many in-town tap devices is another matter. The number of mechanical connections introduced by relatively heavy tapping in the in-town section could reduce the overall system reliability on the extensions. For this reason, the REA recommends a second cable be placed paralleling the extension routes through town and that all subscriber taps along these routes be inserted into this second cable.

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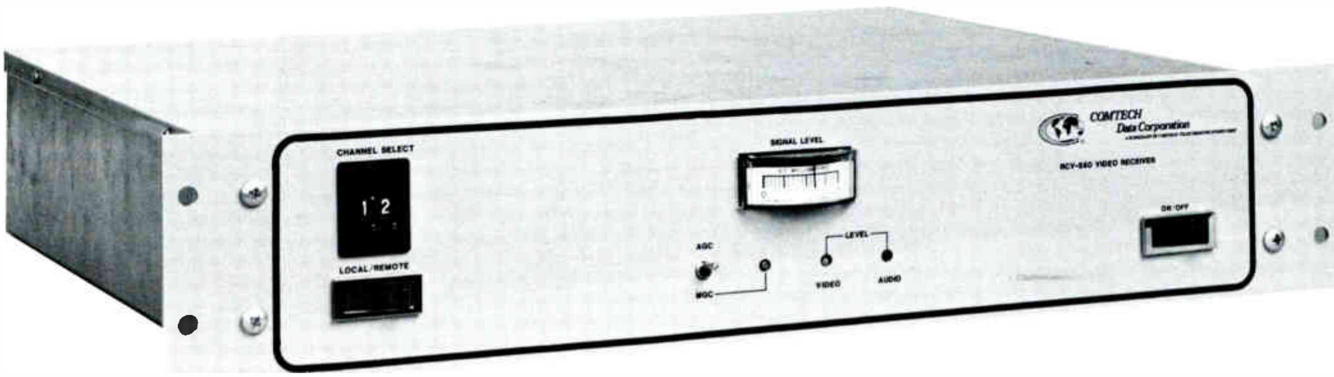


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## Transmission Performance

Since some combination of manual-gain-control and automatic-gain-control amplifiers is proposed, and since the two different types of amplifiers have different characteristics regarding noise and output capability, it is convenient to establish the noise and intermodulation distortion for both types individually, factor in the ratio of usage (in this example, two manual units for each ALC unit) and then determine the characteristics for a single, equivalent unit or average amplifier. This equivalent unit gives the identical system performance that would be produced through the use of the two basic types in the ratio proposed.

To do this, input- and output-signal levels must be established. (In this example, the levels are +8 dbmv input and +40 dbmv output. These levels represent the optimum compromise between system transmission performance and attainable system length or "reach.")

The performance of manual-gain-control and automatic-gain-control amplifiers is calculated in the following way. The system performance characteristics of the manual-gain-control and automatic-gain-control amplifiers in this example are presented in Table 1.

Derating the maximum gain provides for the insertion losses of two-way filters, cable equalizers, etc., such that amplifiers may be spaced 32 db of the transmission loss apart.

**Table 1**

| | | |
|---|---|---|
| Maximum gain | 36 | db |
| Usable gain (spacing) | 32 | db |
| Noise figure | 9 | db |
| Output capability (for -57 dB X-mod -21 chans.) | +53.5 | dbmv |
| Operating input level | +8 | dbmv |
| Operating output level | +40 | dbmv |

**Table 2**

| | | |
|---|---|---|
| Maximum gain | 36 | db |
| Usable gain (spacing) | 32 | db |
| Noise figure | 8 | db |
| Output capability (for -57 db X-Mod -21 chans.) | +52 | dbmv |
| Operating input level | +8 | dbmv |
| Operating output level | +40 | dbmv |

The C/N ratio (carrier-to-noise) for a single manual-gain-control unit operating at +8 dbmv may be determined by

$$C/N_1 = S_{in} + 59 - NF$$

where

$C/N_1$ = C/N Ratio per amplifier
$S_{in}$ = Operating-input-signal level
59 = Thermal noise
NF = Specified noise figure

then

$$C/N_1 = +8 + 59 - 9$$
$$C/N = 58 \text{ db per amplifier}$$

The cross-modulation distortion (X-Mod) per manual amplifier operating at +40 dbmv output may be determined by

$$XM_1 = XM_s + 2\,(OL_o - OL_s)$$

where

$XM_1$ = X-Mod distortion per amplifier
$XM_s$ = Specified X-Mod per amplifier
$OL_o$ = Operating output level
$OL_s$ = Specified output level

then

$$XM_1 = -57 + 2\,(+40 - 53.5)$$
$$= -84 \text{ db X-Mod per amplifier}$$

The system performance characteristics of the automatic-level-control amplifier in this example are listed in Table 2.


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Derating the maximum gain provides for the insertion losses of two-way filters, cable equalizers, etc. and the ALC amplifier includes an additional 3 db of gain reserve for ALC action.

The C/N ratio for a single ALC amplifier operating at +8 dbmv may be determined by

$$C/N_1 = S_{in} + 59 - NF$$
$$= +8 + 59 - 8$$
$$C/N = 59 \text{ db per amplifier}$$

The X-Mod distortion per ALC amplifier operating at +40 dbmv output may be determined by

$$XM_1 = XM_s + 2\,(OL_o - OL_s)$$

then

$$XM_1 = -57 + 2\,(+40 - 52)$$
$$XM = -81 \text{ db per amplifier}$$

## Equivalent Or Average Amplifier

The example in this article uses a combination of two manual control units for each automatic control unit (other combinations are possible). The first step is to establish a convenient, single unit of amplification that will provide the flexibility needed to discuss the example. The unit must be equivalent in gain, usable spacing, noise and intermodulation distortion so that the three units are identical with the combination of three. This can be done by using computations or table-for-power (noise) addition and voltage (X-Mod) addition.

Given two manual amplifiers, both with a C/N ratio of 58 db, the combination of two would be 3 db poorer than a single unit or 58 minus three, which is 55 db. Combining 55 db with the C/N ratio of a single ALC amplifier (which is 59 db) produces a C/N ratio that is 1.5 db poorer than the lower figure or 55 db minus 1.5 db. This gives 53.5 db C/N ratio for the combination of three units. The C/N ratio of an equivalent amplifier which, when a combination of three units is established, would be identical with this figure (53.5 db C/N ratio), may be determined by this calculation:

$$C/N_1 = C/N_{comb} + 10 \text{ Log } n$$

where:

$C/N_1$ = C/N ratio for one equivalent amplifier

$C/N_{comb}$ = C/N Ratio for combination of three amps. (2 man + 1 ALC)

N = number of amps. in combination

then

$$C/N_1 = 53.5 + 10 \text{ Log } 3$$
$$C/N = 58.2 \text{ db per equivalent amplifier}$$

The X-mod distortion for an equivalent amplifier may be determined by taking the X-mod of two identical manual units and derating the individual amplifier X-mod figure of -84 db by 6 db to produce -78 db. Combining this -78 db X-mod with the X-mod from a single ALC amplifier (-81 db) can be shown to produce an X-mod distortion contribution from the combination of three which is 4.7 db poorer than the worst figure. In this case, it is -78 + 4.7 = -73.3 db X-mod.

The X-mod of an equivalent amplifier which, when a combination of three units is established, would be identical with this figure (-73.3 db), may be determined by this calculation:

$$XM_1 = XM_{comb} + 20 \text{ Log } n$$

where

$XM_1$ = X-mod for a single-equivalent amplifier

$XM_{comb}$ = X-mod for the combination of three (2 man + 1 ALC)

n = Number of amps. in combination

then

$$XM_1 = -73.3 + 20 \text{ Log } 3$$
$$XM = 82.8 \text{ db for one equivalent amplifier}$$

The next step is to use the equivalent amplifier characteristics (usable gain: 32 db; C/N ratio per equivalent amplifier: 58 db; and X-mod distortion per equivalent amplifier: -83 db) to analyze or evaluate the system performance.

The system transmission performance for various lengths of cable only (no taps or splitters) can be established using the following formulas:

$$C/N_{sys} = C/N_{eq.} - 10 \text{ Log } n$$

where

n = Number of equivalent amplifiers in cascade

$$XM_{sys} = XM_{eq.} - 20 \text{ Log } n$$

Since the cable loss is known to be 64.84 db per mile (.500 in o.d. cable at 220 MHz), the maximum amplifier spacing for 32 db of usable gain can be set at 2,605 feet (assuming no taps or splitting losses are involved).

A development of practical system length and transmission performance produced is listed in Table 3.

Table 3 does not apply in a practical actual design where taps, splitters or couplers are involved.

When similar figures are developed under loaded-plant conditions, a margin of error is introduced. For example, just how often cable splitting will be required is not known in this example, because no actual maps or other application information is available. Therefore, some level of splitting must be assumed. In this example, 1 db will be allowed for splitting loss in each amplifier section. The estimate is reasonably conservative but may not reflect the actual requirements of any specific system layout, and error may be encountered. Next, +10 dbmv minimum output level will be assumed for each subscriber-service drop. If the actual layout were to include many long drops that would require higher signal level inputs, some error would obviously be introduced. In effect, the system length or reach, developed here would decrease or "shrink" in actual system layouts.

Error can be minimized by assuming that every tap will have 1 db for trunk splitting loss, and that every amplifier section will have 1 db for trunk splitting loss, 1 db for directional coupler loss for back-feed application, and 1 db for future growth insertion losses. This will not produce absolute accuracy in any specific design, but it should limit inaccuracies to a tolerable level.

Since the sample design has three levels of subscriber tapping loads (four, eight and 12 taps per mile of cable plant), the number of taps required per amplifier section must be established. At four taps per mile taps spaced out at 1,320 feet apart, the system will have 1.7 taps per amplifier section. At 1 db per tap, this is 1.7 db also.

An amplifier section at four-taps-per-mile loading must accept 4.7 db of passive loss per section (1 db for coupler loss, 1 db for splitting loss, 1 db for future growth losses, and 1.7 db for tap losses). This loss, subtracted from the 32 db of

**Table 3**

**System Performance and Length vs. Amplifier Cascade**

| Tot. Amps. | Man. Amps. | ALC Amps. | C/N Sys. | X-mod Sys. | Sys. Length |
|---|---|---|---|---|---|
| 6 | 4 | 2 | 50.2 | -67.4 | 2.9 mi. |
| 9 | 6 | 3 | 48.4 | -63.9 | 4.4 mi. |
| 12 | 8 | 4 | 47.2 | -61.4 | 5.9 mi. |
| 15 | 10 | 5 | 46.2 | -59.4 | 7.4mi. |
| 18 | 12 | 6 | 45.4 | -57.8 | 8.8 mi |
| 21 | 14 | 7 | 44.7 | -56.5 | 10.3 mi. |
| 24 | 16 | 8 | 44.1 | -55.4 | 11.8 mi. |
| 27 | 18 | 9 | 43.6 | -54.3 | 13.3 mi. |
| 30 | 20 | 10 | 43.2 | -53.4 | 14.8 mi. |
| 33 | 22 | 11 | 42.8 | -52.6 | 16.2 mi. |
| 36 | 24 | 12 | 42.4 | -51.8 | 17.7 mi. |
| 39 | 26 | 13 | 42.0 | -51.1 | 19.2 mi. |
| 42 | 28 | 14 | 41.7 | -50.5 | 20.7 mi. |
| 45 | 30 | 15 | 41.4 | -49.9 | 22.2 mi. |

**Table 4**

**Tapped System Performance and Length vs. Amplifier Cascade (.500 in. O.D. Cable-220 MHz)**

| Tot. Amps | Tapped System Length | | | System | |
|---|---|---|---|---|---|
| In Cascade | 4 taps/mi. | 8 taps/mi. | 12 taps/mi. | C/N | X-mod |
| 6 | 2.5 mi. | 2.4 mi. | 2.3 mi. | 50.2 | -67.4 |
| 9 | 3.8 mi. | 3.6 mi. | 3.4 mi. | 48.4 | -63.9 |
| 12 | 5.0 mi. | 4.8 mi. | 4.6 mi. | 47.2 | -61.4 |
| 15 | 6.3 mi. | 6.0 mi. | 5.8 mi. | 46.2 | -59.4 |
| 18 | 7.5 mi. | 7.2 mi. | 6.9 mi. | 45.4 | -57.8 |
| 21 | 8.8 mi. | 8.4 mi. | 8.1 mi. | 44.7 | -56.5 |
| 24 | 10.1 mi. | 9.6 mi. | 9.2 mi. | 44.1 | -55.4 |
| 27 | 11.3 mi. | 10.8 mi. | 10.4 mi. | 43.6 | -54.3 |
| 30 | 12.6 mi. | 12.0 mi. | 11.6 mi. | 43.2 | -53.4 |
| 33 | 13.9 mi. | 13.2 mi. | 12.7 mi. | 42.8 | -52.6 |
| 36 | 15.1 mi. | 14.4 mi. | 13.9 mi. | 42.2 | -51.8 |
| 39 | 16.4 mi. | 15.6 mi. | 15.0 mi. | 42.0 | -51.1 |
| 42 | 17.6 mi. | 16.8 mi. | 16.2 mi. | 41.7 | -50.5 |
| 45 | 18.9 mi. | 18.0 mi. | 17.4 mi. | 41.4 | -49.9 |

gain for cable loss, allows 2,223 feet between amplifier locations. The spacing for eight and twelve taps per mile is 2,117 feet for eight and 2,042 feet for twelve.

A reference chart correlating end-of-system transmission performance with tapped cable lengths developed is presented in Table 4 on page 39.

If the longest system length required is relatively short—ten miles for example—it is entirely possible to improve on the spacing of amplifiers, since the total system noise and intermod distortion would permit operating at higher operational output levels. But first, an acceptable end-of-system performance must be determined.

The selection of end-of-system performance specifications will have a direct impact on system cost. Every db improvement in this specification will require 1 db higher input level at each amplifier. This will reduce amplifier spacings by 1 db over the entire length of the system—obviously, a severe penalty. End-of-system specifications in an urban system are usually on the order of 43 db C/N ratio and -52 db X-mod. But the extremities of an urban system might serve several hundred subscriber stations. In a rural system, the end of the system serves only two or three homes, a very small percentage of the total subscriptions. Since this is the worst-case transmission quality and every station closer to the headend should receive better quality, it is reasonable to impose tighter performance specifications to avoid cost penalizing the entire project. In the example developed in this article, 40 db C/N ratio and -50 db cross-modulation have been chosen as acceptable end-of-system performance. Cable system designers are free to establish a different spec but must be prepared to accept the cost penalty involved. The REA believes these figures represent reasonable quality and will produce usable, saleable pictures. Caution must be used to avoid out-of-

specification performance when the system is extended at a later date. The designer ought to develop operating levels consistent with the ultimate length of the system and not simply with the initial construction.

Note that the preceding data is for a single-cable system including subscriber tap loads, providing 1 db per amplifier section in gain reserve for future tapping, and using the most economical cable size throughout (.500 in O.D.). Obviously, the use of larger, lower-loss cable would reduce the number of amplifiers required in any given length system but would also increase the system cost significantly. The lower loss of larger, more expensive cable could also permit a system of greater length using the same number of amplifiers.

A cable system using .750 o.d. cable and using the same number of amplifiers could expand its reach by approximately 40 percent. For example, 42 amplifiers in a system with four taps per mile would reach out 17.6 miles using .500 o.d. cable. Using .750 o.d. cable and 42 amplifiers tapped four per mile, the system could reach 25.1 miles and produce the same transmission quality. If, on the other hand, it were necessary to reach out only 16.5 miles, tapped four to the mile, this would require only 28 amplifiers with .750 size cable as opposed to 39 amplifiers with .500 size.

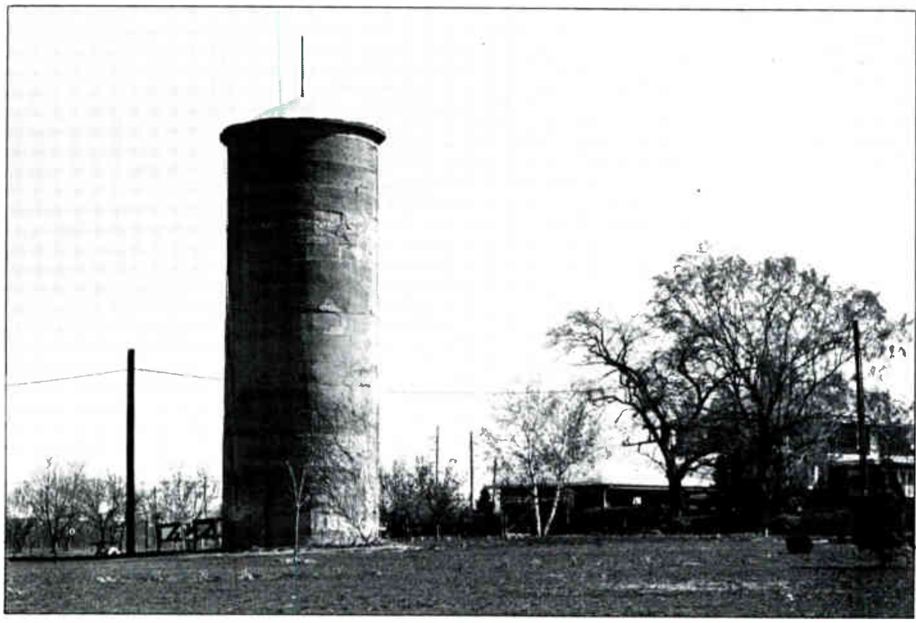
The system designer must equate the amplifier initial and long-term maintenance costs against increased cable costs to make a decision.

## Cost Analysis

This section will develop cost estimates for all three tap loading conditions (four, eight and 12 taps per mile) based on a ten-mile section of plant. Each unit and cost involved will be identified. Where available, optional or alternative equipment or construction techniques will be mentioned. The cost analysis, however, will be based on the higher cost option as a conservative estimate approach.

The question of individual amplifier cost is difficult to resolve. The example in this piece uses two manual units at a cost per unit of $369 and one ALC unit at a cost per unit of $960. Other equipment combinations are possible and unit costs may vary. Based on the concept of the equivalent amplifier developed for the transmission design, an average amplifier cost is $625. This is representative of several supplier product lines. The cost development does not identify manual or ALC amplifiers separately but costs in every required amplifier at the average figure ($625). The amplifiers are capable of retrofit to two-way service at a future time but are not equipped for two-way service initially. Note that the example has not included the costs of and accessories for service drops. This equipment would cost the same whether a single-or-double-cable design is used.

All costs assume buried plant is to be constructed and every amplifier section includes the purchase and labor placement costs for 700 feet of back-feed cable. Though this is an alternative option



of management, the cost analysis in this article assumes a 100-percent requirement for back-feed cable. The use of pedestal housings at tap-only locations can be eliminated, since the tap units themselves are weatherproof. The example takes the most expensive approach and provides a housing at every possible location. Although the cost estimate includes a directional coupler at every amplifier output, it only assumes a trunk- or main-cable-splitter every third amplifier. This is consistent with the transmission design. Power supplies do not include battery standby options but again this alternative could be equated easily for both single-cable and other design concepts.

The unit costs used for this development are as follows:

| Item | Unit Cost |
|---|---|
| .500 coax cable (unarmored but jacketed for direct burial) | $220 per kft. |
| amplifier | $625 ea. |
| AC power station | $480 ea. |
| subscriber taps | $28 ea. |
| couplers and splitters | $45 ea. |
| small pedestal housings | $50 ea. |
| large pedestal housings | $75 ea. |
| cable placement labor | $1,200 per mi. |
| engineering overhead | 15 percent |

The cost of serving four taps per cable mile in a ten-mile system is computed in Table 5.

Using the same method, plant tapped at eight per mile is estimated to cost $7.085 per mile and at 12 per mile, $8,006.

These estimates represent a conservative, highest cost for plant "in place" and tapped to serve subscriber drops along its entire length.

Table 6 presents a subsequent cost estimate prepared using .750 inch o.d. cable in a ten-mile system.

Note that the longer amplifier spacing possible through the use of lower-loss cable requires longer back-feed cable sections. As pointed out earlier in this article, the trade-off is fewer amplifiers against higher cable costs. This example shows a cost per mile of $6,076 with .500 size cable against $6,981 with .750 cable. This is an increase of approximately 14.5 percent in initial cost. The required number of amplifiers, however, is reduced from 26 to 18.

The REA has made several cost studies to examine the economic penalty of a higher transmission frequency that

## Table 5

| Item | Unit Cost | Quantity Required | Cost | | |
|---|---|---|---|---|---|
| .500 cable | $1,170/mi. | 10 miles | $11,700 | Total materials | $42,403 |
| back-feed cable | $1,170/mi | 3.4 miles | $3,978 | Engineering overhead (15%) | 6,360 |
| amplifiers | $625@ | 26 | $16,250 | Total material plus overhead | $48,763 |
| AC power supply | $480@ | 6 | $2,880 | Labor for placement | |
| subscriber taps | $28@ | 40 | $1,120 | (@ $1,200/mile) | 12,000 |
| couplers & splitters | $45@ | 35 | $1,575 | Total cost (ten miles) | $60,763 |
| small pedestals | $50@ | 50 | $2,500 | Cost per mile | |
| large pedestals | $75@ | 32 | $2,400 | (four taps/mile) | $6,076 |

## Table 6

| Item | Unit Cost | Quantity Required | Cost | | |
|---|---|---|---|---|---|
| .750 coax cable | $2,244/mi. | 10 mi. | $22,440 | Total materials | $50,287 |
| back-feed cable | $2,244/mi. | 3.8 mi. | $8,527 | Engineering overhead (15%) | 7,530 |
| amplifiers | $625@ | 18 | $11,250 | Total materials | |
| AC power supply | $480@ | 4 | $1,920 | plus overhead | $57,817 |
| subscriber taps | $28@ | 40 | $1,120 | Labor for placement | |
| couplers & splitters | $45@ | 24 | $1,080 | (@ $1,200/mile) | 12,000 |
| small pedestals | $50@ | 46 | $2,300 | Total cost (ten miles) | $69,817 |
| large pedestals | $75@ | 22 | $1,650 | Cost per mile (four taps/mi.) | $6,981 |

would provide more transmission capacity. To extend the cost estimates presented in the example above to 300 MHz top transmission frequency would impose an approximate 15-percent cost penalty. Assuming six MHz of transmission spectrum is required for a television channel, the 220 MHz system is generally accepted as being capable of 21-channel transmission. The 300 MHz system can accommodate 35 channels. Some degree of realism must be preserved when considering small rural systems. It is difficult to justify 35 channels in a rural system. With the new emphasis on 400 MHz and 50-plus-channel systems, which is becoming evident in urban CATV applications, rural designers may be tempted to consider such designs. The REA suggests the economic realities simply don't support this in most instances.

## Single-Cable Designs Versus Trunk-Plus-Feeder

The REA has had ample opportunities to review rural CATV designs. Almost exclusively, these systems have been trunk-plus-feeder layouts. This comes as no surprise. The CATV industry has steadily evolved not into less dense population areas but into larger urban applications. Logically, the entire thrust of development has been towards maximum efficiency in serving high-density areas. As a result, the conventional trunk-plus-feeder design became highly refined.

The following analysis will show, however, why the single-cable design is more cost-effective in rural applications.

It is difficult to make direct comparisons on theoretical designs, but some basic factors can be examined. Back-feed cable cannot be eliminated in the single-cable design, but a trunk-plus-feeder design would require much more cable to provide full-length tapping capacity. Taps are not a factor in the cost comparison, because the same number of drops must be used in either case.

Removing all taps from the single-cable trunk would reduce the insertion loss in ten miles of plant by 40 db (assuming four taps per mile and 1 db per tap). At best, this would eliminate fewer than two trunk amplifiers in the ten-mile run, since each amplifier produces 32 db of gain. Obviously, the feeder cable will require additional amplification either in the form of bridger units or line extender amplifiers or both.

In effect, the basic single-cable cost can be reduced by two amplifiers at $625 each for a total savings of $1,250. In the example, 6.6 miles of additional cable has been introduced. At a unit cost of $1,170 per mile, the additional cost is $7,722. This does not take into account the cost of additional feeder amplifiers. Thus, the basic one-cable design cost has been increased by $7,722 less $1,250—which is $6,472, or $647 per mile additional.

In reviewing trunk/feeder rural designs, the REA has found the single-cable design to be less expensive in every case. Cost analysts took several systems proposed for trunk/feeder and layed out single-cable systems for precisely the same service drop requirements. The cost reduction varied between 25 percent and 40 percent.

Cost reductions on the order of even several hundred dollars per mile in rural systems are significant. When one considers the potential revenues of four to eight homes per mile of plant, it is apparent that many rural systems will not be economically viable using conventional urban designs and construction. The single-cable design is not merely attractive but is essential in many cases.

## Future Growth And System Expansion

There may be some misconceptions on the matter of adding service feeds to an existing coaxial system. The single levels throughout a system are obviously affected and determined by the multiplicity and frequency of service feeds. During the layout of the system, some energy must be allocated for each such feed. If future feed points are to be readily accommodated, the designer must not

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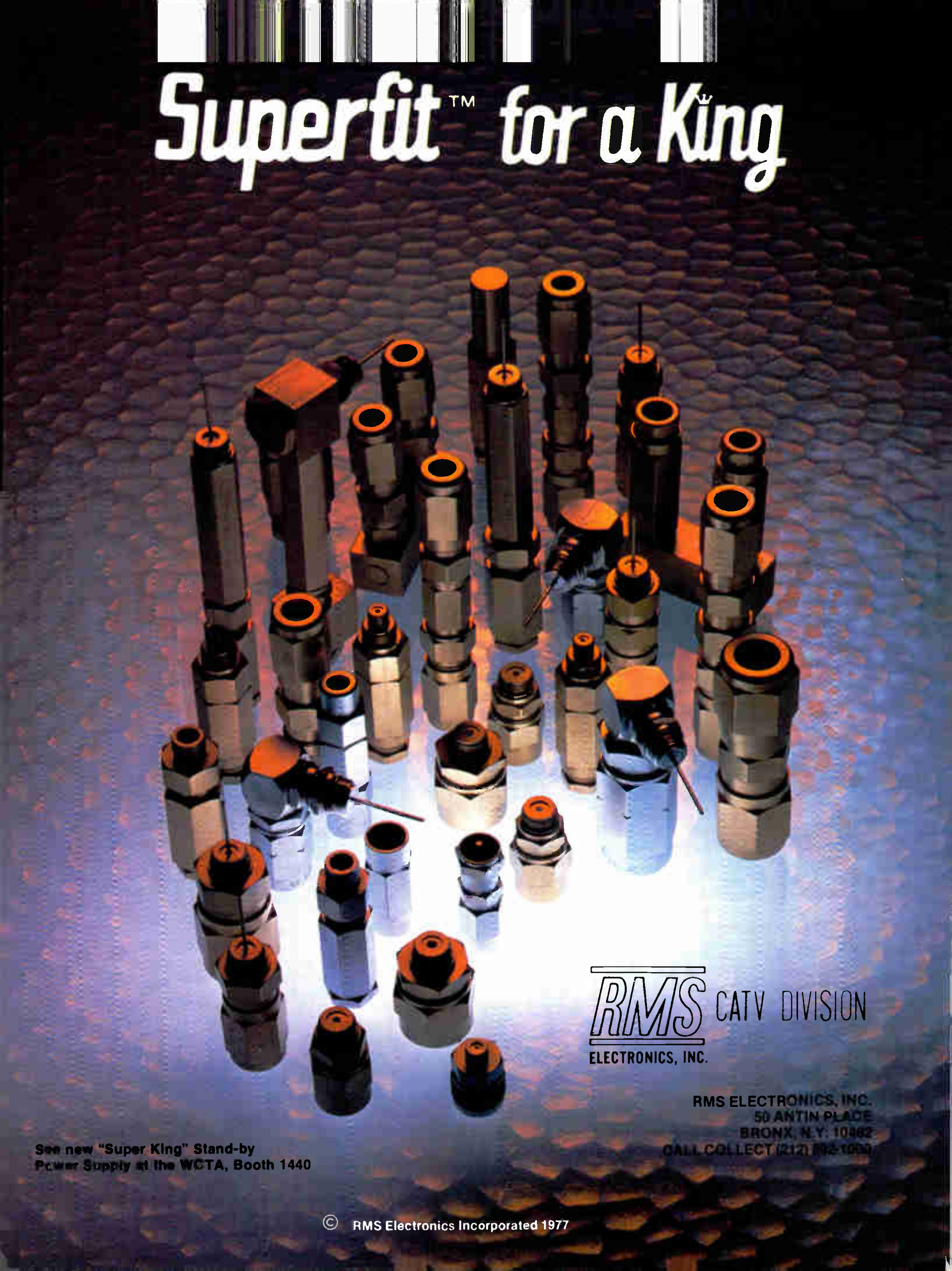
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utilize all available system gain in the initial layout. Some capacity must be reserved for future feed additions.

This condition applies to a single-cable design as well as to trunk-plus-feeder designs. In the example, 1 db of reserve gain is provided in each amplifier section to permit the addition of a service feed point anywhere in each section. This was achieved through a system design predicated on +8 dbmv input level to every amplifier and a system layout based upon a +9 dbmv input to each unit. In effect, the initial construction transmission performance will be better than the transmission design, since the system would not be fully loaded initially. When, or if, the system is loaded to full capacity, the transmission objectives will still be met.

In practice, adding a single tap in any amplifier section requires a slight readjustment of the next amplifier down the line. If a section required a new cable lead to serve a development project or apartment complex, the cable firm would need to insert a low-loss, high-value coupler and feed a new amplifier in the new cable leg. It is assumed no such requirement would be encountered unless the new cable lead will feed enough new subscribers to justify the cost of the amplifier. Note that a second-cable or a trunk-and-feeder-cable combination does not in itself provide expanded growth capabilities. The same reserve gain would be required in the second cable subsystem to accommodate growth.

## Rural Service Drops

Whether a single-cable or trunk-plus-feeder design is employed, there are some identifiable potential problems with rural drops themselves. In the thinly populated environment, many service drops will be long compared to the in-town portion of the system. Although a +10 dbmv tap output may be adequate for drops averaging 120 feet, rural drops may approach lengths of 600 feet or more. This can be accommodated in several ways. In some cases, larger size, lower-loss drop cable or cable reel ends left over from main cable route construction could be used.

It is also possible during the layout phase to select a tap unit that provides higher output levels so that long drops are fed with higher signal levels than the +10 dbmv determined to be satisfactory for in-town services. Heavier tapping in this manner will shorten the system reach, but since the frequency or length of special situations cannot be predetermined, this cannot be avoided. Thus, the actual system lengths as developed in this discussion could shrink during the actual layout of a system. One might also expect that the "slope" of signal levels at the end of very long drops could be excessive and could require equalization in order to meet system specifications.

None of these potential problems are unique to one cable design, but all are inherent in rural application itself. The urban system designer may encounter similar problems, but they will occur less frequently and can be handled as individual, special cases.

## Pros and Cons Of Single-Cable Design

It would certainly be misleading and irresponsible not to call attention to the disadvantages of the proposed design concept.

Perhaps the most obvious drawback is the vulnerability to service interruption. Having active devices (amplifiers) common to the supply of service to many subscribers is an inherent weakness. When many units are connected in cascade, as in coaxial cable systems, this weakness is compounded. This same basic drawback, however, is inherent in a trunk-plus-feeder design to almost the same degree.

Although redundant (dual) amplifier equipment is available from suppliers, few urban CATV systems with high subscriber counts incorporate them in their plant. The point might be taken that the failure rate of today's state-of-the-art equipment is too small to warrant the protection that is available. With the distinctly limited revenue base offered by most rural systems, it will be difficult to justify economically, in any event.

The weakest link or lowest reliability portion of every coaxial transmission system is the provision for powering the amplifiers. The most significant improvement will undoubtedly be produced in this area. The REA strongly recommends consideration of battery-standby equipment for all power supply locations.

One must also consider the mechanical reliability of a large number of cable connectors in a coaxial system. To some extent, this is aggravated in a single-cable design, since most passive devices, including subscriber taps, are directly inserted into the main cable itself. In the trunk-plus-feeder layout, taps are removed from the trunk cable. But connectors themselves are relatively simple mechanical devices. Most new systems experience a period of "debugging," when poor workmanship and improperly installed connectors are found and rectified. Historically, the mechanical reliability of a system is acceptable after this period. Using two cables requires a large number of connectors, due to the frequent need for amplifiers. The insertion of couplers, splitters and subscribers taps into the cable causes a gradual but cumulative distortion of the frequency response of the system. Each device, even within a rigid flatness-of-response specification, will contribute its "signature" or characteristic variation. The solution is adjustable equalization in which periodically the flatness of response across the band of interest is restored through adjustment, or "tuning." The adjustment is required only during initial line-up of the system.

In earlier generations of RF amplifying equipment, where discrete transistors were employed, several interstage couplers were available. This readjustment was easily and inexpensively provided. The advent of hybrid or chip amplifiers has eliminated this useful facility. The provision of adjustable equalizers, however, should not introduce any significant or inhibitive cost penalty. Cable companies should discuss the matter of adjustable equalizers with their equipment suppliers before making a final selection of equipment.

Beyond these considerations, the REA can identify no technical limitation or penalty that would disqualify the single-cable design.

## Conclusions

Several studies have verified that the single-cable design is less expensive in both the in-town and rural area applications. Undoubtedly, some density level will justify the trunk-plus-feeder designs, but in towns with 1,500 or so homes, the REA simply could not prove in this approach. Unless 4,000 homes or more are involved, the single-cable design will always be less expensive. Further study is necessary to establish this figure. In any event, communities of this size will rarely be addressed in rural applications. The single-cable design has its greatest cost advantage out in the rural sections.

The REA has noted an interesting negative reaction to the concept of single-cable designs from people both within and outside the CATV industry. Perhaps it is the novelty or unconventionalty of the concept that disturbs the skeptics. More likely it's because the concept and its practical justification have not been presented well.

A world of difference exists technically between an urban and a rural application. An even wider gap exists economically. The merit of any new approach must be determined on an objective and realistic examination of facts. The REA submits that the economic advantages of the single-cable design merit serious consideration. It is prudent businesswise to develop two designs for at least a representative portion of any project so that the possible overall cost difference can be compared.

*William Grant is a communications consultant for the Rural Electrification Administration. He is a 20-year industry veteran.*

Cover Story

# M/A-COM Builds Toward End-to-End Distribution System

*By Pat Gushman, publisher*

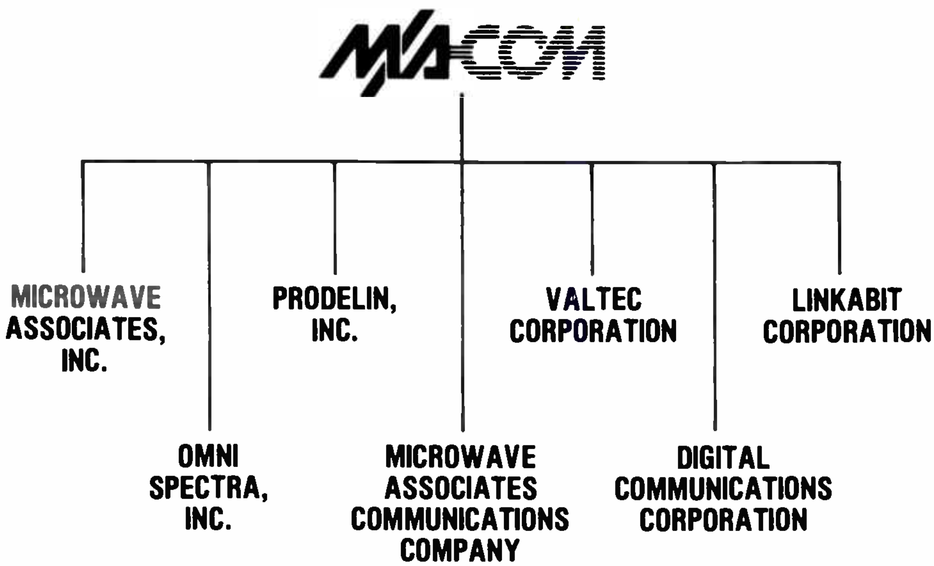
Recently, a distinguished group of financial analysts nominated M/A-COM, Inc., formerly Microwave Associates, as one of the 16 "great growth companies" of the next decade. Also in that league are Scientific-Atlanta and Warner Amex. According to *Dun's Review*, the analysts' reasoning was quite simple. Most of the companies picked to flourish in the 1980s and 1990s are positioned with products and services that are geared toward solving the major problems which lie ahead.

Lumped into that category is an interesting mix of companies involved in everything from defense to health services. In the middle of it all are the telecommunications industries, including CATV. In fact, Warner Amex was one of the few firms listed that is not entirely industrial. But it is M/A-COM, with the dramatic changes and timely mergers it has undergone during the last five years, that has, the experts say, emerged on the fast track. The firm is positioned now, says John Puente, an M/A-COM senior vice president and board chairman of subsidiary Digital Communications Corporation, to apply all of its experience in military and space technology to cable television.

Even now, E.F. Hutton, Salomon Brothers and Merrill Lynch are underwriting an offering of some 4,000,000 shares of M/A-COM stock. The company is stepping forward and its performance is beginning to speak for itself. Last month, it reported net income of $24,905,000 for its recently completed fiscal year, up 89 percent from $13,173,000 reported for fiscal 1979. It's earnings per share were $0.77, a 67 percent increase over the $0.46 reported for the previous year.

Consolidated net sales of $322,480,000 were 42 percent higher than the $227,083,000 reported last year and orders for the year totaled $354,376,000, compared with $314,056,000 for fiscal 1979. Backlog at the close of the fiscal year was $222,132,000, compared with $188,019,000 for fiscal 1979.

These 1979 and 1980 results give retroactive effect to the acquisition of LINKABIT Corporation, Omni Spectra, Inc., and Valtec Corporation, which are being accounted for on a pooling of interest basis. The results also give retroactive effect to M/A-COM's recent two-for-one stock split and a 50 percent




stock dividend paid on April 7, 1980.

According to Dr. Lawrence Gould, chairman and chief executive officer, the earnings results for fiscal 1980 reflect printing, legal and similar direct costs of approximately $1.4 million that were incurred primarily in the fourth quarter in connection with these acquisitions. Already, there has been another acquisition: Prodelin. Still others are in the works. In a little more than five years, the once-obscure microwave company is nearly positioned to provide end-to-end communications systems.

M/A-COM now offers equipment and systems for communications not only by terrestrial microwave and coaxial-cable transmission but also by satellite, fiber optics and infrared signals. It is into the design, development, and manufacture of microcomputer-based "intelligent" digital-signal processors, which makes it capable of serving a broad range of commercial telecommunications submarkets, including cable television, satellite telecommunications, terrestrial data communications and business-communications networks. Cable television systems as local distribution systems figure prominently in the company's plans.

According to M/A-COM's own prospectus, it has:

• Become the primary supplier of digital Single-Channel-Per-Carrier (SCPC) and Time-Division-Multiple-Access (TDMA)

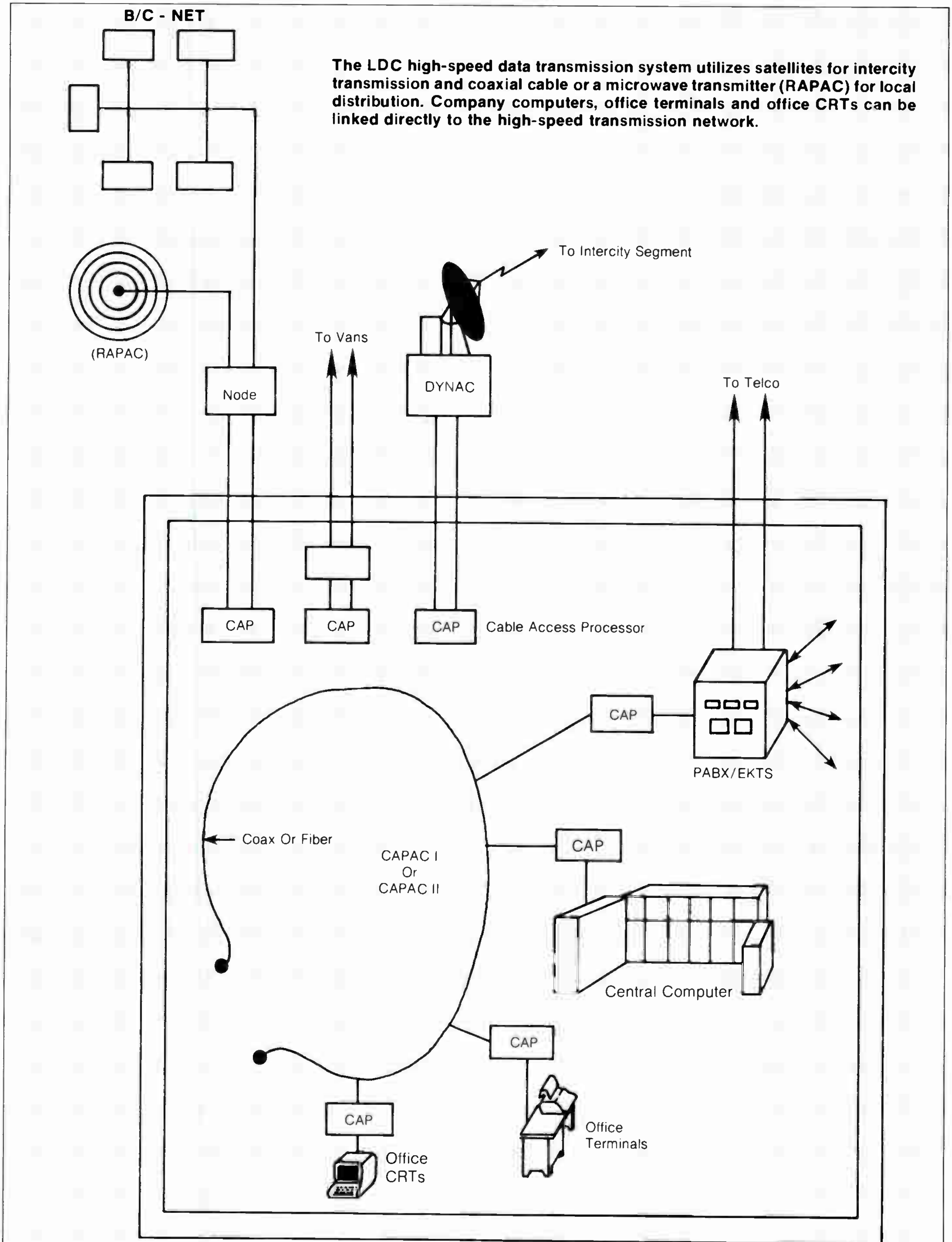



**Figure 1 Intrafacility Network Segment**

equipment to many of the world's satellite telecommunications systems;

- Developed a line of digital communications processors, including specialized high-speed modems and network processors, for the data telecommunications market;
- Become one of the nation's largest producers of coaxial cable and microwave equipment for the CATV industry;
- Developed turn-key fiber optics transmission systems for CATV tailored to meet the needs of individual customers;
- Pioneered the design and development of totally solid-state microwave-radio-relay equipment and systems;
- Established itself as a leading manufacturer of lightweight and portable electronic news-gathering equipment (ENG);
- Developed products to provide intraplant and interplant information distribution via satellite and terrestrial microwaves, coaxial cables and fiber optics; and
- Designed the DYNAC rooftop earth terminal, the RAPAC data transceiver and CAPAC communications equipment to provide significant cost reductions in the transmission and reception of signals for digital business-communications networks.

The acquisition of Prodelin adds to M/A-COM's capabilities the manufacture and marketing of earth stations and microwave point-to-point communications systems, as well as waveguide products for cables. In addition, there are agreements in principle to acquire Power High Hybrids, Inc., of Torrance, California; Microwave Power Devices, Inc., of Hauppauge, New York; and Baytron Company, Inc., of Medford, Massachusetts, during the next few months for an exchange of stock. Power Hybrids, Inc., designs, develops and manufactures discrete power-radio-frequency and microwave transistors and hybrid integrated circuits for cable systems and other applications. Microwave Power Devices, Inc., is a supplier of solid-state radio-frequency and microwave-power amplifiers and related products. Baytron Company, Inc., manufactures millimeter wave components.

## Joint Ventures

It doesn't appear that M/A-COM's Gould is any less bashful about joint ventures than he is about acquisitions. Gould, an engineer himself, came to Microwave Associates in 1962. When he became CEO in 1975, he demonstrated an immediate sense for where technology would take the marketplace. If M/A-COM's own expanding resources aren't adequate to seize those opportunities, then, as a good engineer does, he looks for other ways to solve the problem.

Subsidiaries of M/A-COM and Aetna Life and Casualty Company have formed

***"SBS, which successfully launched its satellite last month, is to provide the channel between the two cities. Tymnet, which already provides extensive packet-switching-data-communications services in both cities, would be responsible for the program's central node in each city and for the interconnection of these facilities in each city with the nationwide packet-switching network. LDC would provide the subscriber transceiver equipment as well as overall program coordination."***

a partnership for the purpose of providing transmission equipment for the local distribution of business communications. The first phase of the venture, which is scheduled to be concluded next summer, contemplates the development and demonstration of the technical, practical and commercial viability of a local data-distribution system in which cable television systems figure prominently. The parties have agreed to contribute up to $1.15 million each to finance the first phase.

The local data distribution system is outlined in Figure 1 on page 52. In the first phase, which will be conducted in conjunction with Satellite Business Systems (SBS) and Tymnet, Inc., the partnership will furnish and install the intra-city equipment for the demonstration of wideband, digital cable- and microwave transmission. As initially conceived, the venture would demonstrate innovative techniques for intra-city distribution of business communications carried between cities via satellite and packet-switching networks. LDC, the partnership with M/A-COM and Aetna, would furnish and install the intra-city distribution equipment to be used in the demonstration.

## Satellite Data Distribution

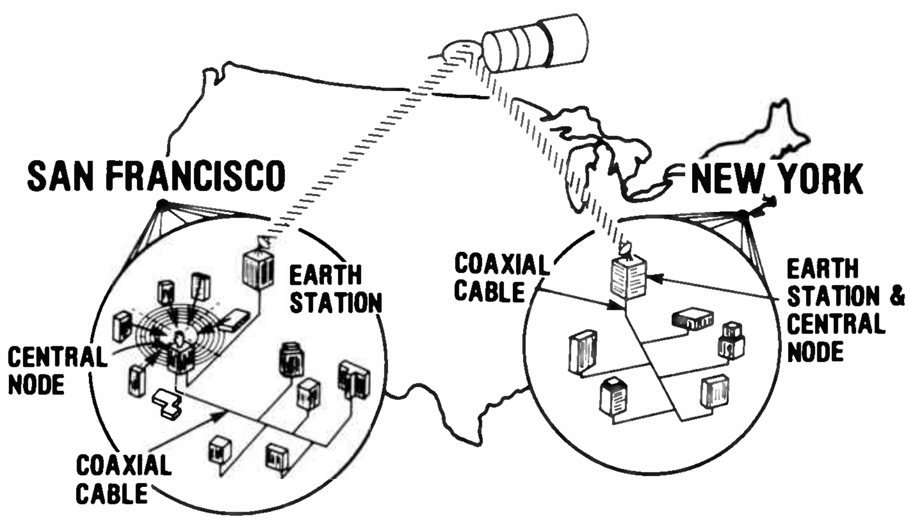
The Federal Communications Commission (FCC) has approved the request for authority to install and operate an earth station in the Wall Street-area of New York and one in downtown San Francisco. Tymnet will install and operate a "cellular" type of radio distribution system in San Francisco. Together, LDC, SBS and Tymnet plan to use cable television facilities to complete what they call their local distribution demonstration network. A limited number of end-user participants in New York and San Francisco would utilize the end-to-end facilities featuring all digital connections for data rates ranging from low speed up to 56 kilobits per second. In New York, data distribution between user terminals and the program's local central node would be carried via broadband-coaxial cable. In San Francisco, it would be a two-part system of coaxial cable and specialized radio using the 10 GHz band.

SBS, which successfully launched its satellite last month, is to provide the channel between the two cities. Tymnet, which already provides extensive packet-switching-data-communications services in both cities, would be responsible for the program's central node in each city and for the interconnection of these facilities in each city with the nationwide packet-switching network. LDC would provide the subscriber transceiver equipment as well as overall program coordination. The central node in each city will be situated at or near the location of the SBS earth station. SBS is installing a 5.5 meter dish on a rooftop in each city.

The demonstration is said to be aimed at "resolving the problem of transmission bottlenecks posed by traditional 'local-loop' facilities in metropolitan areas." According to one spokesman, "To date, the development of high-speed business communications has been hindered by inadequate and costly methods of local distribution. SBS has minimized this problem in its own service plans by using earth stations placed directly on customer premises. However, to the extent that any local-loops are required, this program will develop and test alternative means for efficient handling."

The proposed demonstration "will test the ability to reduce or eliminate many of the local distribution problems by means of a combined cable- and specialized-radio network that will circumvent the local telephone plant." Each participating location would be outfitted with radio-connected or cable-connected terminal equipment featuring simplified all-digital design. Transmission to the central node, from the central node to the SBS earth station, and cross-country to the other

### Local Data Distribution Demonstration Network

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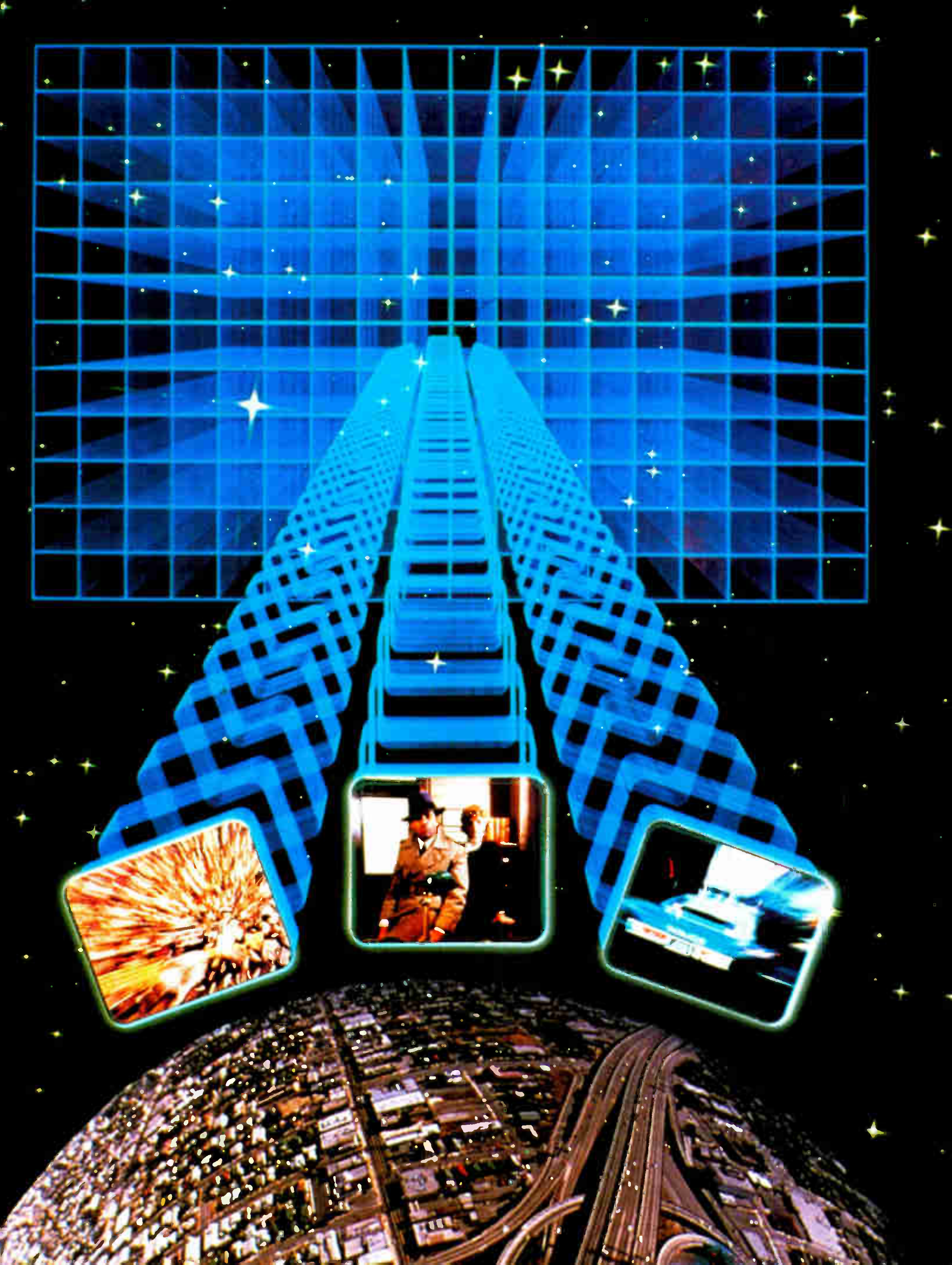

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earth stations would use time-division multi-plexing throughout.

Whether the local distribution is by cable or radio, each user will be provided with one low-speed port (50 to 9,600 bits-per-second) and one high-speed port (56 kilobits-per-second). Cable television companies in each city are being sought to provide the interconnections from their headend facilities to the central nodes of the demonstration program. Major announcements with regard to the demonstration are planned for the Western Cable Television Convention in Anaheim, California, this month. And based on confidence in the concept, LDC officials are already approaching cable television executives around the country with the prospects of establishing local-loops to expand the potential network's penetration—even to the point of installing a second cable for the local system to enhance its data-transmission capabilities and establish a "local data-distribution" network.

The cellular radio technique divides the radio users by location into four quadrants, each quadrant being served by a microwave transceiver with an antenna that has a 90 degree fan-shaped area of coverage. The four quadrants constitute a "cell." The quadrants are to operate in different channels, with a bandwidth of approximately 250 KHz. Each channel will offer a total transmission capacity of 256 kilobits-per-second.

Is all this beyond the reach of the cable television industry, to become local data-distribution networks? Not at all, say M/A-COM's executives, who believe the cable television industry is in a position to reap the benefits of the company's R&D capabilities resulting from multi-million dollar defense contracts.

They point out that in order to compete successfully for government contracts in highly complex, technological fields, M/A-COM, by necessity, must continually attract and retain qualified personnel and maintain a program of improvement and refinement of existing products as well as development of new ones. M/A-COM's total research expenditures for the nine months ended June 28, 1980, amounted to approximately $12.8 million, an increase of approximately 21 percent over the $10,600,000 spent in the same period of the year before.

"This is what is driving the costs to the cable television industry down and making the types of things we are talking about doing in the cable industry affordable," says Frank Drendel, who became an M/A-COM senior vice president following M/A-COM's merger with Valtec Corporation of which he is chairman and chief executive officer. "Plus, the software is already there in the data- and information industries. We don't have to wait for the movies to become available, like Home Box Office and Showtime have to do," says Drendel, who, like other industry executives, believes data communications will become one of the major sources of revenue for the industry once home-subscriber demand for services peaks out.

Digital's Puente agrees and stresses it is a matter of leapfrogging the technologies. "Everyone can't keep thinking analog," he says, and adds that the potential return for the cable television industry depends on what the competition (telephone companies) will do and how much the cable industry is willing to commit in order to widen the market and drive down the costs even further.

The lucrative data transmission market is there for the taking and M/A-COM's Gould has seen to it that his company will be right in the middle of it with its semiconductors, power supplies and amplifiers, circuits, assemblies, transceivers, modulators, duplexers, couplers, waveguides and cable, and earth stations. All that is missing is access to that local loop. At this point, in applications where radio waves won't suffice, there appears to be two choices—telephone companies or cable television systems. M/A-COM and the other high-technology companies that the analysts are so high on are going to be there regardless.

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# Turning CATV System Distortion Into a Maintenance Tool

**Table 1**

| Frequency | STD | | IRC | | HRC | |
|---|---|---|---|---|---|---|
| | 2nd | 3rd | 2nd | 3rd | 2nd | 3rd |
| 5.25 | | 41 | | | | |
| 6.00 | 32 | | 32 | | 32 | 272 |
| 6.75 | | 37 | | | | |
| 7.25 | | 101 | | 145 | | |
| 8.75 | | 3 | | | | |
| 9.25 | | 3 | | | | |
| 10.00 | 1 | | | | | |
| 10.75 | | 80 | | 118 | | |
| 11.25 | | 43 | | | | |
| 12.00 | 29 | | 30 | | 30 | 273 |
| 12.75 | | 35 | | | | |
| 13.25 | | 109 | | 155 | | |
| 14.75 | | 3 | | | | |
| 15.25 | | 3 | | | | |
| 16.00 | 2 | | | | | |
| 16.75 | | 73 | | 109 | | |
| 17.25 | | 44 | | | | |
| 18.00 | 27 | | 29 | | 29 | 274 |
| 18.75 | | 33 | | | | |
| 19.25 | | 118 | | 165 | | |
| 20.75 | | 3 | | | | |
| 21.25 | | 3 | | | | |
| 22.00 | 2 | | | | | |
| 22.75 | | 66 | | 100 | | |
| 23.25 | | 44 | | | | |
| 24.00 | 26 | | 28 | | 28 | 276 |
| 24.75 | | 31 | | | | |
| 25.25 | | 128 | | 176 | | |
| 26.75 | | 3 | | | | |
| 27.25 | | 4 | | | | |
| 28.00 | 1 | | | | | |
| 28.75 | | 60 | | 92 | | |
| 29.25 | | 44 | | | | |
| 30.00 | 25 | | 26 | | 26 | 280 |

STD—Standard Frequency Assignments
IRC—Incremental Frequency Assignments
HRC—Harmonic Frequency Assignments

*By Harry J. Reichert, Jr., Systems Engineer, Jerrold Division, General Instrument Corporation.*

Everyone involved with the performance of cable television systems has developed a mental relationship with the villainous distortions that govern television distribution systems. Composite triple beat, cross-modulation and second-order beat are members of the distortion family that have limited the system designer and user depending on the generation of amplifiers used in the system and depending on the channel loading conveyed by the system. Unfortunately, it seems there will always be some form of distortion, caused by the nonlinear transfer characteristics of the active devices, that will limit the system design. However, there is a member of the distortion family that occurs in cable television systems that is not widely recognized. This distortion does not affect the system design but can be used as an element of a preventative maintenance procedure by the two-way system operator.

The name "common-path distortion" (CPD) has been chosen for this tool: "common-path" because this form of distortion typically needs a common conduction path for both the forward and reverse signals in order to manifest itself; and "distortion" because the forward signals generate new signals that occupy both the forward and the reverse frequency spectrums.

The mechanism that causes common-path distortion is a nonlinear transfer of forward-signal energy at any point in the system where forward and return signals

***"The mechanism that causes common-path distortion is a nonlinear transfer of forward-signal energy at any point in the system where forward and return signals share a common signal path. This nonlinear transfer is typically caused by metallic oxides that exist or form on the system's metal members. Any electrical connection that does not constantly maintain intimate metal-to-metal contact can cause this form of distortion."***

share a common signal path. This nonlinear transfer is typically caused by metallic oxides that exist or form on the system's metal members. Any electrical connection that does not constantly maintain intimate metal-to-metal contact can cause this form of distortion.

Common-path distortion may be observed at the headend or hub where the return systems direct their signal energy. With the aid of a spectrum analyzer connected to the return system culmination point, a display of the signals returning on the system can be observed.

Typically, when CPD exists in a system, signal energy can be observed over the entire return spectrum, spaced at 6 MHz intervals. This is due to the 6 MHz spacing of the forward system carriers. The magnitude of these signals is controlled by the degree of the nonlinear transfers that exist in the system and the absolute level of the forward signal energy at these transfer points.

The exact frequencies of the CPD products can be predicted by using the following standard formulas for cable television systems. The forward system carrier frequencies are substituted for A, B and C.

| 2nd Order | 3rd Order |
|---|---|
| 2A | 2A±B |
| A±B | A±B±C |
| | 3A |

Table 1 on page 61 contains data generated using the applicable formulas with 35-channel assignments at standard, incremental and harmonically related carrier frequencies. The table lists the

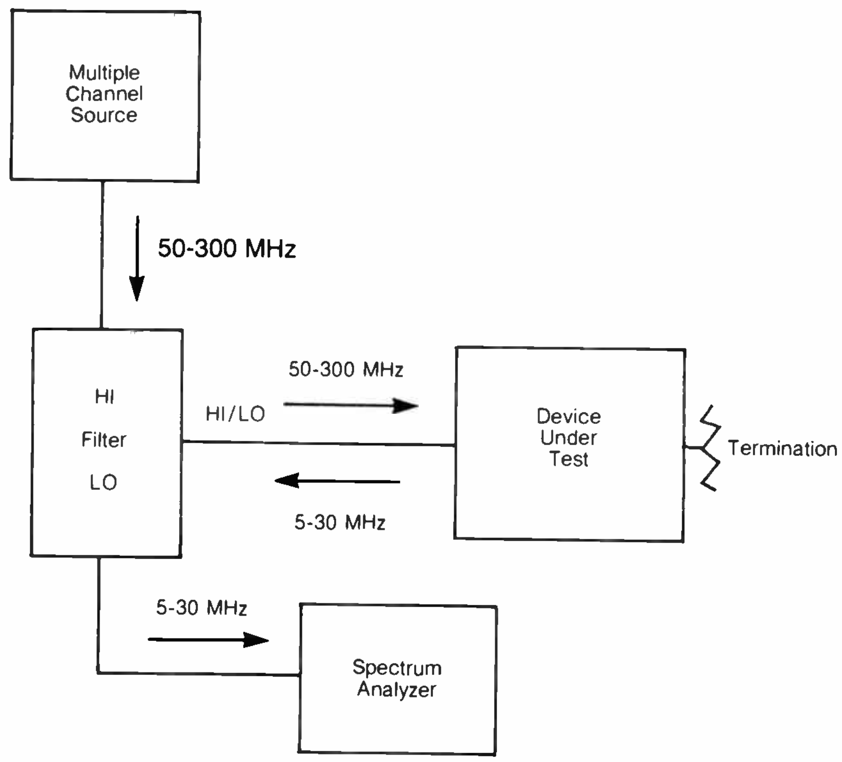



**Figure 1**

number of beat combinations that fall at frequencies ranging from 5.25 to 30.00.

The value of this distortion can be realized by conducting a simple bench experiment, as shown in Figure 1.

The set-up in Figure 1 provides the capability to test a typical cable television system passive device for the generation of common-path distortion. With multiple modulated or unmodulated signals applied to the passive under test at a level of at least +35 dBmV, and with the spectrum analyzer (adjusted for maximum sensitivity) connected to the low-frequency side of the filter, loosen one of the cable center conductor seizing screws to the point where an intermittent connection is made. The next step is to tap lightly on the passive device to simulate system vibration conditions and observe the display on the spectrum analyzer.

The test will reveal a series of predominant signals (beats) spaced at intervals of 6 MHz. The number of signals seen will depend on the number of channels that are being supplied by the signal source. The higher the level from the source, the more likely the phenomenon will occur. A level of approximately +50 dBmV is sometimes required because oxides have not had a chance to develop significantly at the point of intermittent contact.

The experiment can be carried further by observing the signals through the passive device with a television receiver while repeating the original experiment. This will reveal the common-path distortion on the spectrum analyzer when there is no subjective impairment of the viewed channel. This condition can therefore be used for preventative maintenance in cable television systems. Before a deteriorating connection can interrupt the forward system, common-path distortion will have sent signals back to the headend by way of the return system.

To take advantage of these distortion signals, cable testers must have some way of monitoring the return system for common-path distortion signals and determining where they are coming from. The spectrum analyzer can be used to monitor the system, but the source of the common-path distortion must still be localized.

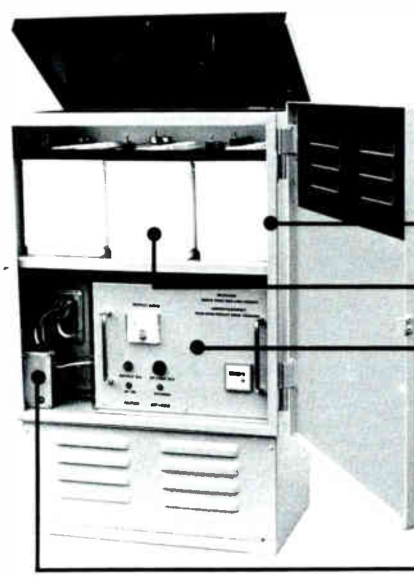
Fortunately, such a capability exists and is called "reverse feeder switching." With this tool, the signals can be observed returning to the headend from distribution segments of the system associated with a particular trunk station. Therefore, cable testers can determine which distribution system contains the offending connection. While the problem could occur in the trunk portion of the system, it is not likely, because that portion of a typical system contains relatively few connections.

If the system is not equipped with reverse-feeder switching, or if the problem is in the trunk, the only proven way to find the cause of the distortion is to interrupt the signal flow in an orderly fashion and observe the analyzer for elimination of the distortion. Of course, even with feeder switching, the indicated distribution system signal flow must be interrupted in order to find the offending system component.

Field experiments are now being conducted to evaluate a technique developed to isolate the cause of common-path distortion to a reasonable physical length of system without interrupting signal flow. Initial experimentation has been quite successful, and completion of these efforts should occur within the next few months.







# Preventive Maintenance: Watching for System Wear

*By Austin Coryell, a CATV engineer.*

Most cable system managers and technicians recommend and endorse system preventive maintenance (PM) programs. Unfortunately, even in those few systems where effective preventive maintenance programs have been established, PM personnel seem to be the first people to get their duties changed when other workloads become heavy. It just seems to be too costly to have a trained technician working at something which cannot be measured in dollars of income.

This article points out tangible and intangible benefits that an effective, well-managed preventive maintenance program can provide to a system. First, the term "preventive maintenance" must be understood as it pertains to a cable TV system.

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*Prevent:* Strongly implies decisive counteractions to stop something from happening.
*Maintain:* To keep something in a condition of good repair or efficiency.
*Manage:* To direct, administer, and/or control given tasks and situations.

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Preventive maintenance should be an established and administered procedure, directed by a person of authority to his or her field personnel. Maintenance procedures, when performed in a routine manner, reduce the number of customer complaints of poor picture quality, signal degradation or system outages, caused by an unbalanced or deteriorating system.

It seems that many systems misinterpret "managed preventive maintenance." These systems allow subscribers to dictate when and how much maintenance is to be performed, since maintenance is stimulated only by service call activity. When service complaints become high for a given channel or system area, technicians, through their normal troubleshooting procedures, are dispatched either to correct the problems or report them to their immediate supervisors for further action. This is called "corrective maintenance"—to remove, remedy, or counteract a malfunction. Corrective maintenance will not prevent this situation from happening again. This is also the most expensive type of system maintenance in terms of customer satisfaction, manpower utilization, and extended system performance.

## Setting Up a PM System

Preventive maintenance, properly established and implemented, identifies and corrects system problems before they can generate subscriber complaints. A good preventive maintenance program will do several things for a cable system:

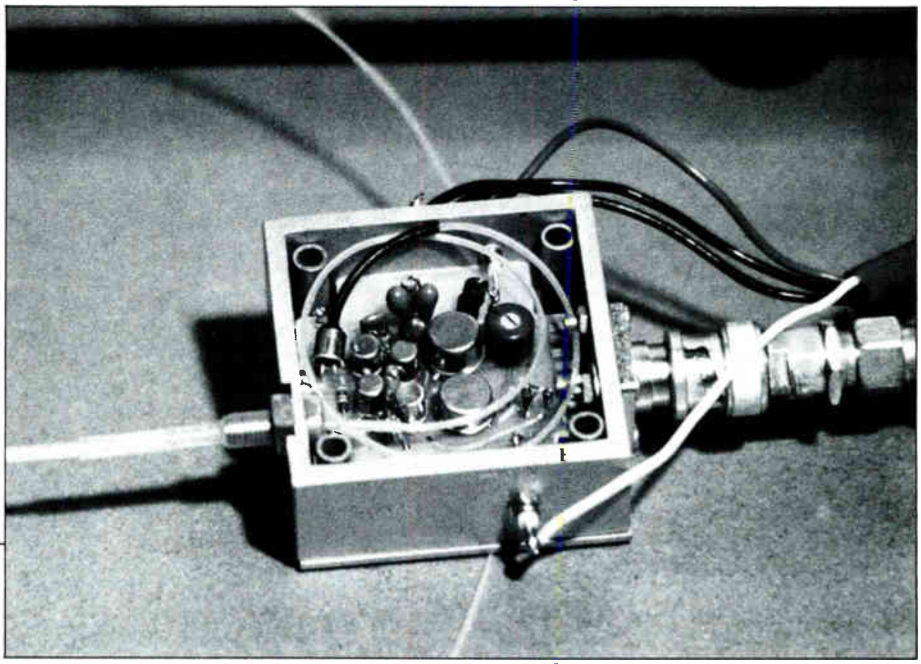
1. Reduce subscriber complaints and corrective maintenance service calls;
2. Improve overall service to subscribers;
3. Give technicians more time to handle other projects instead of handling emergencies;
4. Reduce system operational costs; and
5. Increase the usable life of the plant.

Many cable system owners, particularly large MSOs, have established excellent preventive maintenance programs. However, it is next to impossible for corporate or regional engineering people to develop one specific PM program which will fit each system's needs or to enforce compliance with the program. Each system is unique. Among the variables are: age of the plant, types of equipment, the weather and atmospheric environment to which equipment is exposed, how well the system was initially constructed, how well the system has been maintained in the past, quantity and quality of program channels received, quality and quantity of programming required by the subscribers and the future plans and objectives of the system owners.

Prior to implementing or changing a preventive maintenance program, companies should consider the following six factors:

1. Objectives of the preventive maintenance program;
2. Electrical and mechanical condition of the system;
3. Costs of labor, tools, test equipment, vehicles, and material;
4. Availability of trained and/or experienced PM technicians;
5. Plans for the immediate future of the system; and
6. Test and inspection data and reporting mechanisms needed to ensure a well-maintained system which meets the criteria set up in items one through five.

The objectives of a preventive maintenance program could be the same or different for various areas of a system. For example, an extremely old or poorly maintained plant may need extensive upgrading or rebuilding. The preventive maintenance program must hold the system together and still provide adequate service to subscribers. An old or neglected plant that can be upgraded needs a good preventive maintenance program to raise the level of service to subscribers and extend the life of the plant. Still another example, an obsolete system requiring greater channel capacity, needs a good preventive maintenance program to accumulate



data to determine to what extent upgrading or rebuilding is required. A new or well-maintained system also needs preventive maintenance to maintain the present condition of the system.

The electrical and mechanical condition and requirements of each system are different. Again, these requirements may be due to age, type of equipment, preventive maintenance, pollutants in the atmosphere, weather conditions, grounding, quality of utility service or the type of equipment and materials used. A preventive maintenance and data reporting program should be set up to detect sources of problems or system conditions, to monitor progress in correcting known problems and to monitor correction procedures established to ensure that the right decisions were made.

After a thorough evaluation and inspection of the system, companies should establish a cost per mile for their respective preventive maintenance programs. The more elaborate the program, the greater the cost per mile to maintain the plant. As an example, it costs approximately $30,000 per year to put a maintenance technician into a system performing full-time preventive maintenance—the sum of which includes labor, tools, test gear, vehicle and power generator. If the technician were assigned 100 miles of system to maintain, the preventive maintenance program would be $300 per mile per year, plus materials used to correct problems encountered. Material costs can only be predicted by system personnel because of their association with the system and its problems. The main objective should be to establish a program whereby costs per mile are minimal but still meet system requirements.

Any good preventive maintenance program should be built around present or proposed manpower. Establishing a program that exceeds the available man hours will only lead to a discontinued plan. It is best to start the program conservatively, with good reporting and monitoring systems, to determine the effect on system performance. From this reporting and monitoring, changes may be made to either improve system performance or reduce maintenance costs.

The next step is to evaluate the skills of the company's technical personnel. If they fall short, set up training programs that will enhance their performance and reduce labor costs. Review the test equipment requirements needed for the preventive maintenance program with emphasis on reducing the man hours required to maintain a mile of plant. Of the $30,000 required to put one maintenance technician in the field, 78 percent of the cost is for labor and overhead.

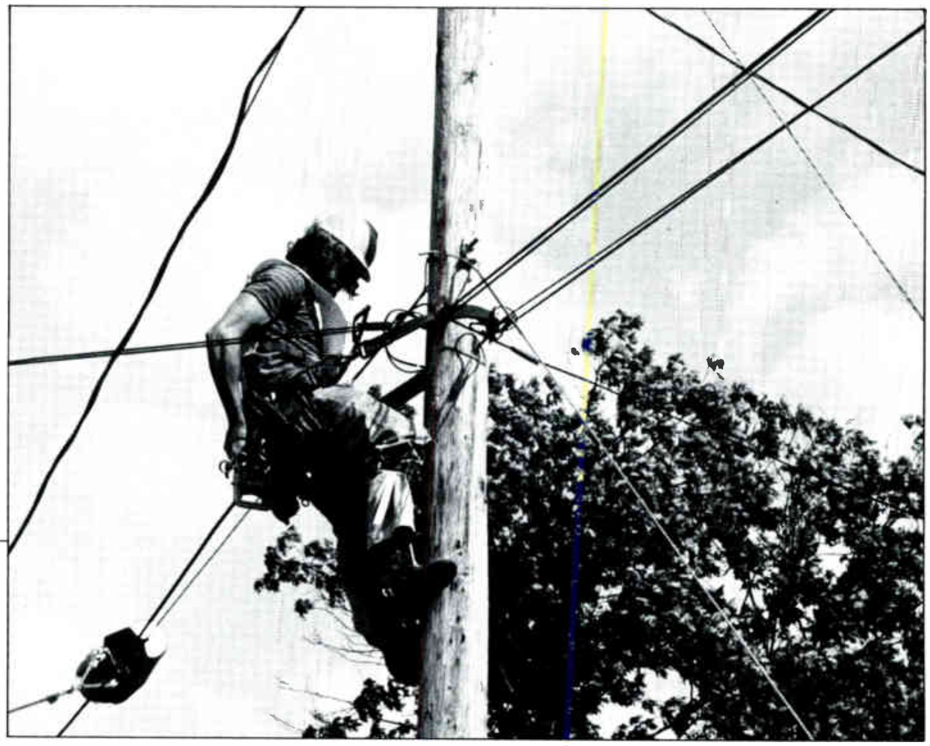
Great emphasis should be placed on such factors as reporting forms, tests, visual inspection, the number of test locations and the frequency of tests, so that data accumulated will reveal system problems and performance accurately. A dedicated program should be set up to monitor data accumulated by system personnel.

The most important rule in establishing and running an effective preventive maintenance program is the collection and evaluation of system performance data. There are four primary sources of data:

1. *Theoretical design data of the system*. This data predicts how well the system should perform. It is also a reference point for comparison with activation and proof of performance measurements. System maps or records should contain, at least, the calculated design data for trunk amplifier spacings, the input signal readings to all electronic amplification, equalization and padding needed, voltages at each station and theoretical degradations of signal-to-noise, second order, triple beat and cross-modulation. Some systems may not have the original design calculations of older plant available. In these cases, it becomes necessary for system personnel to do their own calculations on amplifier spacings, input signal levels, feeder-end levels, system powering and system signal degradations.

2. *Activation and initial proof of performance data*. This data on new plant is vital. It indicates whether the system's actual performance is correct in relation to the theoretical design. If the activation and proof of performance data is comparable to the theoretical calculations, these measurements can be used for comparison with all future system test data.

3. *Preventive maintenance data*. Maintenance technicians must log all preventive maintenance activities for future referral. Preventive maintenance data may be accumulated from periodic electrical measurements, physical inspections, preventive maintenance program activities and corrective maintenance that is performed during electrical and physical inspections. Periodic electrical measurements should be logged with dates and names of the person making measurements. These measurements should be compared to reference data to ensure that the system is not degrading. Problems found during physical inspections should be logged. This information is useful when reviewing maintenance logs and enables personnel to establish preventive maintenance programs to prevent these problems from happening again. Log all preventive maintenance activities to keep track of



which particular locations have already been worked. Should a problem reoccur at these locations in the future, the maintenance logs will show whether the preventive maintenance program is effective. All corrective maintenance work performed on problems found during the electrical tests and physical inspections should be logged in the maintenance records during periodic review of procedures.

4. *Service call records*. These reports, which service technicians fill out and turn in, are a useful source of system performance data. To make good use of service call reporting systems, first establish what key test information should be on all service call reports in order to provide data necessary to determine system performance and problems. Second, service call reports must be reviewed daily to ensure personnel are providing complete data on the reports and to extract data that will enhance the preventive maintenance program and correct system problems.

The key to a successful preventive maintenance program is to collect accurate, useful data from reliable sources, review the data on a continuous basis and reestablish new procedures (when necessary) to improve upon system performance.

## Maintain the Entire System

Far too often, cable companies establish preventive maintenance programs only for the trunk or backbone of the systems. Since most systems have approximately four-to-one feeder-to-trunk ratios, only 25 percent of the system's stranded plant is properly maintained.

Most cable systems have more house-drop cable and "F" connectors in the plant than total trunk and feeder cable and feeder connectors. In a system with only 35 house drops per mile, the amount of house-drop cable will equal the feeder cable and the number of house-drop connectors will be more than double the number of feeder connectors. In an older operating system, house drops could exceed 70 per mile, doubling the amount of house-drop cable and connectors.

Preventive maintenance of a drop cable is important because chances are good that some drop-cable installations are not up to par. Many systems use contract installers for new installations. This requires close quality control and tight adherence to installation procedures. In other systems, installation work is performed by the least experienced, least trained and least skilled company personnel. Installation materials are often of lesser quality than trunk and feeder materials and consequently have less life expectancy. Close observation of material deterioration by the environment is needed.

Many systems have preventive maintenance programs which are dedicated to approximately 25 percent of the strand-supported plant (trunk and feeder) and less than 12 percent of the total distribution plant (trunk, trunk feeder and house-drop). Over 50 percent of the total distribution system is house-drop materials and personnel, which are more difficult to monitor and control. With these two major points in mind, it becomes obvious that maintenance technicians cannot perform preventive maintenance on the entire system and that all technical personnel in the work force should be included in a total preventive maintenance program.

## Data Acquisition

Data acquisition should cover three areas:

1. Retrieval of system performance data;
2. Consolidation and evaluation of data; and
3. Establishing and/or changing preventive maintenance programs based on data gathered.

System performance data may be retrieved from several forms, including installation work orders, service-call reports, system maintenance reports—both electrical and mechanical—special reporting forms and additional information requests. Three things should be done when requesting data from personnel: first, give the reasons or objectives for acquiring the data; second, give specific details and instructions on how to acquire information needed; and third, provide personnel with the results of their efforts. It is futile to request personnel to perform specific data-gathering tasks without giving reasons or following through with the results of their accomplishments.

Here is one example of useful data: An analysis of service-call reports indicates that the highest percentage of calls in the system are attributed to bad house-drop connections. If the service order is a standard form with quick-check squares, bad house-drop connections could cover a lot of different problems. The list includes improperly made connections, connections severely corroded, drop-center conductor pulled back due to tension, cracked connectors, and moisture.

Information retrieval can be used for many types of system evaluation and any number of system personnel can be used to obtain such data. The advantage of using as many different personnel as

***"Systems with poor bench repair equipment or procedures may have a high percentage of recurrent equipment failures and intermittent equipment problems as well as a high percentage of equipment-related customer calls or increased man hours per service call."***

possible is that it eliminates the need for specific personnel and reduces costs. Information retrieved by system personnel should be consolidated and evaluated periodically.

After a manager has consolidated and evaluated the collected data, he may discover that changes need to be made in the preventive maintenance program or new procedures added to correct or reduce present system problems. Preventive maintenance programs should be reviewed periodically to determine their effectiveness.

Systems with poor bench repair equipment or procedures may have a high percentage of recurrent equipment failures and intermittent equipment problems as well as a high percentage of equipment-related customer calls or increased man hours per service call.

For a bench technician to successfully analyze and repair equipment brought in from the field, he must have all available pertinent information. All equipment brought in for repairs should be accompanied by the following information:

1. *Location from which equipment was removed.* This will assist in determining the cause of problems or failures, such as beats, cross-modulation, power supply failures, equipment burn-up, inability to maintain proper levels, gain or slope, etc. Older systems may have areas which are improperly designed or over-cascaded. A good bench technician should be familiar with these areas and may detect reasons for defective equipment or performance.

2. *Symptoms which led to replacement of the equipment.* This will reveal if the field technician is properly trained and is using logical troubleshooting procedures. It can also enable the bench technician to analyze and repair faster and more effectively.

3. *Specific information may be needed on certain symptoms:*

A. Hum problems: should have the input AC voltage listed and VOM number.

B. Cannot get proper output level: should have listed input and output levels, and values of pads and equalizers at this location.

C. Cannot get proper slope: same information as needed above.

D. Frequency response bad: should have all input and output signal levels listed, before and after equipment replacement.

E. Power supply failure: should have input AC voltage and VOM number and whether or not this particular amplifier station is properly grounded.

4. *Whether replaced equipment corrected problems or just improved performance.*

5. *Whether location has had similar problems before.* In some cases, parts of a system may have inherent problems which cause improper equipment performance.

Defective equipment brought in from the field should receive mechanical and electrical inspections and a record should be kept for future reference and performance data.

A good bench repair facility should have the following: well-kept test equipment which will adequately perform all tests required; instruction manuals on all test equipment and equipment in the field; adequate inventory of spare parts necessary to repair equipment; a good set of equipment repair policies and procedures; a good set of equipment repair records; and a knowledgeable bench repairman, capable of maintaining all system equipment.

## Mechanical Inspection

In addition to checking for corrosion of parts, an inspection should ensure that all fastening hardware is present and that modules and circuit boards have good ground contacts for heat dissipation, RF shielding and RF return and bypass. These preliminary inspections should be, in turn, followed by a physical inspection of solder joints, keeping an eye out for burnt components, loose sockets and tight terminal connections. Also check the equalizer, power director and fuses and make certain that "F" and five-eighth-inch entry threads are clean and in good condition.

## Electrical Inspection

Electrical measurements and testing should be made per the instruction set-up in the equipment manual. When testing is completed, the equipment should perform through the entire range of the equipment specifications.

Voltage and current measurements should be checked at key locations—in fact, power supply performance should be tested through its entire range. Check gas discharge devices to ensure they are operating properly. Tweak all pots and trimmers to determine if they are operating properly. And check all feeder output ports, and bridger and AGC/ASC down ports to ensure they are working satisfactorily. Check the input and output match of the equipment and align the amplifiers to perform under the entire system operating dynamic range for amplifier spacing, gain and tilt; if amplifiers are automatically controlled, run tests through the entire ACG/ASC range. Ensure that all equipment modifications are employed in all equipment before final alignment and testing and make certain that all test points are within tolerances, fuses are of proper values, and all circuitry for powering is working properly.

Following the above guidelines should improve on system performance, reduce customer-related calls, reduce preventive maintenance time and increase the usable life of the system. If effectively managed, a good preventive maintenance program will also make the bottom line look better at the end of the fiscal year.

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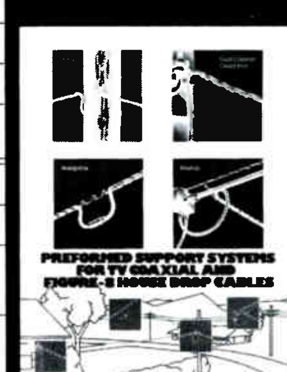


PREFORMED LINE PRODUCTS

# Intermod

By Glenn Chambers

## SCTE "Forty Questions"

All paid-up members of the Society of Cable Television Engineers (SCTE) should have received recently a four-page survey questionnaire. This questionnaire was developed to find out more about the personal circumstances and the desires and plans of SCTE members. The more any society knows about its members, the better it can serve them with what they want and need.

The questions on the form are excellent and should gather a wealth of information about the members. I strongly urge everyone who received the questionnaire to fill it out completely and return it as soon as possible. There is even a postage-paid envelope. Members who have not received the form should contact the SCTE right away and request that one be sent. The results of the survey will be tabulated and published early next year. You will be able to see how the majority of members responded, and see if you are part of the majority or if you are, as your manager has often thought, some kind of an oddball.

To me, one of the key questions in the survey concerns your thoughts on a national certification program for cable television technical people. As most of you know, the Federal Communications Commission (FCC) is seriously considering doing away with the first-class radiotelephone license which so many of us sweated blood to get.

If it goes, and it looks like it may, a lot of employers won't really have any way to judge the technical competency of potential employees. Even though a FCC license is no guarantee that a person is technically competent, or that he or she knows a cable from an amplifier, it at least shows that the holder could read, memorize answers, and was willing to devote a lot of time to studying.

If the FCC license program is dropped, something else must be devised. In the opinion of many cable engineers and managers, having a certification program for cable technicians makes a great deal of sense. The Society of Broadcast Engineers (SBE) has one, and most SBE members feel that it is even better and more worthwhile than the FCC license.

Such a program would require a tremendous amount of work and study to establish and administer properly, but I for one believe it should be done. I also feel that the SCTE would be the proper group to devise, implement and control the program. I know that I would be more than willing to help in any way possible and I'm sure there are lots of other people who would volunteer also. Let the SCTE know how *you* feel.

## Western Holiday

In my mind, one of the better times of the year is fast approaching—the end of another year. It seems that many of the things that I really enjoy happen then. There is Thanksgiving with a couple of days off from work and turkey with all the trimmings. There is Christmas, with presents and kids' happy faces. There is New Years with football and parades and celebration. And there is the best of all for me, the Western Convention, which is like Thanksgiving, Christmas and New Years all in one.

I understand from Ross Wileman that the technical sessions planned for this year are bigger and better than ever before, with topics that should be of interest to almost everyone technical. There are also many management sessions, informational sessions, and lots of plain old bull sessions.

And then there are all those shiny new products on display. I think all of us still have some feeling of being a kid again on Christmas morning when the display room doors are opened. It is almost too much to take in at first look. There are the rows and rows of displays and booths, trucks, vans, earth station antennas and, probably, even a partridge in a pear tree.

Judging from the crowds that were there the last few years, few people who are even remotely connected with, or interested in, cable television have not attended at least one Western Convention at the Disneyland Hotel in Anaheim. Those who have missed the show have been missing out on one of the biggest and best. Come on out. The weather is always fine. Golf and tennis are great, and you'll see almost everyone and everything in the business.

# International Cable

## France Funds Fiber Optics Project

NEW YORK, NEW YORK—The French Ministry of Posts, Telecommunications and Telediffusion (PTT) has awarded a contract estimated at approximately $100 million for the design and implementation of a major fiber optics network in Biarritz, France. The recipient of the award is the Societe Anonyme de Telecommunications (SAT). The firm, a major French telecommunications company, will be involved in a joint venture with General Optronics Corporation of New York, a U.S. laser manufacturing firm headed by cable entrepreneur Irving B. Kahn.

Under the terms of the contract, General Optronics will supply the lasers and transmitters for the Biarritz network. Last October, SAT and General Optronics announced the formation of a company called Europtronique as a manufacturer of laser diodes, transmitters, receivers and related fiber optic systems for sale in the common market. The Biarritz project will be the first undertaking for the company.

*Irving Kahn's General Optronics Corporation will supply injection laser diodes for a fiber optics project in France.*

According to Kahn, the plans for Biarritz involve developing one of the largest and most sophisticated telecommunication systems in the world. Specific services proposed for the network are picture phones, data transmission and facsimile, 30 channels of television and additional audio signals. These will be delivered through picturephone switching centers and TV program selectors based on a fiber optic distribution system to a target audience of 1,500 subscribers.

Competing proposals for the Biarritz award were submitted by all major French telecommunications companies to the PTT, which is also responsible for the French telephone network. SAT has had extensive dealings with the PTT in the past and ranks among the leading telecommunications suppliers for both the PTT and the French Ministry of Defense. The company's group sales in the worldwide telecommunications industry is reported to total over $1 billion.

The Biarritz contract award is expected to give Kahn a strong foothold in the European telecommunications market. He has already indicated plans to expand into other countries.

## Canada Plans Hearings On Remote Cable Service

OTTAWA, ONTARIO—The Canadian Radio-Television and Telecommunications Commission (CRTC) has moved a step closer to tackling the problem of extending cable television services to remote and northern areas of the country. Hearings on the issue are scheduled to begin in February, and December 1 was the deadline for interested parties to submit comments.

The extension of service has been established as the highest cable priority by the CRTC and has become the main encumbrance to the introduction of pay television in Canada. According to a study concluded earlier this year by the Committee on Extension of Services to Northern and Remote Communities, the pay TV issue would divert attention from the prime goal of providing broadcast services to underserved communities. Based on that recommendation, the CRTC decided to devote its attention to the extension problem, although promising to hold hearings on the pay TV topic by the end of 1981.

In Canada, the configuration of cable systems is unlike that of the United States. Most major urban areas are wired in the southern regions, but even the urban centers in what are termed the "prairie provinces and maritime regions" are still waiting for telecommunication services. The delay has been attributed to the extreme expense and difficulty of wiring these provincial areas. According to the CRTC, unless an adequate program is established to promote the introduction of cable in these areas, the needs of Canadian viewers will not be served. The February hearings are expected to begin the long-awaited process of eliminating the barriers to pay TV.

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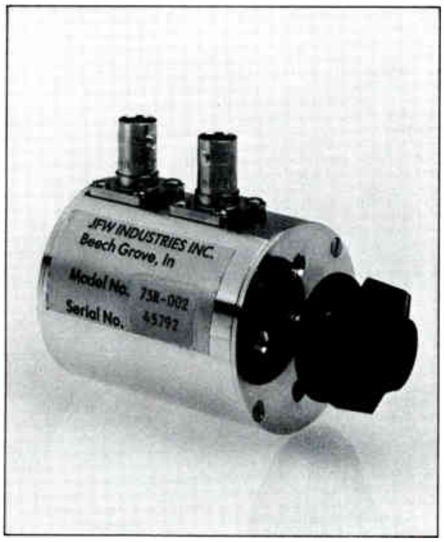
**JFW Industries Markets 75 Ohm Rotary Attenuator**

**JFW Industries, Inc.**, has introduced a line of 75 Ohm rotary attenuators which feature small size, low cost, 1 watt average power and high accuracy.

The line has a frequency range of DC-500 MHz; impedance of 75 Ohms; and VSWR of 1.3:1 maximum. The series has an insertion loss of .4 dB maximum. The line comes in three models: model 75R-001 has an attenuation range of 0-70 dB in 10dB steps; model 75R-002 has an attenuation range of 0-10 dB in 1 dB steps; and model 75R-003 has an attenuation range of 0-50 dB in 10 dB steps.

Model 75R-001 has attenuation accuracy of 30 MHz plus or minus .2 dB; 300 MHz plus or minus .5 dB; and 500 MHz plus or minus .3 dB. Model 75R-002 has attenuation accuracy of 30 MHz plus or minus .1 dB; 300 MHz plus or minus .2 dB; and 500 MHz plus or minus .3 dB. Model 75R-003 has an attenuation range of 30 MHz plus or minus .2 dB; 300 MHz plus or minus .5 dB; and 500 MHz plus or minus .8 dB.

For information, contact JFW Industries, Inc., P.O. Box 226, Beech Grove, Indiana 46107; (317) 783-9875.




*JFW Industries' Model 75R-002 75 Ohm rotary attenuator.*

**Panduit Corporation Develops Terminal Crimping Tool**

A new terminal crimping tool that provides multi-purpose performance at reasonable cost is announced by **Panduit Corporation**, Electrical Products Group.

The CT-160 crimping tool installs insulated and non-insulated terminals, disconnects, splices and wire joints on wires from #22 to #10 AWG. It forms the insulation sleeve to provide insulation grip or support on nylon or vinyl terminals.

In addition, the tool cuts and strips wires and cuts and rethreads screws for both U.S. and metric sizes. Another feature is the plier nose for light duty use. The design of the CT-160 tool provides low crimping forces and the convenience of comfortable, cushioned handles.

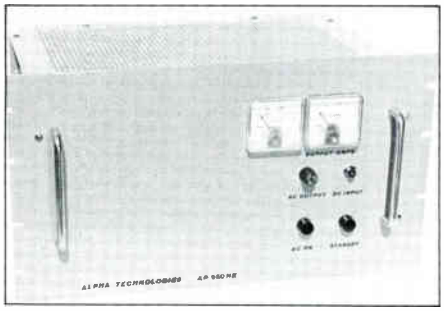
For information, contact Panduit Corporation, 17301 Ridgeland Avenue, Tinley Park, Illinois 60477; (312) 532-1880.

**Alpha Technologies Introduces Headend Power Supplies**

**Alpha Technologies Ltd.** has introduced a new series of power supplies for headend applications. The model AP-

960HE (120V-1000 VA) features excellent regulation and noise rejection in normal and standby mode, inherent and electronic current limiting, line synchronization, crystal control, automatic charger with temperature compensation and float/equalized mode, less than one cycle transfer time as well, as additional proven features of the CATV power products.

For information, contact Alpha Technologies Ltd., 5676 Dorset Street, Burnaby, British Columbia; (604) 430-1476.



*Alpha Technologies' Model AP-960HE power supply.*

# Miscellaneous

**ComSonics Adds 440 MHz Spectrum Analyzer**

**ComSonics, Inc.**, has announced the addition of a 440 MHz spectrum analyzer to its line of equipment. The Model SA440 offers lab grade performance and is compact enough for field use. It offers LED read-out, a frequency range of 1 to 440 MHz, storage mainframe, internal calibration, on-screen dynamic range of 72 dB at 1KHz and is available with a rigid front cover.

It can be used to eliminate co-channel and track down spurious beats within the band. It is sensitive to the response of each carrier (aural and visual) and is sensitive to the visual response of individual channels or the entire system at once. In addition, a bandwidth of 3KHz to 30 MHz to 30 MHz allows use of the SA440 for Data Channel range analysis by broadband users.

The ComSonics® Spectrum Analyzer is a complete package including oscilloscope, analyzer and mainframe.

For information, contact ComSonics, Inc., P.O. Box 1106, Harrisonburg, Virginia 22801; (703) 434-5965.

**LNR Communications Markets Wideband Converter**

**LNR Communications, Inc.**, is offering Model UC14/DC12 Dual Wideband Converters and Model TL14/12 K-Band Test Translators to be used for Ku-Band Satellite Communications.

The LNR Series UC14/2/70 and DC12/2/70 Earth Station Frequency Converters, which will be supplied, feature dual (wideband *and* narrowband) IFs. These units have a 500 MHz bandwidth input/output at 2 GHz for wideband (500 Mb/s) QPSK or BPSK, data and TDMA Carriers. In addition, there is a narrowband (40 MHz bandwidth) input/output at 70 MHz for 60 Mb/s data traffic. Specific key parameters that led to the selection of LNR included: group delay ripple (over 500 MHz) less than 1 nanosecond; low phase noise; low amplitude ripple; low VSWR; and low spurious response.

The associated Model TL14/12 Loop Test Translator is rack-mountable and can be fed from a directional coupler ahead of the earth station HPA. The units are intended for new Ku-Band (+10 dBm) satellites such as Advanced Westar, SBS, etc. and are based on previously delivered wideband converters designed for a Bit Error Rate Test Subsystem for the TDRSS Satellite. Its output is inserted into the off-line port of the LNA redundant system or a directional coupler at the LNA input. Full alarm, monitor and test facilities are provided.

For additional information, contact Jeannie Piotrowski, marketing administrator, LNR Communications, Inc., 180 Marcus Boulevard, Hauppauge, New York 11787, (516) 273-7111.

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WISI, founded in 1926, has been a leader in the communications industry in Europe for over 25 years manufacturing communications products for the world market.

Nova Engineering Services, Inc. is currently seeking qualified representatives for the Northeast, Midwest, and West Coast territories. Interested parties should be experienced in cable operations and CARS Band Microwave. A strong technical sales ability is required, along with the capability of maintaining WISI's professional reputation already established in Europe.

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Reply to: Matthew R. Bedosky, President
Nova Engineering Services, Inc.
310 Breesport, Suite C
San Antonio, Texas 78216
512 349-8601 Tlx. 767736 Nova SNT

## WANTED: CATV MARKETING REPRESENTATIVE

Rapidly expanding Wisconsin area cable TV company is seeking an experienced marketing person. This person will primarily be responsible for making presentations to promote the acquisition of new CATV franchises. Ideal candidate should have 3-5 years broad-based technical experience in CATV with demonstrated public contact or sales experience. Must be willing to travel. Salary commensurate with experience and background. We offer an excellent fringe benefit plan. If you are interested in this position, call or send resume to:

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# WANTED

## Seminar Instructors

Major manufacturer (EOE) wants individuals to conduct CATV training courses nationwide. Qualifications: BS or Assoc. Degree in electronics or equivalent experience in CATV system operation. Salary commensurate with experience. Send resume to: Box C-ED 0980-2.

## CONSTRUCTION SUPERVISOR

Growing CATV construction company requires experienced person to supervise apartment wiring. Must be experienced in supervision, cable splicing and general CATV skills. This is a management position with work being located in northern New Jersey and southern New York state. Interested persons should send resume and salary requirements to S & J COMMUNICATIONS, INC., P.O. Box 283, Greenwood Lake, NY 10925, Attention: John Hamshar.

## SENIOR FIELD ENGINEER

Major MSO is seeking an experienced Senior CATV Field Engineer to assist the director in all functional areas. You will be the primary interface between the system and regional technical people and corporate engineering. You will be based in our corporate headquarters in Denver.

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Contact: Dick Amell
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211 Perimeter Center Pkway
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## CATV SYSTEM ENGINEER

Technical Engineer required for coordinating the design and installation of a new CATV system serving 2 adjacent rural communities in south-central Alaska. Applicants should have 5 or more years CATV experience with a background in system design, microwave distribution systems and maintenance. Telecommunications engineering experience would be beneficial but not mandatory. Salary commensurate with experience. Excellent benefit program. Send resume in confidence to:

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MTA
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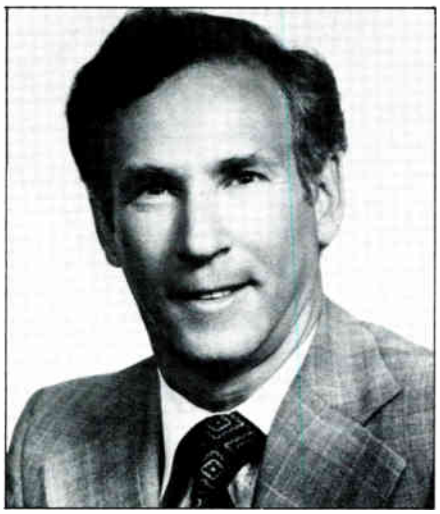
# Ad Index

# People News

★ **Stephen H. Kovel** has been appointed special projects manager for fiber optics by **Times Fiber Communications, Inc.**, a subsidiary of Insilco Corporation.

Kovel brings to Times Fiber Communications a background of general management experience in technologically-oriented business environments, including positions in engineering supervision, project management and contract administration. Kovel was previously with M.J. Whitman & Company as a consultant to the President's Commisssion on the Accident at Three Mile Island. Previous career positions include consulting in the Corporate Financial Services Division of Bankers Trust Company and several positions including engineering, project and contract management for United Nuclear Corporation. From 1963-1970, Kovel was an operational officer with the U.S. Navy Nuclear Powered Submarine Fleet. He has completed the U.S. Navy Nuclear Power Training Program and is qualified as a naval nuclear reactor engineer.

Kovel received his undergraduate degree in electrical engineering from the University of Pennsylvania in 1963. He also holds a master's degree in public and private management (Charter Class of 1978) from Yale University School of Organization and Management. He is a resident of New Haven, Connecticut.



*Stephen H. Kovel*

★ **Candex Pacific, Inc.**, an engineering consulting firm in Redwood City, California, appointed **Jeffrey Halnon** and **John Paul Grogan** to its Department of Microprocessor-based Product Development.

Halnon comes to Candex with experience in both circuitry and software design of data-communication and military-testing systems. He is a graduate of the Georgia Institute of Technology in Atlanta. Grogan is a recent engineering graduate of Purdue University, where he was involved in several projects in microcomputer digital design.

New microprocessor-based products that have recently been developed by Candex for their clients include a controller system for the lumber industry, precision laser instrumentation, a computer-assisted drafting system and test sets for communication lines and air-traffic-control radar. Candex also has extensive experience in computer peripherals, digital controllers and interfaces, broadcast equipment, magnetic recording systems and consumer products.

*Jack C. Engbrecht*

★ **ITT Cannon Electric** has named two new managers. **Jack E. Engbrecht** has been named product manager, filters, for the firm's Phoenix, Arizona, operation; and **George R. Deacon** has been promoted to manager, prototype product fabrication, at the firm's operation in Santa Ana, California.

Engbrecht joined International Telephone and Telegraph Corporation in 1976 as a product specialist. Prior to this he worked for Ohmite Manufacturing Company and Licon Switch, both in Chicago. He has a degree in mechanical engineering from the Illinois Institute of Technology.

Deacon, with International Telephone and Telegraph Corporation since 1962, has worked as supervisor, design tooling and production, toolroom foreman, senior mechanical engineer, and model shop supervisor. The recipent of two decorations from the Royal Air Force, Deacon previously worked for Master Tool and Die, Hollywood, and Kaiser Aluminum, Chicago.

*George R. Deacon*

★ **Irving Rabowsky** has been appointed to the new position of senior scientist for **Hughes Aircraft Company's microwave communications products**.

Rabowsky was previously chief of the data/digital transmission division of the Los Angeles County department of communications. A number of years ago, he was chief engineer for the Hughes product line's predecessor organization, the AML division of Theta-Com, where he played a key role in the design and development of several of the AML systems currently in production.

★ **Joseph H. Scott, Jr.**, has been named Director, Corporate R&D Laboratory, at **General Instrument Corporation's** corporate research and development laboratory in Chandler.

In his position, Scott will be responsible for research and development activities in support of General Instrument's diversified electronics divisions, and for the administration of the Chandler facility.

Primary areas of advanced semiconductor research at the Chandler laboratory include microelectronics VLSI, optoelectronics, computer aided design systems, and software development.

In addition to ensuring technological leadership in those segments of the semiconductor industry General Instrument serves, the laboratory provides the company's systems divisions—Data, Business, Cable TV and Entertainment—with state-of-the art technology to ensure continued leadership.

General Instrument's Chandler facility, completed in 1979, is one of the finest semiconductor research laboratories in the world, utilizing the very latest research and pilot production equipment available.

Scott will report to L.R. Hill, vice president-technology. Scott received the RCA Achievement Award in 1968 and 1969 and the David Sarnoff Gold Medal in 1972. He is a member of Sigma XI and a senior member of IEEE. Scott received an AB in chemistry in 1957 from Lincoln University, Pennsylvania, and also attended Howard University, Washington, D.C., the Harvard Advanced Management Program, and the Wharton School of Business.

★ **Roy L. Winkels** has been appointed quality programs manager for **General Cable Company**, a division of GK Technologies, Inc.

Winkels joined General Cable in 1959 as superintendent of test and final inspection in the firm's Bonham, Texas plant. In his new assignment, he will be responsible for monitoring the product quality programs of General Cable's Apparatus (Mopeco, Puregas and Telsta), Cornish Products, Genca Tool, Exchange Cable, Indiana Steel and Wire and Station Products Divisions.

A graduate of East Texas State University, Winkels received his M.S. from Sam Houston State University in Huntsville, Texas. Prior to joining General Cable, he taught in the Texas school system.

*Glenn Kriegel*

★ **Glenn Kriegel** of Denver, Colorado, has been named director of CATV education at **RETS Electronic Schools**. Kriegel will be responsible for all CATV training from installers to chief technicians.

Kriegel joins RETS from Cablecom General, Inc., Englewood, Colorado, where he was the Eastern division franchising manager. Kriegel has a B.S. in aeronautical engineering from the Illinois Institute of Technology. He began his cable career as the vice president of operations for Jones Intercable, Inc. He has also served in numerous NCTA committees and has acted as a consultant to new and established cable companies.

★**Dr. Patrick Nettles** has joined **Microwave Associates Communications Company** (MAC) as product line manager of microwave data products, according to an announcement by Peter Pifer, president of MAC.

Prior to joining MAC, Dr. Nettles had served as engineering manager of the business telecommunications product line at Scientific Atlanta. Previously, Dr. Nettles was physics instructor at the University of North Carolina in Chapel Hill and served as a research associate at Triangle University's nuclear laboratories, Durham, North Carolina.

Dr. Nettles received his B.S. degree in physics from the Georgia Institute of Technology in 1964 and his PhD. in physics from the California Institute of Technology in 1970. He is a member of the IEEE and was a participant in the IEEE COMSOC Space Communications Committee.

★ **David A. Biddle**, 40, has been named head of product planning and research at **TRW RF Semiconductors**. He reports to Warren Gould, RF operations manager. In the newly created post, Biddle analyzes RF product mix, sales trends, and profitabiltiy, then makes recommendations regarding product additions and deletions.

Biddle earned a B.S. in physics from Northern Polytechnic, London, in 1964 and an M.S. in management science from West Coast University, Los Angeles, in 1974. He has an extensive background in RF engineering and sales, including positions with Sylvania and Bunker Ramo. He joined TRW RF Semiconductors in 1977 as a sales engineer, left in early 1980 to become marketing manager for Powertec then rejoined TRW in the new position.

★ **Gerald N. Bobeczko** has been appointed vice president-general manager, **GTE Products Corporation**, CATV Division. In his new capacity, Bobeczko will have full responsibility for business planning, product design, manufacturing and marketing of Sylvania Pathmaker brand CATV products.

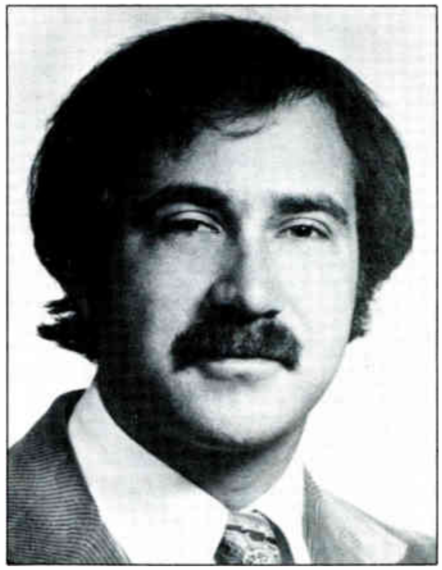
After joining GTE in 1964, Bobeczko served in management and financial capacities with four subsidiaries before being named controller for the CATV Division in 1975. He received a B.S. degree at Allegheny College in 1963 and an M.B.A. from the University of Pittsburgh in 1964. A native of Cleveland, Ohio, he now resides in El Paso with his wife and three children.

★ Gary G. Weik, vice president and general manager of **Cox Cable Communications'** West Coast Division, has announced that **Kenneth M. Gores** has been appointed division engineer. He will have overall engineering responsibility for 13 cable systems in California, Oregon, Texas and Washington.

Prior to being named to this new position, Gores was a corporate staff engineer providing assistance to the Cox Cable regional and system engineers throughout the country. Gores has an extensive history of cable experience having joined Cox Cable in 1970 as an installer in its Aberdeen, Washington, cable television system.

Gores was a technician in the Cox Cable systems in Aberdeen and Seaside, Oregon, and was named system engineer for Cox Cable's system in The Dallas, Oregon, in 1975. In 1978, Gores was named regional engineer and provided corporate engineering direction to the company's Southeastern and North Central regional cable operations.

Currently, Gores is working toward a B.S. degree in electrical engineering at Southern Technical Institute, Marietta, Georgia. He has completed various technical cable courses offered by Pennsylvania State University and supervisory management courses through Portland Community College.



*Clarke V. Greene*

★ **Clarke V. Greene** has been appointed systems engineer by **Times Fiber Communications, Inc.**, a subsidiary of Insilco Corporation. The appointment was announced by Robert E. Miller, director of TFC's Fiber Optic System Engineering Group, who said that Greene would assist in the design of systems for the CATV, military, and telecommuications markets.

Greene was previously a project engineer at the Radio Amateur Satellite Corporation (AMSAT), where his responsibilities included design, testing and fabrication of spacecraft antenna and computer systems. From 1976 to 1978, Greene was a technical editor for the American Radio Relay League. He has also been a science instructor at the Talcott Mountain Science Center in Avon, Connecticut.

He is a graduate of Worcester Polytechnic Institute and lives in Forestville, Connecticut.

# In Orbit

| Signal | Day | Start/Stop | Alert Tones | Satellite/ Transponders |
|---|---|---|---|---|
| **CBN** | | 24 hrs. | No | F1,#8 |
| **CNN** | | 24 hrs. | No | F1, #14 |
| **C-SPAN** | Mon.-Fri. | 12 pm-6:30 pm | 195°/1# | F1,#9 |
| **ESPN** | | 24 hrs. | No | F1,#7 |
| **Front Row** | | 2:30 pm/2:30 am | 481°/# | F1, #12 (E,C)<br>F1, #10 (P,M) |
| **HBO** | | | Program | F1,#24 |
| | | | 729°/# | F1,#22 |
| | Dec. 1 | 6:00 p.m. 1:00 a.m. | Scramble | F1,#23 |
| | Dec. 2 | 5:30 p.m. 1:35 a.m. | 835°/# | F1,#20 |
| | Dec. 3 | 6:00 p.m. 1:39 a.m. | Duplication | |
| | Dec. 4 | 6:00 p.m. 2:40 a.m. | 940°/# | |
| | Dec. 5 | 5:30 p.m. 3:33 a.m. | Take-2 E. | |
| | Dec. 6 | 2:00 p.m. 4:15 a.m. | 592°/# | |
| | Dec. 7 | 3:00 p.m. 2:07 a.m. | Take 2 W. | |
| | Dec. 8 | 5:00 p.m. 2:29 a.m. | 681°/# | |
| | Dec. 9 | 5:30 p.m. 1:01 a.m. | | |
| | Dec. 10 | 5:00 p.m. 1:30 a.m. | | |
| | Dec. 11 | 5:30 p.m. 2:14 a.m. | | |
| | Dec. 12 | 6:00 p.m. 4:33 a.m. | | |
| | Dec. 13 | 3:00 p.m. 3:28 a.m. | | |
| | Dec. 14 | 3:00 p.m. 2:01 a.m. | | |
| | Dec. 15 | 6:00 p.m. 2:09 a.m. | | |
| | Dec. 16 | 6:00 p.m. 2:00 a.m. | | |
| | Dec. 17 | 5:30 p.m. 2:16 a.m. | | |
| | Dec. 18 | 5:00 p.m. 2:39 a.m. | | |
| | Dec. 19 | 6:00 p.m. 3:45 a.m. | | |
| | Dec. 20 | 3:50 p.m. 3:33 a.m. | | |
| | Dec. 21 | 2:00 p.m. 12:59 a.m. | | |
| | Dec. 22 | 5:00 p.m. 1:50 a.m. | | |
| | Dec. 23 | 5:30 p.m. 1:26 a.m. | | |
| | Dec. 24 | 5:30 p.m. 2:35 a.m. | | |
| | Dec. 25 | 2:00 p.m. 3:18 a.m. | | |
| | Dec. 26 | 3:30 p.m. 3:39 a.m. | | |
| | Dec. 27 | 3:00 p.m. 3:15 a.m. | | |
| | Dec. 28 | 2:30 p.m. 1:02 a.m. | | |
| | Dec. 29 | 5:30 p.m. 1:27 a.m. | | |
| | Dec. 30 | 5:30 p.m. 12:51 a.m. | | |
| | Dec. 31 | 5:00 p.m. 5:00 a.m. | | |
| **HTN** | | 8 pm-10 (11) pm | 517°/# | F1,#21 |
| **KFIX** | (time permitting) | 2-4 hrs./day | No | F1,#1 |
| **KTVU** | weekdays<br>weekends | 7 am-1 am<br>7 am-4 am | No | F1,#1 |
| **Modern Talking Pictures** | weekdays<br>weekends | 12 pm-5 pm<br>7 am-12 pm | 243°/# | F1,#22 |
| **The Movie Channel** | | 24 hrs. | No | F1,#5 (E,C)<br>F1,#11 (M,P) |
| **Newstime** | | 24 hrs. | 276°/# | F1,#6 |
| **PTL** | | 24 hrs. | No | F1,#2 |
| **Reuters** | Mon.-Fri. | 4 am-7 pm | No | F1,#18 |

E = eastern M= mountain
C = central P = pacific

| Signal | Day | Start/Stop | Alert Tones | Satellite/ Transponders |
|---|---|---|---|---|
| **Showtime** | | | | F1,#12 (E,C)<br>F1,#10 (M,P) |
| | Dec. 1 | 3:30 p.m. 4:47 a.m. | | |
| | Dec. 2 | 3:30 p.m. 3:35 a.m. | | |
| | Dec. 3 | 3:30 p.m. 2:39 a.m. | | |
| | Dec. 4 | 3:30 p.m. 2:55 a.m. | | |
| | Dec. 5 | 3:30 p.m. 3:30 a.m. | | |
| | Dec. 6 | 1:30 p.m. 2:49 a.m. | | |
| | Dec. 7 | 1:30 p.m. 3:05 a.m. | | |
| | Dec. 8 | 3:30 p.m. 3:08 a.m. | | |
| | Dec. 9 | 3:30 p.m. 3:27 a.m. | | |
| | Dec. 10 | 3:30 p.m. 2:36 a.m. | | |
| | Dec. 11 | 3:00 p.m. 2:00 a.m. | | |
| | Dec. 12 | 3:30 p.m. 3:27 a.m. | | |
| | Dec. 13 | 1:30 p.m. 3:36 a.m. | | |
| | Dec. 14 | 1:30 p.m. 2:00 a.m. | | |
| | Dec. 15 | 3:30 p.m. 2:35 a.m. | | |
| | Dec. 16 | 3:00 p.m. 2:04 a.m. | | |
| | Dec. 17 | 3:30 p.m. 2:46 a.m. | | |
| | Dec. 18 | 3:30 p.m. 3:47 a.m. | | |
| | Dec. 19 | 3:30 p.m. 2:33 a.m. | | |
| | Dec. 20 | 1:30 p.m. 4:18 a.m. | | |
| | Dec. 21 | 1:30 p.m. 4:05 a.m. | | |
| | Dec. 22 | 3:00 p.m. 3:18 a.m. | | |
| | Dec. 23 | 3:30 p.m. 2:08 a.m. | | |
| | Dec. 24 | 3:30 p.m. 4:13 a.m. | | |
| | Dec. 25 | 1:30 p.m. 3:00 a.m. | | |
| | Dec. 26 | 3:30 p.m. 3:22 a.m. | | |
| | Dec. 27 | 1:30 p.m. 3:09 a.m. | | |
| | Dec. 28 | 1:00 p.m. 2:57 a.m. | | |
| | Dec. 29 | 3:30 p.m. 3:23 a.m. | | |
| | Dec. 30 | 3:30 p.m. 4:02 a.m. | | |
| | Dec. 31 | 3:30 p.m. 4:18 a.m. | | |
| **SIN** | | 24 hrs. | No | Westar II, #6 |
| **Trinity (KTBN)** | | 24 hrs. | No | F1,#13 |
| **USA Network** | | | | F1,#9 |

Off-times are listed below. For on-times, see notes below.

| | | | |
|---|---|---|---|
| Dec. 1 | 1:00 a.m. | Dec. 17 | 3:00 a.m. |
| Dec. 2 | 3:00 a.m. | Dec. 18 | 1:30 a.m. |
| Dec. 3 | 3:00 a.m. | Dec. 19 | 1:30 a.m. |
| Dec. 4 | 1:30 p.m. | Dec. 20 | 1:30 a.m. |
| Dec. 5 | 12:30 a.m. | Dec. 21 | 4:30 a.m. |
| Dec. 6 | 11:30 p.m. | Dec. 22 | 2:00 a.m. |
| Dec. 7 | 3:00 a.m. | Dec. 23 | 2:00 a.m. |
| Dec. 8 | 1:00 a.m. | Dec. 24 | 10:30 p.m. |
| Dec. 9 | 3:00 a.m. | Dec. 25 | 1:30 a.m. |
| Dec. 10 | 3:00 a.m. | Dec. 26 | 3:00 a.m. |
| Dec. 11 | 1:30 a.m. | Dec. 27 | 1:30 a.m. |
| Dec. 12 | 12:30 a.m. | Dec. 28 | 3:00 a.m. |
| Dec. 13 | 1:30 a.m. | Dec. 29 | 2:00 a.m. |
| Dec. 14 | 3:00 a.m. | Dec. 30 | 2:30 a.m. |
| Dec. 15 | 2:00 a.m. | Dec. 31 | 12:30 a.m. |
| Dec. 16 | 12:00 a.m. | | |

USA Network on-time is 6:30 p.m. except on the following days: Dec. 6: 10:00 a.m.; Dec. 7: 7:00 p.m.; Dec. 13: 10:00 a.m.; Dec. 14: 7:00 p.m.; Dec. 20: 10:00 a.m.; Dec. 21: 5:30 p.m.; Dec. 27: 10:00 a.m.; Dec. 28: 7:00 p.m.

Calliope 10:00 a.m. to 1:00 p.m. Saturdays, and 6:30 p.m. to 7:30 p.m. weekdays.

The English Channel, on-time 10:30 p.m. Sundays and Tuesdays except for following dates: Dec. 2: 11:00 p.m.; Dec. 9: 1:00 a.m.; Dec. 16, 21, 23: 10:00 p.m.; Dec. 30: 8:00 p.m.

| Signal | Day | Start/Stop | Alert Tones | Satellite/ Transponders |
|---|---|---|---|---|
| **WGN** | Mon.-Thurs.<br>Sat. & Sun. | 5:42am-3(3:30)am<br>Ends 3 am on Sun. | No | F1,#3 |
| **WOR** | | 24 hrs. | No | F1,#17 |

All program times are listed for the eastern time zone, unless otherwise noted.