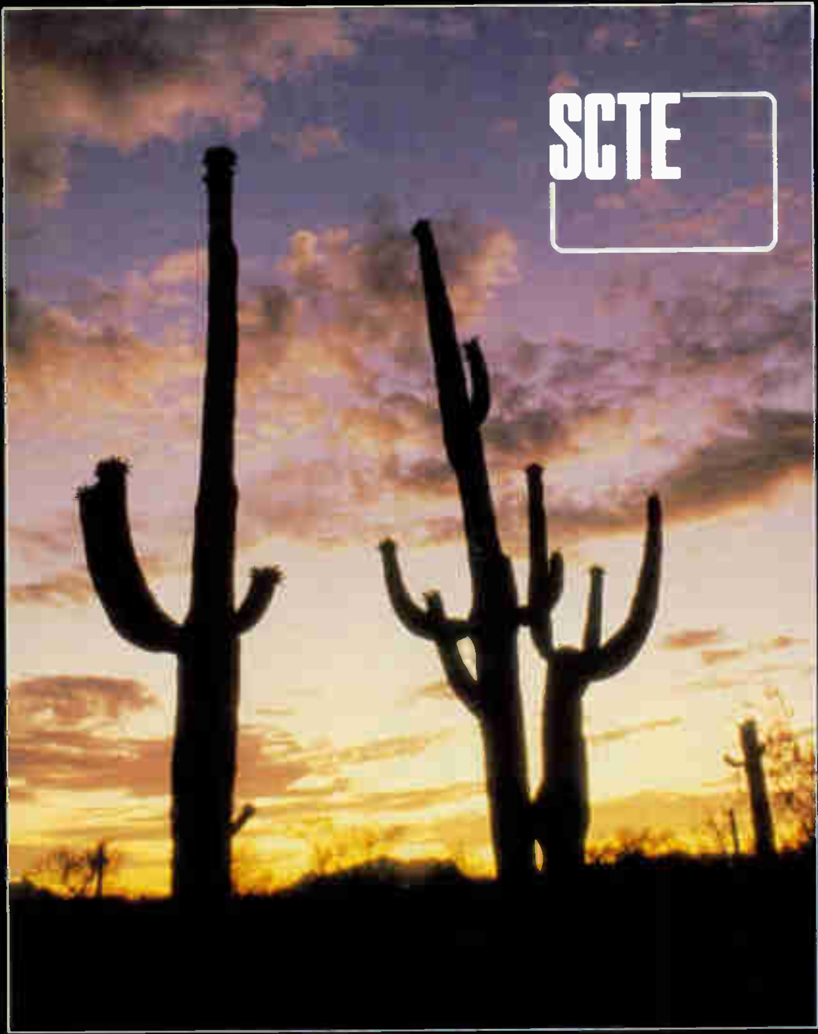
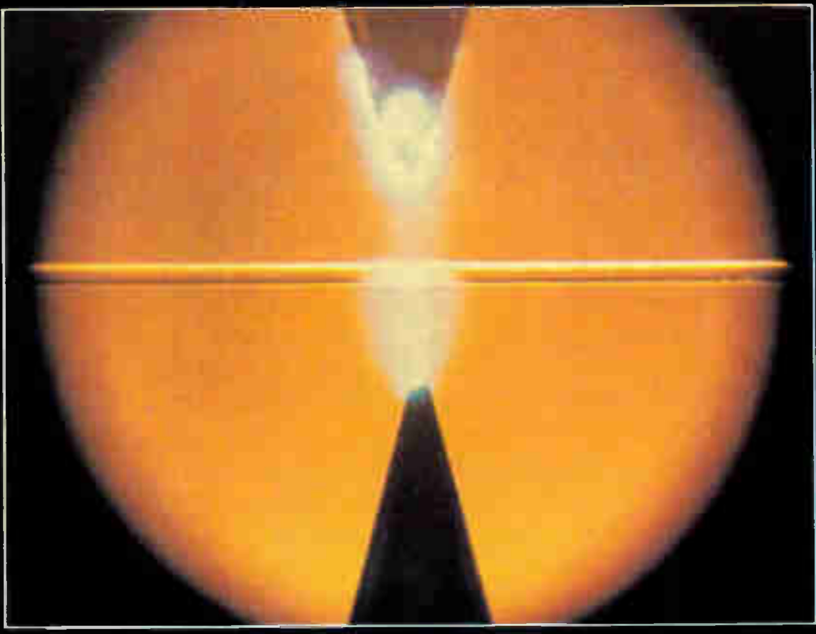
COMMUNICATIONS TECHNOLOGY

Official trade journal of the Society of Cable Television Engineers

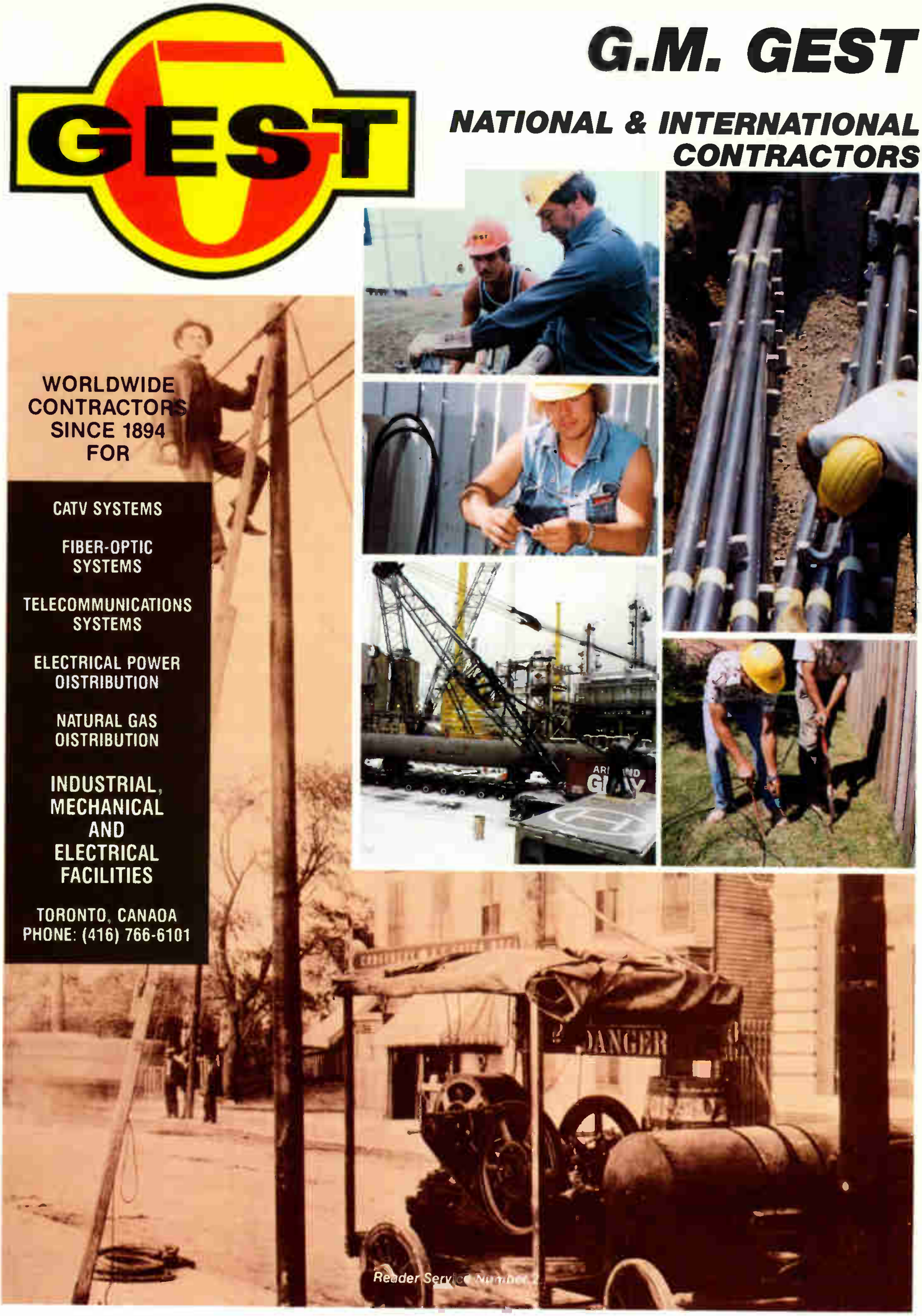


Tec Expo heats up in Phoenix



Fiber-optic advances

June 1986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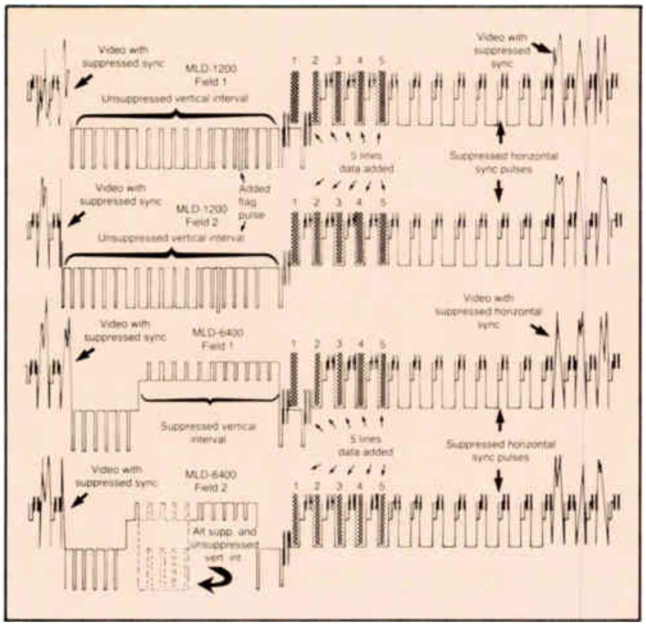
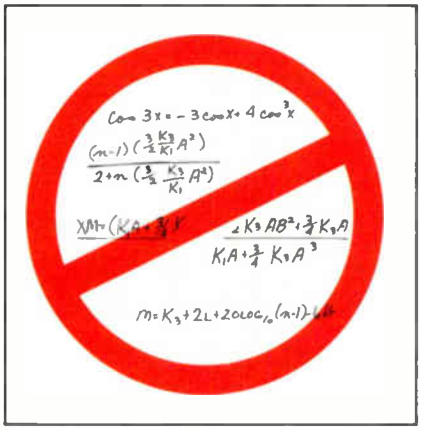
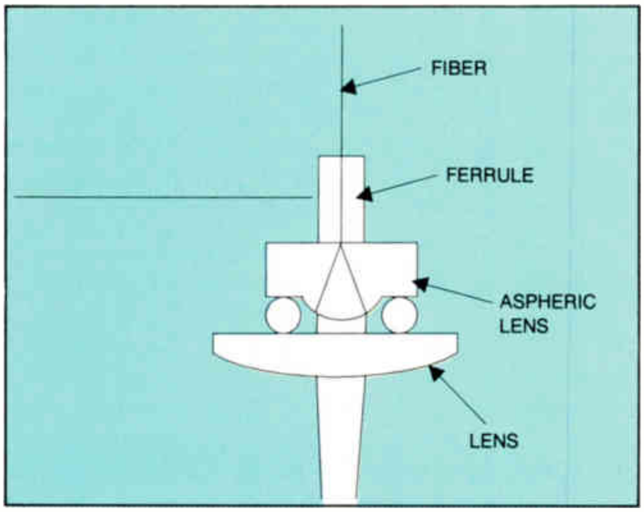
CONTENTS

Departments







Features

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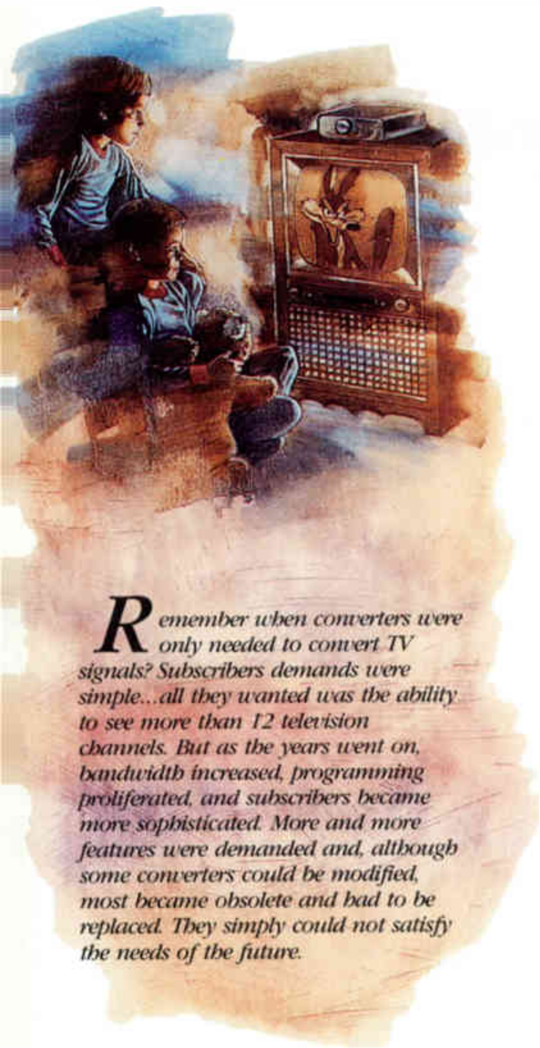

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GENERAL INSTRUMENT

By the time we get to Phoenix

Once again it's time to roll up the shirtsleeves and get down to work at the SCTE's Cable-Tec Expo in Phoenix. And once again, *Communications Technology* is quite proud to be representing the SCTE as its official trade journal. While the SCTE's ranks have been swollen by 25 percent since our premiere issue in March 1984, there are still many engineers who could benefit by joining this esteemed organization. We strongly encourage membership in the SCTE for the overall benefit of the cable industry.

New additions

Last month we instituted a department called "Tech Book." This monthly pull-out section has been designed as an everyday work tool for engineers. The idea for this section was the brainchild of our friends at Jones Intercable — Ron Hranac and Bruce Catter. The first installment provided basic information on all you need to know about dBmV to microvolt conversions. This month's section describes in detail North American television channel frequencies.

This show issue also includes the first of many columns from our East Coast Correspondent Lawrence W. Lockwood. Lockwood, a well-known veteran of the cable and data industries, has been an engineer for more than 40 years, presently specializing in telecommunications. Currently president of TeleResources, a consulting firm in Arlington, Va., he is a member of the NCTA engineering committee and the IEEE 802.7 subcommittee (setting standards for LANs).

Operator alert

While I don't usually delve into heavy technical matters in my publisher's letter, my editors insisted I reprint an operator alert disseminated by the NCTA on leakage:

"A recent incident, resulting from carrier frequency drift and signal leakage, reemphasized the need for compliance with the FCC frequency tolerance specifications and signal leakage monitoring requirements.

"The local oscillator of an amplitude modulated link microwave receiver drifted, apparently due to an unusual failure of the phase lock system, resulting in all carriers on the affected portion of the system changing frequency. In particular, the frequency of the Channel 14 (A) visual carrier drifted from the authorized frequency of 121.25 MHz to the air and marine emergency frequency of 121.5 MHz. This frequency drift would probably not have caused a problem if the system did not leak. Unfortunately, the system leaked at a level high enough to trigger the monitoring circuitry in the COSPAS/SARSAT satellite.

"The COSPAS/SARSAT satellite is located in a polar orbit and one of its functions is to monitor the emergency frequencies of 121.5 MHz and 243.0 MHz. When it receives a distress signal on either of these frequencies the location information is relayed to the Air Force and search and rescue operations begin. In this instance the Air Force determined that the signal was not a normal emergency locator transmitter signal. They passed the location information on to the FCC, who located the source of the signal and had the channel turned off until the problems were rectified.

"The FCC, in their final disposition of Docket 21006 allowed the cable industry access to the aviation band providing assigned carrier frequencies were maintained within 5 kHz and signal leakage was monitored and corrected. Every system operating in these bands, as part of its routine maintenance, should be checking to ensure compliance with the frequency tolerance specifications. The checks should be performed on the output carriers of all devices that could cause a change in frequency, including modulators, heterodyne processors and AML receivers. Also, signal leakage levels should be monitored continuously and repairs made when limits are exceeded.

"Compliance with the regulations will ensure cable's continued access to the bands. Non-compliance will result in forfeiture proceedings and could eventually lead to the loss of cable access to the bands."

Paul R. Levine

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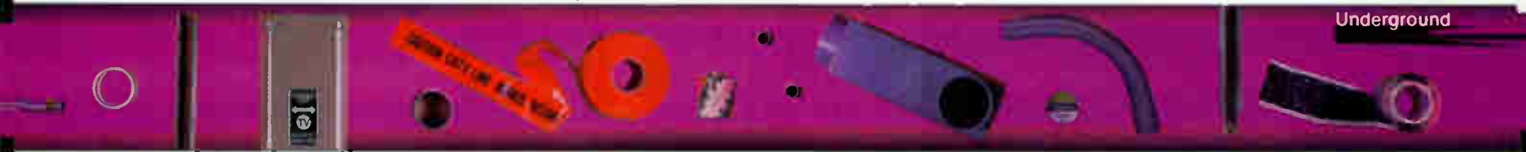

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Official trade journal of the Society of Cable Television Engineers

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Cable-Tec Expo '86: Bigger and better than ever

WEST CHESTER, Pa.—This year's Cable Tec Expo, taking place June 12-15 in Phoenix, Ariz., plans to be even larger than the 1985 show held in Washington, D.C. During this annual event, over 1,000 cable engineers and technicians are expected to participate in nine different workshops ranging from commercial insertion to signal sweep and analysis.

With pre-registration numbers well ahead of last year's, the 1986 show has plotted more exhibition space and hands-on equipment demonstrations than ever before. This has put the Cable-Tec Expo in the enviable position of being one of the few conventions steadily increasing in participants and features.

The schedule of events for the Annual Spring Engineering Conference is as follows:

Wednesday, June 11
6-8 p.m.—Registration (Ballroom foyer)

Thursday, June 12
7:30-9 a.m.—Registration (Ballroom foyer)

9-9:30 a.m.—Opening remarks: William Riker, executive vice president, Society of Cable Television Engineers

9:30-10:30 a.m.—Session A: Developing Technical Management Skills. Edward Scannell, University Conference Bureau, Arizona State University

10:45 a.m.-noon—Session B: Pay-Per-View Revisited. David Archer (moderator), general manager, Viacom Telecommunications

Noon-2:00 p.m.—Luncheon, SCTE membership meeting with awards and Keynote Speaker James Mooney, president, NCTA

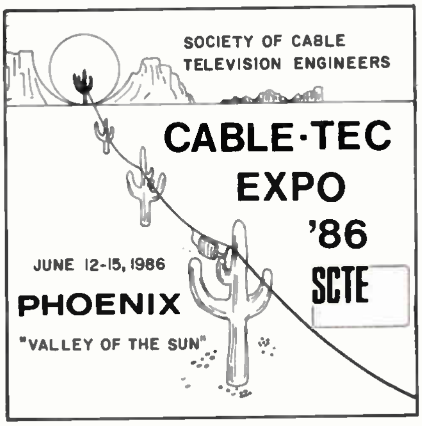
2-3:15 p.m.—Session C: Improving Communications Between Engineering and Management, Part II. Robert Luff (moderator), senior vice president, engineering, United Artists Cablesystems Inc.

3:30-5:30 p.m.—Session D: New Technologies in Cable System Powering. Dan Pike (moderator), vice president, engineering, Prime Cable Corp.

The agenda for the Cable-Tec Expo, which takes place at the Phoenix Civic Plaza, is as follows:

Thursday, June 12
3-5 p.m.—Expo registration (Hyatt Regency Ballroom foyer)

7-11 p.m.—Hospitality events presented by exhibitors



Friday, June 13
7:30 a.m.-4 p.m.—Expo registration (Phoenix Civic Plaza lobby)

8:30-9:30 a.m.—Workshop Period A

9:45-10:45 a.m.—Workshop Period B

11-noon—Workshop Period C

Noon-5 p.m.—Exhibit Hall open (Civic Plaza Exhibit Hall A)

Noon-2 p.m.—Lunch served in Exhibit Hall

4-5 p.m.—Exhibitors' reception (Exhibit Hall A)

5-8:30 p.m.—Tour of Scientific-Atlanta and Gilbert Engineering manufacturing facilities (space is limited)

7-11 p.m.—Hospitality events presented by exhibitors

Saturday, June 14
8 a.m.-4 p.m.—Expo registration (Phoenix Civic Plaza Lobby)

8:30-9:30 a.m.—Workshop Period D

9:45-10:45 a.m.—Workshop Period E

11-noon—Workshop Period F

Noon-5 p.m.—Exhibit Hall open

Noon-2 p.m.—Lunch served in Exhibit Hall

6:30-11 p.m.—Expo Evening: Steak barbecue and hayride at "Rawhide" (Redemption coupons must be exchanged for admission tickets at the SCTE Membership Booth before 1 p.m. on Friday, June 13)

Sunday, June 15
8:30-noon—BCT/E Professional Certification examinations

9:30-11 a.m.—Chapter Development Meeting (Roundtable discussion on how to start new SCTE chapters and improve the operation of existing groups. All Expo attendees are invited). Various committee meetings.

Every workshop will be presented during each workshop period designated in the schedule of events, except where noted. This repetition of workshops allows for a reduced attendee-to-instructor ratio, encouraging greater interaction. Each attendee may choose the six workshops of most interest from the following list. If one workshop is overly crowded, please select an alternate for that period and try again later.

- CPR and Industrial First Aid, American Ambulance Co.
- Video and Audio Signals and Systems (BCT/E review course), Paul Beeman, MTV Networks
- Developing a Preventative Maintenance Program, Ron Hranac, Jones Intercable
- Basic Electronics and Electricity, Ray Randolph, NCTI
- Implementing Stereo Headend Equipment, Tom Williams, Scientific-Atlanta and Ned Mountain, Wegener Communications
- Field Intensity and RF Field Strength, Ron Adamson, Texscan
- Commercial Insertion Equipment Update, Tom Carbaugh, Telecommunication Products Corp. and Alan Kirby, Falcon Communications
- System Sweep and Analysis, Steve Windel, Wavetek
- One-on-One With the FCC, Syd Bradfield and John Wong, FCC

NCTA asks FCC to favor frequency use

WASHINGTON, D.C.—The National Cable Television Association (NCTA) has endorsed the FCC's proposal to allow cable operators to use frequencies in the 2, 6.4 and 7 GHz bands. In comments filed during the FCC's proceedings on spectrum utilization, NCTA opposed efforts by broadcasters and common carriers to exclude cable operators from these frequencies.

"There is no basis for the suggestion that broadcasters' use of microwave frequencies for electronic news gathering (ENG) and remote pickups is somehow infused with unique public interest responsibilities while cable's is not," the association said. "Broadcasters and cable operators generally engage in ENG and remote pickups for the same reason: to provide programming that appeals to and meets the needs of viewers."

NCTA said it found "equally offensive and groundless" some broadcasters' claims that cable operators should be excluded from the 2 and 7 GHz bands because they might not cooperate in voluntary frequency coordination arrangements. NCTA noted that it is currently participating with the NAB and others in the formation of a council to deal on a continuing basis with frequency coordination problems.

NCTA also endorsed the FCC's proposal to make available on a primary basis to cable operators and broadcasters the 6.4 GHz band, noting that common carriers typically use the band for local television transmission service (LTTS). "If there happen to be no available frequencies in the 2 and 7 GHz bands, it makes no sense to force the broadcaster or cable operator to hire a carrier to perform a service that he could perform himself," NCTA said.

Winegard initiates statistical controls

BURLINGTON, Iowa—The Winegard Co. has adopted a system of quality control through statistical education. The program, "Transformation of American Industry," also is known as the Deming system, after Dr. W. Edwards Deming, who introduced statistical quality control to the Japanese in the 1950s. The concept uses

statistical tools to control quality, based on the idea that everything can be measured.

Statistical process control (SPC) is aimed at preventing scrap and rework, thereby lowering costs and improving efficiencies associated with manufacturing and other departments in the company, according to Randy Winegard, president of Winegard. "The system is geared to the prevention of problems — not detection of failures after the work is completed."

Statistical specialist Terry Reichardt joined Winegard in January as director of quality assurance and has organized all SPC activities. Reichardt defined SPC as "trying to improve our competitive position through improvement in productivity, product quality and reliability. The principal objective," he explained, "is to improve productivity, which will allow us to maintain control over the cost of manufacturing while improving our product."

Winegard has instituted training programs at all levels of the company, from the custodians to the president. Continued involvement after training is encouraged by employee membership on one of the product-process improvement committees, designed to assure access to all the knowledge and talents of every Winegard employee. Major programs that address the issues of productivity are being developed.

Microdyne adds Allied to roster

OCALA, Fla.—Microdyne Corp. has announced the appointment of Allied International as a stocking distributor of selected Microdyne satellite communications products. Allied will represent Microdyne in certain locations around the world.

Earl Currier, Microdyne sales manager, said Allied was chosen because of its experience in selling broadcast products in the international marketplace. Allied has over 60 broadcast representatives worldwide. This, combined with product support, is expected to increase Microdyne's ability to provide complete TVRO and SCPC systems to the international market, as well as individual products. Allied also will offer antennas ranging from 1.2 to 7 meters in size for S-band, C-band and Ku-band applications.

Microwave Filter to sell ham radio division

EAST SYRACUSE, N.Y.—Microwave Filter Co. Inc. announced it will sell its Unadilla Amateur Radio Products Division. The division produces antenna accessories for amateur radio operators.

"The ham division is being sold to allow the company to increase efforts on its high growth markets including cable television, satellite communications and government products," said Emily Bostick, executive vice president of sales and marketing.

"The division's employees and floor space will be absorbed into other operations," she added.

• Effective May 1, 1986, Audioguard Inc. has changed its name to Power Guard Inc. In May 1982, Audioguard was established as a manufacturer of sonic burglar alarms. Since February 1985, the company has devoted its time to the development of a line of ferroresonant and standby power supplies for use in the cable television industry.

• Pirelli Cable Corp.'s Communications Division has completed production and delivery of its first fiber-optic cables from its manufacturing facility in Lexington, S.C.. The cables are to be used for both voice and data transmission by Indiana Telephone Co. as part of an operation to upgrade its copper-cable system to a high-speed digital network connecting to major nationwide long-distance carriers.

• The St. Louis regional sales office of Scientific-Atlanta Inc. has moved to Copper Bend South, 936 S. 59 St., Belleville, Ill. 62223, (618) 233-7203.

HEART and SOUL

80% of all operating expenses are directly related to converters and line electronics, they are the heart and soul of a cable system.

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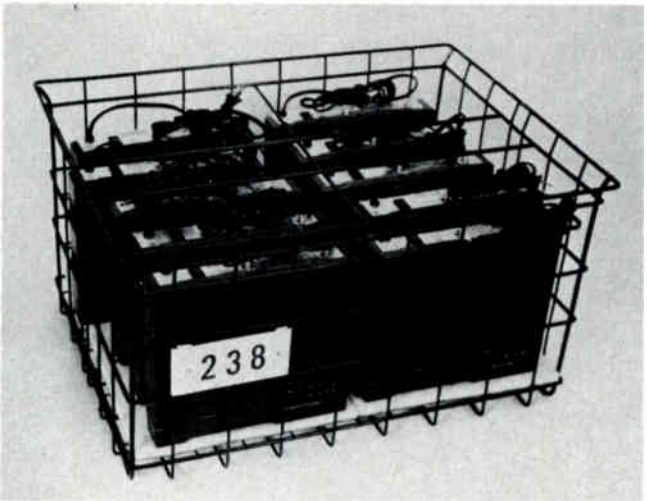

The new converter management system to handle and transport converters in an orderly and professional manner.

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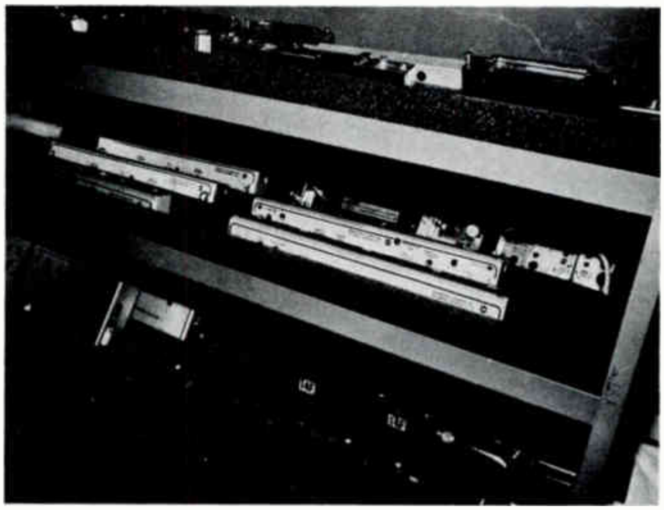

The new system to protect and control line electronics used in plant operations.

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- Protect TV's and test equipment.
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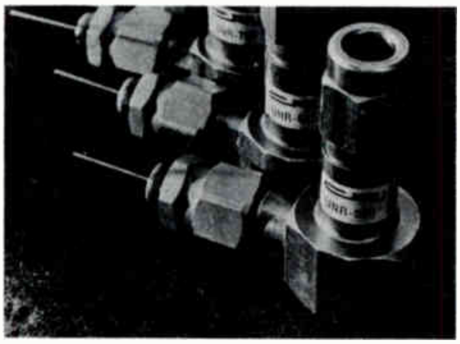

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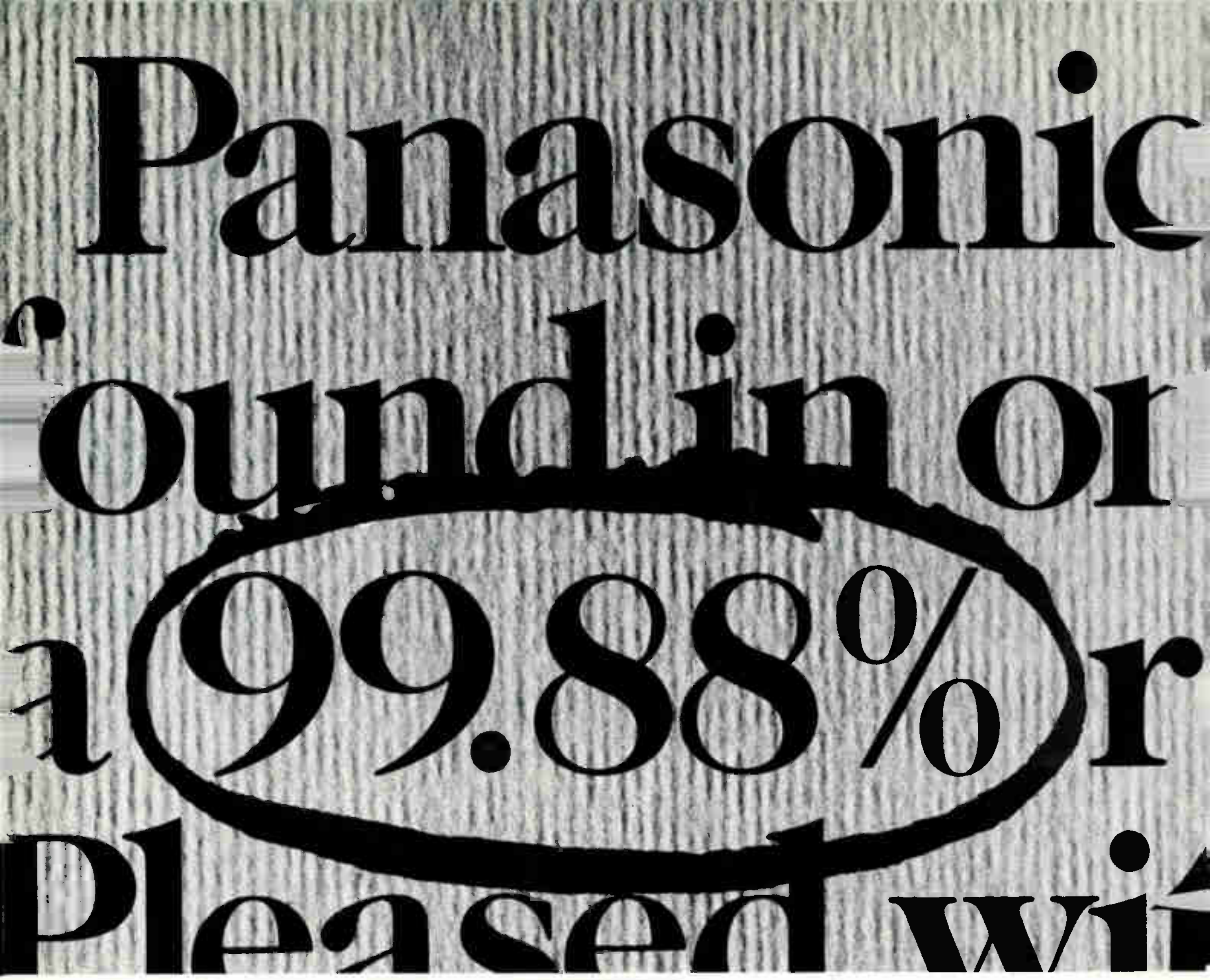

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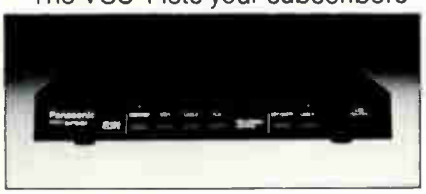
For your subscribers who want to get the most out of their video components, offer them the Panasonic® VCS-1 switcher.

The VCS-1 lets your subscribers



record a pay channel while they watch a basic channel. In fact, your subscribers can record any CATV channel while they watch any one of four video sources. Like a second VCR, a second converter/descrambler—even a video camera.

To get the VCS-1 message to your subscribers, Panasonic provides extensive marketing support. Like cooperative advertising funds, statement stuffers, point-of-purchase displays, create kits containing complete print ads—even a TV spot to run on your local avails.

The TZ-PC120 and TZ-PC150 converters.

Our Non-Addressable Remote Converter, the TZ-PC120, features

68-channel capability. Each channel is precisely controlled by phase-locked synthesized tuning, switchable between HRC and Standard/IRC offsets.

We didn't forget the favorite-channel memory. In fact, the TZ-PC120 can store up to 68 channels. It also features direct-access tuning, two-speed all-channel scan and last-channel recall. All this without an "Enter" button.

When it comes to our optional

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parental control, the TZ-PC120 lets your subscribers lock out the sensitive channels they don't want their children to see, without affecting the remaining channels. And thanks to our innovative *Stored Charge Non-Volatile Memory,* parental control channels and other memory functions will not be affected by a power outage. There's also an 18-button infrared remote control. It's compact, controls every function and comes complete with Panasonic batteries.

For your subscribers who want even more, there's the TZ-PC150. It has all the features of the TZ-PC120 plus *volume control* and *mute*. Parental control and base-band audio and video outputs are optional.

The new addressable PC-200 converter.

When it comes to your headend, the new PC-200 addressable converter

can help give you a head start. Downloadable features include channel map, channel authorization, clear parental control, initial activation and emergency alert.

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3-D TV

By Isaac S. Blonder
Chairman, Blonder-Tongue Laboratories, Inc

The buzzword of today in television is stereo. To be precise, stereo *sound*, not stereo *vision*, is the new ingredient in the TV world. No one misinterprets the phrase *TV stereo* to mean anything else but binaural sound. That is, no one except me, and some scientists in Russia, Japan and Germany. To properly relate the saga of stereo vision, we will begin at the beginning.

Sir David Brewster in 1856 wrote, "It is, therefore, a fact well-known to every person of common sagacity that the picture of bodies seen by both eyes are formed by the union of two dissimilar pictures formed by each. This palpable truth was well-known and published by ancient mathematicians."

Sir Charles Wheatstone invented the mirror stereoscope in 1833 and was the first scientist to describe stereo vision in modern terms. He created many line drawings that appeared three dimensional in his stereoscope. When photography was born in 1839, Wheatstone employed the Talbotype process to create the first stereographs. However, it was not until the London exhibition in 1851, when Queen Victoria was presented with a Brewster stereoviewer, that this science became a fixture in every home. View-master cards are the only modern survivors of a once dominant photographic medium.

Motion pictures, both single and stereo vision, started as early as 1855 with sequential photos mounted on a cylinder rotated by hand and viewed through a slit. Edison, who is credited with inventing the first practical motion picture camera system, also filed patent applications for stereoscopic cameras.

The art of amateur stereo photography flourished after World War II in the 35mm color "Stereo Realist" format until the '50s, when suddenly the fickle public turned to TV and forgot the realism of stereo.

By far the finest quality 3-D technique is with an optical single-person viewer blending two photographs into a superb image. A television stereo format for the individual viewer is also simple and effective.

Various methods of 3-D

Polarization is too well-known to waste space in description. The big screen theater in 3-D still attracts an audience and occasionally an itinerant producer will try again with another "arrow-in-the-face" spectacular. Unfortunately, the 3-D effects swamp the storyline and detract from, rather than enhance, the entertainment quality of the film. Thus, only at the Disneyworlds is there an ongoing continuous showing of the polarized 3-D format.

Back in 1853, the *anaglyph method* of combining two images, one red and one green, first was proposed. This became a low-cost stereo TV delivery method and created some transient interest that apparently has run its course. Anaglyph has serious defects — blurred image without glasses, green bleeding through the red filter causing ghost images, lack of color, eye fatigue and light level loss.

Lenticular stereoscopy is another very old procedure using either slits or a cylindrical lens sheet, which, properly located, presents to each eye its own stereo view while hiding the other image. The attractiveness of this glassless technique has resulted in more research on lenticular systems than all the others combined. Russia, in particular, as related by Professor Valyus, built many lenticular versions for the giant screen without regard to the expense, a body of work largely unknown in the western world. Three-dimensional TV research is well-funded in Russia, Japan and Germany, not so in the United States, where I could not find a single significant current research project report.

Lenticular also has many drawbacks. Pseudostereo occurs when the eyes see the wrong images. Autostereoscopic viewing (without glasses) only occurs in zones horizontal to the screen and limited in distance from the screen as well. It is also advisable to present as many views as possible (seven is common) to increase the autostereoscopic viewing areas. New on the horizon is an LCD lenticular TV presentation that combines autostereoscopic viewing along with the polarization of each picture element, allowing simultaneous viewing with polarized spectacles. This may be tomorrow's television!

Holographic TV: What a marvelous excuse for the physicist to wallow in mathematics and indigestible viewing proposals! Too complex to cover in a few words, but some general comments will suffice. It is hard to find a working system even for stationary scenes, color adds to the confusion, autostereoscopic viewing may never happen, and the bandwidth needed — hold your head and pocketbook — is from 120 MHz for the least and 1,500 GHz for the maximum quality system.

Nevertheless, 3-D TV is in our future, not from the U.S. R&D, but from our friendly overseas neighbors.

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By 1990 all headend systems must meet the new offset frequency standards set by the Federal Communications Commission. ISS believes in thinking ahead. With the new **ISS GL-2610** you can buy a hyperband frequency modulator that fulfills FCC requirements today.

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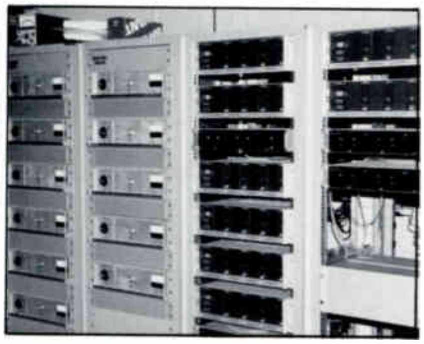
No fear of fiber optics in Queens

The ins and outs of the Queens satellite antenna farm. The site also will be used as a hub.



By Roosevelt Mikhail
Senior Vice President, Engineering and Construction
Brooklyn Queens Cable Television, a Warner Cable Co

One of the basic technical problems we faced in the development of our franchise in the New York City borough of Queens was the need to place the headend at a different location from the antenna farm.

It was necessary that the headend and offices be toward one end of the franchise area, at a location with appropriate height to mount the off-air antennas and common carrier microwave receiving antenna. On the other hand, the satellite antenna site had to be in a location suitable for satellite signal reception although not necessarily suitable for antenna towers.

Essentially, Queens is a sprawling, high-density "bedroom borough" with a population of about 1.9 million people. Although it contains several industrial areas, it has many neighborhoods and shopping strips, rather than a single, centralized downtown area. So while our headend is located in a shopping strip situated in the Flushing community, not far from the Whitestone Bridge, the nearest practical site for our satellite antenna farm turned out to be 6 kilometers south of the headend. This location also will be used as a hub to serve the 60 percent of our subscribers in the southern section of our franchise.

Our basic design called for 930 miles of plant reaching about 285,000 homes passed or as many as 112,000 subscribers by the end of 1988. The system is addressable and has a total capacity of 77 television channels.

At the satellite antenna farm, we now have two 7-meter dishes by Scientific-Atlanta and one 7-meter Simulsat antenna. We're taking signals from four satellites: Galaxy I, Satcom F3R, Telstar 303 and Satcom F4. A total of 38 satellite channels, coming in at 3720 to 4160 GHz, are received. We take the signals from each antenna to the satellite receivers, through ⅞-inch pressurized coax cables.

A 40-channel capacity transportation system is required to carry the satellite signals in the upstream direction from the antenna farm to the headend. Also, in the opposite direction, the transportation system would have a capacity of 80 channels to carry the cable TV signals from the headend to the hub.

The CATV engineer typically has three options to implement such a transportation system: microwave, FM on coaxial cable and fiber optics. In our case, however, we were limited to only two choices: FM coaxial cable and fiber optics.

Analysis and selection

Both systems were analyzed to select the most appropriate one. The factors considered in the analysis were cost, system fidelity, reliability and maintainability. In addition, consideration was given to the difference between construction of five .875-inch coaxial cables and one .500-inch fiber cable. Two of the coaxial cables would carry the 40 upstream channels and the other three would carry the 80 downstream channels. Each of the cables would take 10 amplifiers in cascade for a total of 50 amplifiers over a 6 kilometer run. On the other hand, no repeaters are required for the fiber-optics system, giving a major savings in maintenance requirements.

Of course many technical considerations had to be studied before we were convinced that a fiber trunk was the best possible option. Ellery Litz, our director of engineering, examined all aspects of the fiber system: wavelength, light source, type and size of fiber and cable, possible need for repeaters, and associated optical transmitter and receiver, before drawing up a set of specifications.

We were fortunate to have the expertise of our commercial data services group on hand. This department is involved in providing fiber-optic alternate access networks in several of our franchise areas.

We also took the time to examine the qualifications of suppliers. Our choice of Pirelli Optronic Systems, in Meriden, Conn., was based on the company's experience, proximity to our location and service policies, as well as its turnkey systems approach and quality products.

Pirelli provided us with a complete transport system, including a 17-fiber (single-mode in loose tube buffers) aerial cable, six single-mode laser transmitters and six receivers (including one spare of each). The system also called for five upconverter/amplifiers, 40 pairs of upconverters and downconverters, and 10 eight-way combiner/splitters.

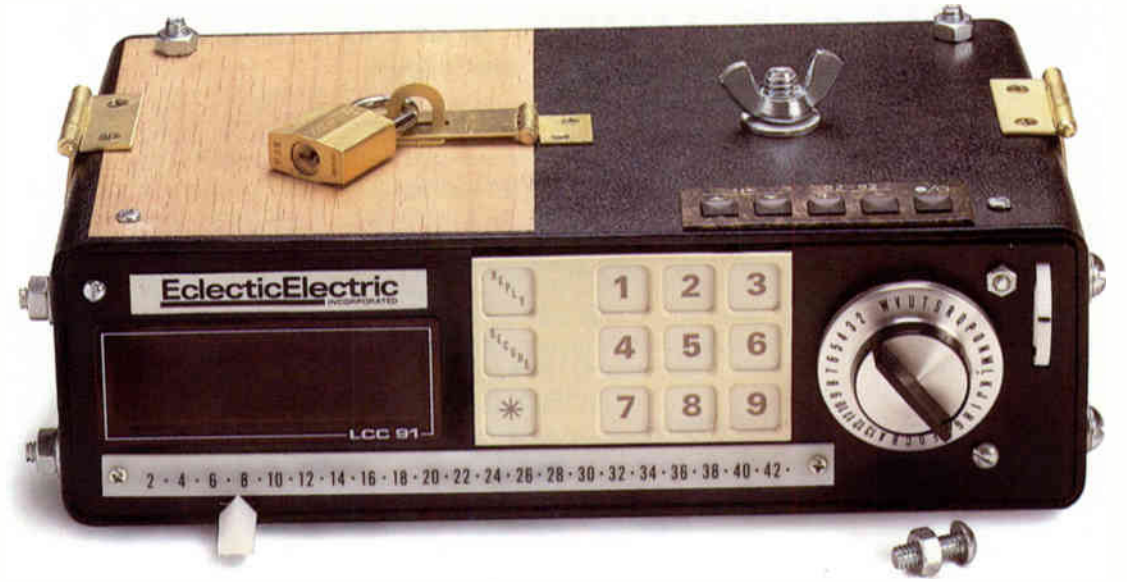
And then there was...

For our application, the signals from the dishes are fed into Scientific-Atlanta 6600 series split-site satellite receivers, bringing them down to 70 MHz intermediate frequency (IF). Then they are frequency multiplexed into the optical transmitters, guided through the fiber-optic cable, *without repeaters*, detected by optical receivers and further demodulated to baseband. The system provides us with 40 baseband video and companion FM audio signals.

The optical transmission is "transparent," that is, measured at less than 1 dB signal-to-noise ratio (S/N) degradation. The distortion products are –40 dB or better, as called for in the specs. Because we were able to stack eight channels on each fiber, we only activated five fibers when the fiber system became operational in November 1985. Since then, we have had only one momentary outage, a power circuit failure, easily replaced with a spare in a few minutes.

The second phase of construction will be to activate the antenna farm as a hub. This involves using the remaining 10 fibers (leaving two spare fibers) running from the headend to the hub. It will allow us to send 80 channels from the headend to the hub, including off-air channels and the local origination channels, which are received and processed at the headend.

Another project for which we will be considering fiber is *system interconnects*, a basic requirement by the city of New York. When the city decides to implement this provision, and all the franchisees get together, I certainly will recommend a thorough investigation of a fiber interconnect system. There's no fear of fiber optics here.



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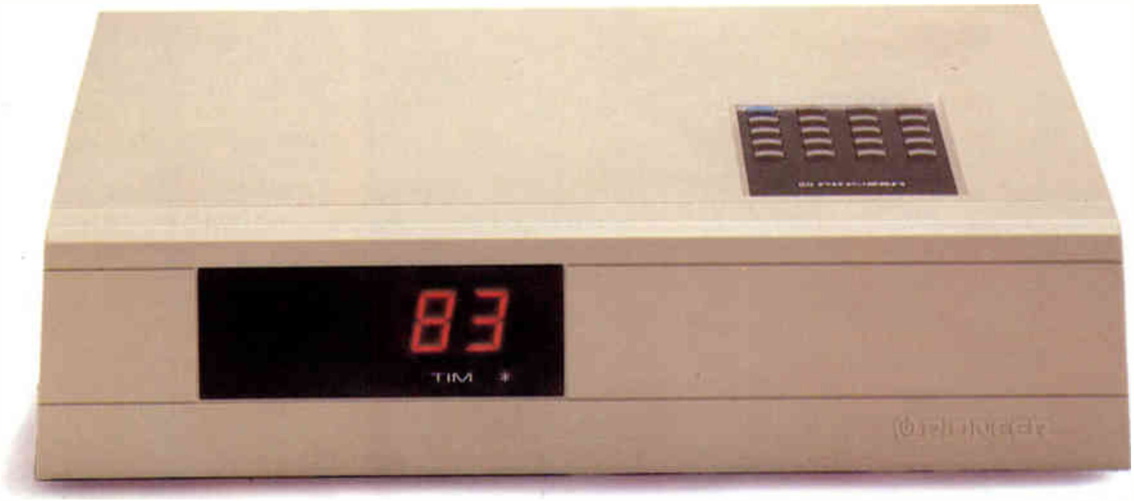

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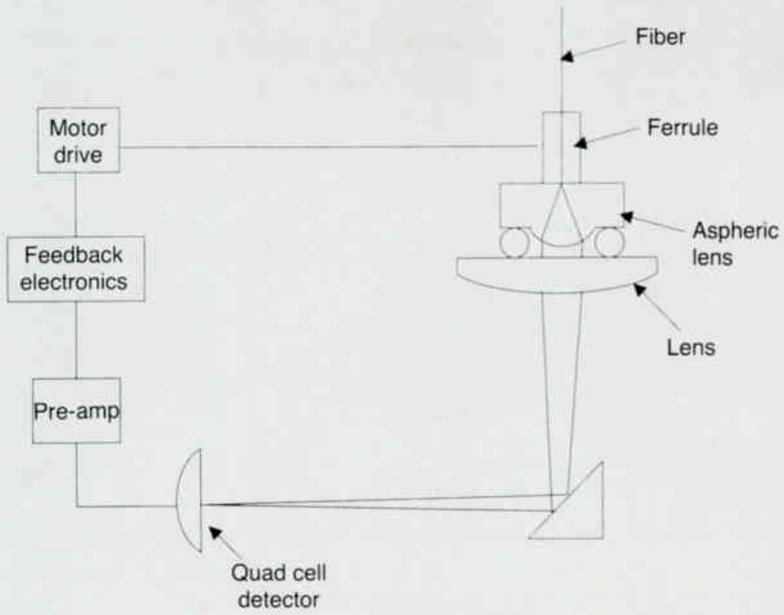
Figure 5: Fiber positioning device



device that was transportable, usable in a field environment, and with automatic positioning capabilities of ± 0.0001 mm over a 1.0 mm range with little or no backlash or friction. Figure 5 shows some of the design elements that will be described.

The leading challenge was to design the positioning device to meet these goals. The design that was developed tackles the problems of friction and backlash through the use of two systems. The first is a gear-driven cam; the second, a flexure-based lever system. In this design, the stepper motor drives through a gear train to a cam. The backlash of the gear train is removed by a constant-force spring. The lever system rides on the cam and transforms the motion of the cam to motion of the fiber/ferrule assembly relative to the lens.

This system is designed with flexure pivots to fully eliminate friction and backlash. This combined design approach allows the problem of coarse and fine motion in fiber positioning to be provided. Ideally, the positioning device should not have to cover the full 1.0 mm range in 0.0001 mm steps. Four stepper motor drive systems are used, one each for coarse and fine in both the X and the Y axis. These four cams are linked to the ferrule holder through two 10:1 leverage systems. The leverage system is then connected to a linkage providing both 20:1 and 200:1 ratio motions. This allows for coarse positioning in steps of 0.001 mm and fine positioning of 0.0001 mm about any point covered by the coarse system. This design meets all of the goals for the micropositioning system.

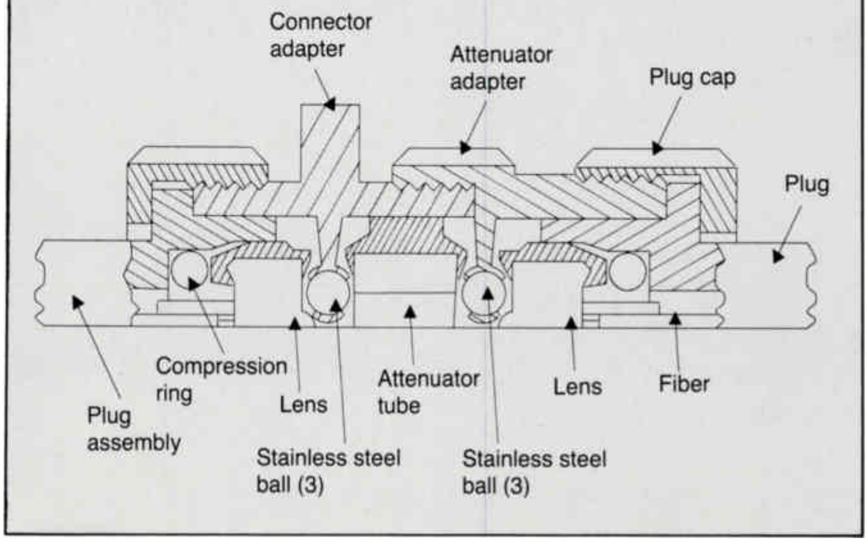
Two other approaches were considered. Piezoelectric positioning elements presented the possibility of very fine motions in a very small package. This approach was not fully developed due to the requirements of 1.0 mm of positioner travel and the uncertainty of piezo performance in high-humidity environments.

Another possible approach was the use of small DC gear drive motors. These motors offer the benefits of small size, ease of control and environmental stability, but fall short of the goals of minimal backlash and low energy dissipation. The starting and stopping inertia of this design approach limited its usefulness in submicron positioning systems, while the high heat generation of analog control was wasteful of energy.

Feedback for the positioning system is the next requirement for a fully automatic fiber positioner. The electro-optical design requires end launch of light from a remote source. The choice of wavelength was resolved by the detector that was needed to sense the position of the light emitted from the connector lens. Position-sensing diodes of either the lateral effect or quad cell geometry for 1,300 nm light are essentially unavailable. Most materials in the size required for a position sensor have an excessive amount of noise and require cryogenic cooling for stable operation. This leaves silicon detectors and light sources emitting wavelengths less than 1,000 nm as the alternative. Experiments have shown that although the fiber is multimode at 820 nm, a silicon lateral effect device can sense the light and provide feedback to position the fiber to the required accuracies.

An original design goal, to use 1,300 nm light locally injected a few centimeters from the fiber/ferrule assembly, was

Figure 6: Single-mode attenuator



abandoned because there was little opportunity to strip the cladding modes before the light entered the positioning device. Aligning the fiber using cladding modes is not an acceptable alternative. Also, local injection of light through a 0.900 mm buffer has not been shown to be universally feasible.

The optical system used in the fiber positioning device is illustrated in Figure 5. The lens was chosen to be plano-convex so that the three-ball mounting system used in the connector could also be used in this device. This lens not only focuses the light onto the detector but it also provides insensitivity to lateral position of the connector lens. The main support rods are made of Invar steel and all of the optical components are made of fused silica for temperature stability. The entire optical system is suspended to offer protection from shock and vibration.

The electronic components of the fiber positioning device also are straightforward. Chopper stabilized pre-amplifiers are used to control offset. All noisy circuitry such as the stepper motor drivers are isolated to prevent crosstalk. The initial electronic design incorporates a pseudo-bus structure allowing the use of both stock and custom PC boards. Future innovation has much to offer in this area of electronic design.

Attenuator design

For a single-mode connector to be judged acceptable in the industry, attenuators are needed to allow the system designer some flexibility in system specifications. Figure 6 illustrates the design approach for meeting the necessary requirements.

The design of the attenuator is based on the fact that the precisely controlled tilts of the lenses result in precise attenuation. These tilts are accomplished by an attenuator tube that has end faces ground and polished at precise angles with respect to each other. The relationship

$$T = e^{-\left(\frac{f \tan \Theta}{N \omega_0}\right)^2},$$

where T is the transmission factor, f is the focal length, N is the lens index of refraction, ω_0 is the $1/e^2$ semidiameter of the gaussian beam within the fiber and Θ is the included lens tilt angle. The value of these angles range from 0 to 8 minutes of arc. The choice of a hollow tube configuration for the attenuator part results in no additional system reflection loss.

An attenuator adapter, similar in concept to the connector adapter, also is required. This allows precision angular alignment of both lenses. It also creates the ability to retain the attenuator tube without affecting the strain relief concept.

This approach for attenuators was chosen over the use of an absorbing filter because of the risk of performance changes (filter fade) over a 20-year design life and because of the potential such filters could have for creating unwanted reflections back into the system. Diaphragms also were considered and not chosen primarily because of reflection considerations.

Acknowledgements

The efforts of the following individuals are gratefully acknowledged: T. Allen, J. Ammons, D. DeJager, R. Dittberner, R. Greenwald, M. James, R. Klumpp, K. McGuire, D. Richards, D. Stephenson.

References

1. D. Gloge, "Weakly Guiding Fibers," *Applied Optics*, Vol. 10, No. 10, October 1971.
2. D. Marcuse, "Loss Analysis of Single-Mode Fiber Splices," *Bell Systems Technical Journal*, Vol. 56, No. 5, May-June 1977.
3. D. Marcuse, "Gaussian Approximation of the Fundamental Modes of Graded-Index Fibers," *Journal of the Optical Society of America*, Vol. 68, No. 1, January 1978.

Reader Service Number 21.

New approaches to securing basic services

The shift toward increased revenue generation from basic services and a corresponding decrease in multi-tier pay revenues strengthens the need to protect basic from signal piracy. In the past, scrambling and addressability have been used primarily to protect pay services. Now there is clearly a need for a cost-effective method to secure basic channels without rendering existing equipment, especially plain converters, obsolete.

This article discusses converter-compatible solutions to the problem and describes two specific examples, each capable of being overlaid on an existing system already equipped with converters. The more secure of the approaches applies encryption to provide a very high degree of security. The other approach is an add-on decoder, examples of which have been available for some time.

By Graham S. Stubbs
Vice President, Science and Technology,
Oak Communications Inc.

Signal security techniques, as applied in cable today, are designed primarily to control the delivery of pay services and to protect revenues. Addressable methods have been introduced to enhance pay TV operations by making the changing of subscription packages less costly to the operator and more convenient to the subscriber. Addressability is almost a prerequisite for most forms of pay-per-view (PPV). Security in scrambled signals has been enhanced by the use of addressability for delivery of decryption keys.

Few cable systems scramble basic channels, yet the greater part of cable systems' revenues in 1986 is projected to come from basic subscriptions, and in future years that percentage of income is expected to increase. Most cable operators admit to some degree of theft of basic, but not many have taken steps to make these signals more secure.

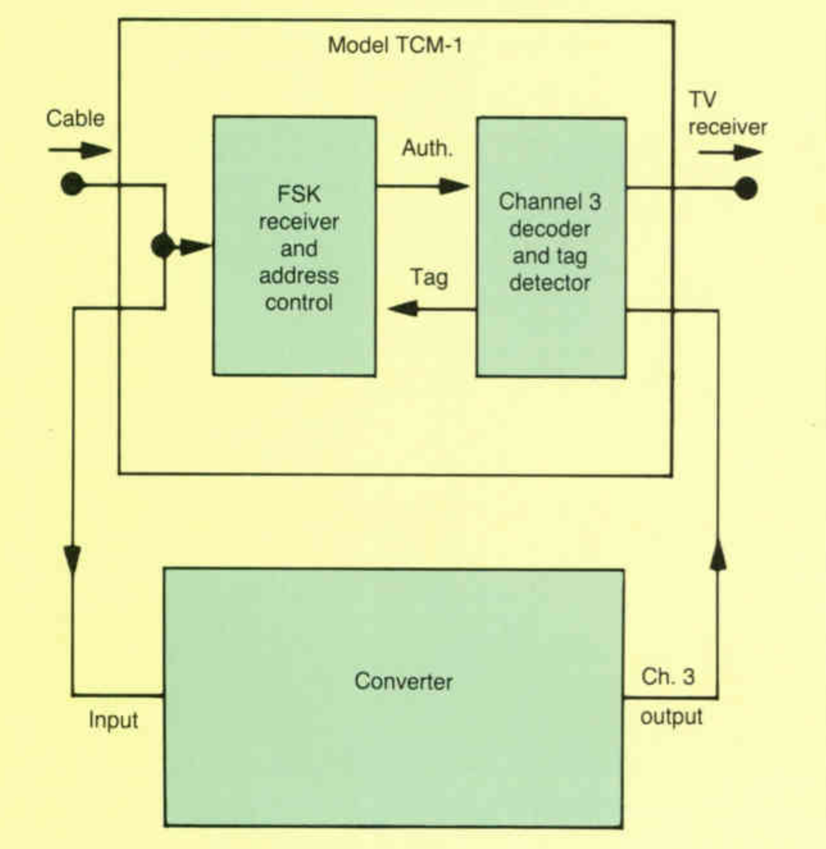
Some pay program material has to be scrambled, for obvious reasons. And of course, it's simplest to deliver basic programs in the clear, either directly to the television receiver or through an inexpensive converter. However, there can be some interesting challenges for cross-innovation in security methods.

In an existing addressable system it is possible to scramble some or all of basic in the same manner as pay channels. However, this means supplying converter/decoders (with their attendant capital costs) to all subscribers, which can place a greater burden on the security of older and less sophisticated scrambling techniques. Most cable subscribers today are supplied with non-addressable converters of either the programmable (converter/decoder) variety, or non-programmable (plain vanilla) type.

Before discussing the details and merits of specific approaches, it is as well to review some observations regarding "basic" requirements.

- *Security* — As the value of the entertainment product continues to increase, so will the ingenuity and determination of pirates. Defeating secured basic as well as scrambled pay could be looked upon as twice as rewarding by the pirate.
- *Compatibility* — A successful approach should not obsolete existing subscriber terminal equipment.
- *Cost* — No technique will be acceptable unless there is a financial pay-off.
- *Addressing* — Individual device control is a necessary component of a secure system. However, the multi-tier/multi-function controls, usually incorporated into addressable pay systems, are not necessary for basic.

Figure 1: Post-converter addressable video decoder



Two proposed methods

In order to illustrate the possibilities of using pay TV security techniques to protect basic, two methods will be outlined having in common the use of an addressable device located on the subscriber's premises, interfaced with an existing converter (or non-addressable converter/decoder). There are significant differences between the two approaches related to adaptability to other uses and security.

Post-converter addressable decoder: Devices of this kind have been offered for several years by a number of manufacturers of addressable systems, marketed primarily for the addition of pay services to systems equipped with non-decoder type converters. Usually they have been designed for system compatibility with converter/decoders that decode the same scrambled signals.

A representative block diagram (Figure 1) is shown of one of these devices that employs out-of-band addressing. The decoder is equipped with four connectors. The signal from the drop cable loops through the decoder to permit access to the out-of-band FSK addressing channel and is connected to the converter input. After channel selection, the converter output signal loops again through the decoder in order to accomplish program tag

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recognition and decoding. The decoder output is connected to the television receiver.

The FSK receiver, similar to that used in other addressable devices, extracts serial addressing control data. The control data contains, in decoder-specific messages, the identity of authorized program levels that are stored in the decoder. The output signal of the converter passes through the decoder tag detection circuit. If the selected channel is scrambled, the decoder automatically extracts program level information from the tag signals, which are transmitted in the vertical blanking interval. Control circuits compare the tag levels with stored authorized program levels, and if there is a match, activate the decoding circuit.

This type of decoder can be used in a system presently employing a mixture of plain converters and converter/decoders, either addressable or non-addressable, to permit scrambling of all channels, including basic. Any scheme involving encoding of basic naturally requires all basic subscribers in the system (or section of the system in which scrambling is employed) to be provided with appropriate decoding devices. Once installed, the same decoder can be used to extend pay coverage without additional investment in converter/decoders.

As the decoder utilizes signals that already have passed through a converter, particular attention must be paid in this type of decoder to the effect of converter fine tuning. In the device described, frequency-sensitive portions of the decoding detection and tag detection circuits operate at a special intermediate frequency (IF). Automatic frequency control (AFC) is used to maintain accurate control of this IF. The decoder is designed to be system compatible with the addressing commands of its converter/decoder counterpart.

Devices of this type are relatively inexpensive—approximately one-half the cost of a converter/decoder — and are already developed and available. They employ, however, relatively unsophisticated analog scrambling.

Post-converter audio restorer: This describes a concept, not a product already developed for low-cost manufacture.

Security of basic channels is achieved by digital encoding and encrypting the audio portions of each channel for transmission through the cable system in the portion of the cable spectrum dedicated to the high-speed data transmission of audio. For example, a single 6 MHz channel could easily carry 10 stereo channels.

Each controlled television channel is transmitted with clear video but with no analog audio modulation. Instead, a tag signal identifying the channel is transmitted on the sound carrier.

The equipment provided to the subscriber is connected in the configuration shown in Figure 2. Again, a four-connector device is used. The cable signal loops through the decoder, allowing the high-speed program audio data to be extracted. The high-speed data channel comprises digital encrypted audio, error protection and control signals.

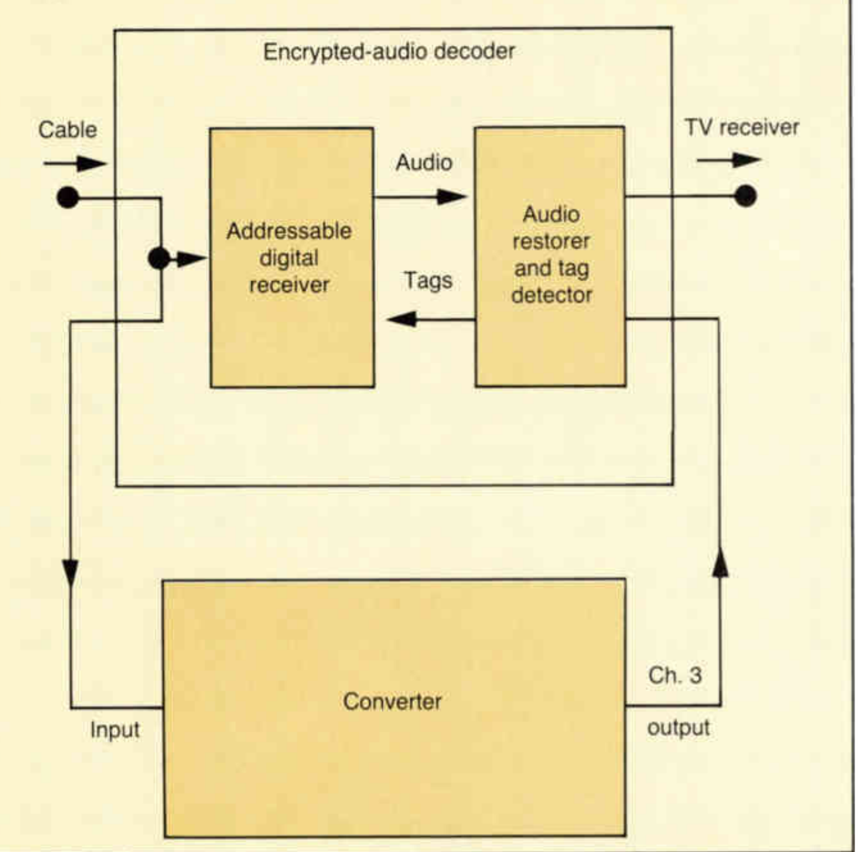
After television program selection by the converter, the signal passes to the tag detector section of the decoder (Figure 3). If the channel selected is "tagged," the decoder's tag receiver identifies the tag signal and seeks a matching digitized audio signal from the receiver of high-speed data by control of the demultiplexer (demux).

The audio data is decrypted and converted to analog audio in the decrypter/DAC circuit. It then modulates a voltage controlled oscillator (VCO) used to generate a restored audio carrier.

The signal from the converter is converted to an IF, passes through a filter to remove the sound carrier transmitted through the cable system and is recombined with the restored audio carrier. Precise phase-lock loop techniques are used in the frequency conversion and VCO circuits to assure maintenance of intercarrier frequency accuracy and to minimize incidental FM noise.

The signal passed to the television receiver is a conventional monaural signal; however, this scheme is readily extend-

Figure 2: Post-converter audio restorer



able to BTSC audio.

This concept is based on encryption already employed in the Sigma product and has the potential to be extremely secure. It is compatible with existing converters and can be used to supplement the security of a wide variety of existing analog scrambling techniques. This device also is estimated to be approximately one-half the cost of a new converter/decoder of similar security.

The principle can be extended to use without a converter. Used with an IS-15 compatible receiver, a device of this kind could recognize tag information in the broadband IS-15 audio output, and supply audio derived from the high-speed data stream directly to the television receiver.

Comparison of the two methods

Both proposed methods employ addressable devices, using time-proven tag-matching methodologies. In both cases basic service can be authorized as a single tier or split into sub-tiers.

The post-converter/decoder can be used to control pay services without the use of additional scrambling equipment. The audio denial method, on the other hand, cannot be used to protect all pay services without some additional means of assuming visual privacy. It can be used to enhance the security of analog scram-

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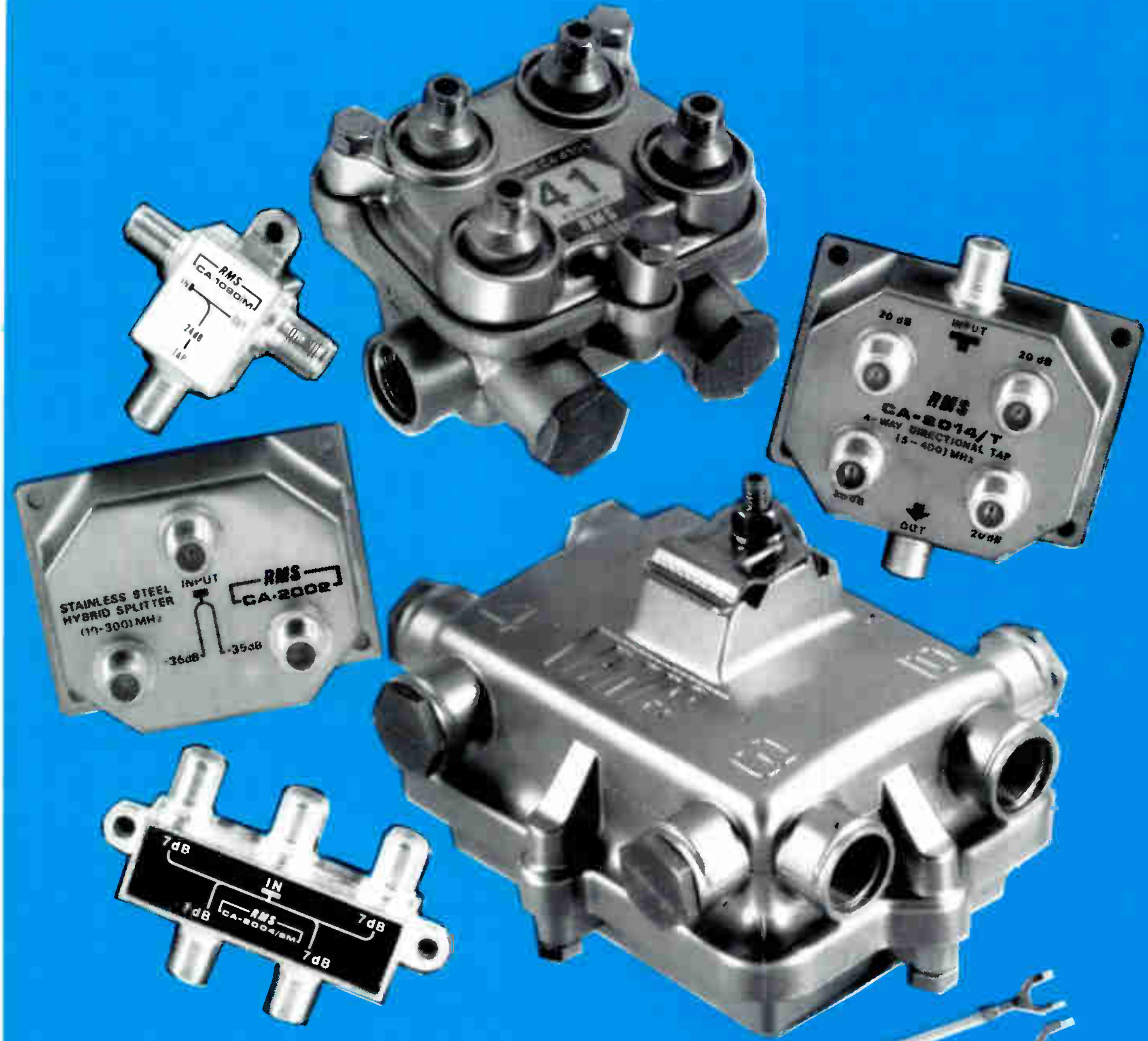

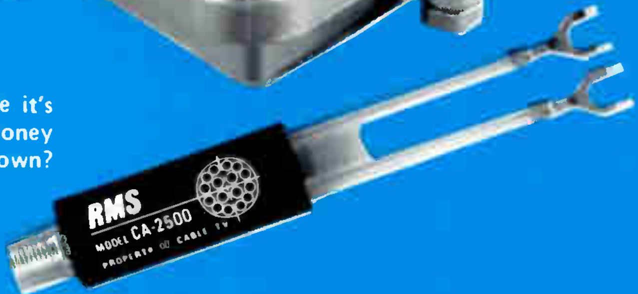

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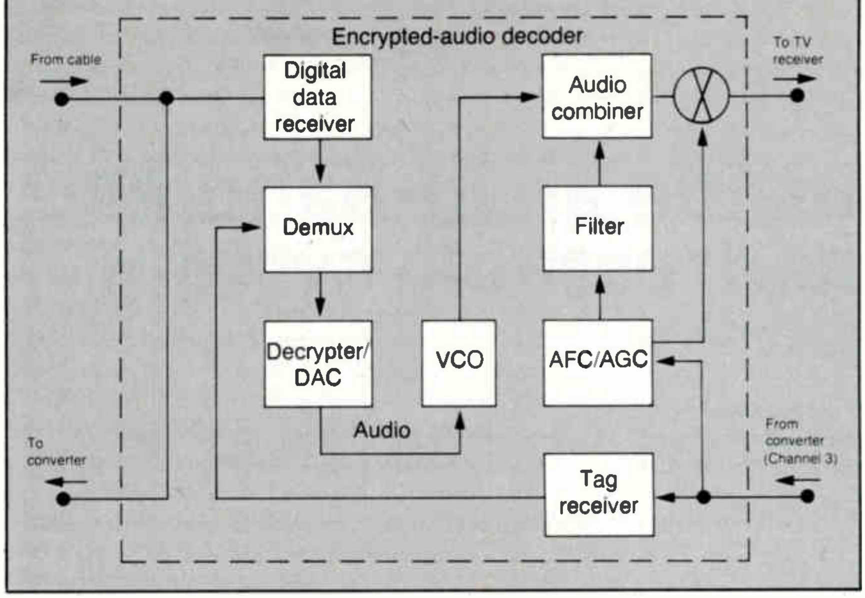
bling methods used to protect pay services.

In both cases, the home terminal device costs about the same — about half the cost of a converter/decoder. Both techniques are designed around the use of existing converters with the assumption that the converters still have significant remaining useful lives.

The decoder method has limitations in relation to stereo. Inherent in the audio denial method, however, is the ability to deliver a stereo signal.

The greatest contrast between the two techniques is the degree of security. Analog video scrambling techniques such as sine wave or gated sync suppression are relatively unsophisticated. Digital encrypted audio, on the other hand, is now well established as the state-of-the-art in securing cable television signals.

Figure 3: Audio decryptor/restorer



Conclusions

In the cable industry scrambling and addressable techniques have in the past been applied primarily to protect pay signals. The financial indicators suggest, moreover, that cable is becoming even more dependent upon revenue from basic services. It is time to consider the application of the developments in program security technology to the protection of these basic service revenues.

Two converter-compatible methods of securing basic services have been outlined and compared. Regardless of the specific advantages or disadvantages of these particular techniques, it is clear that pay TV technology can already provide some useful tools to protect cable's primary revenue stream from piracy.

It is timely to re-examine our priorities and determine whether all our efforts to secure signals within cable should be directed at pay TV and PPV, or whether perhaps some of this ingenuity is better redirected to securing basic.

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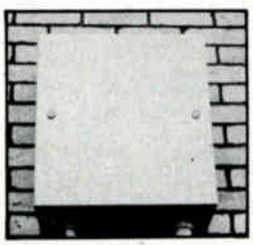
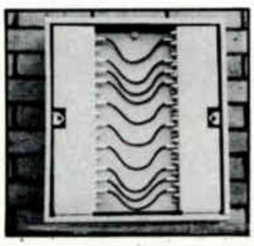
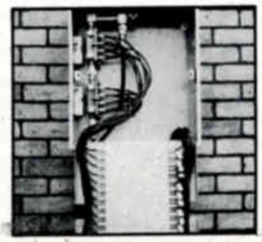




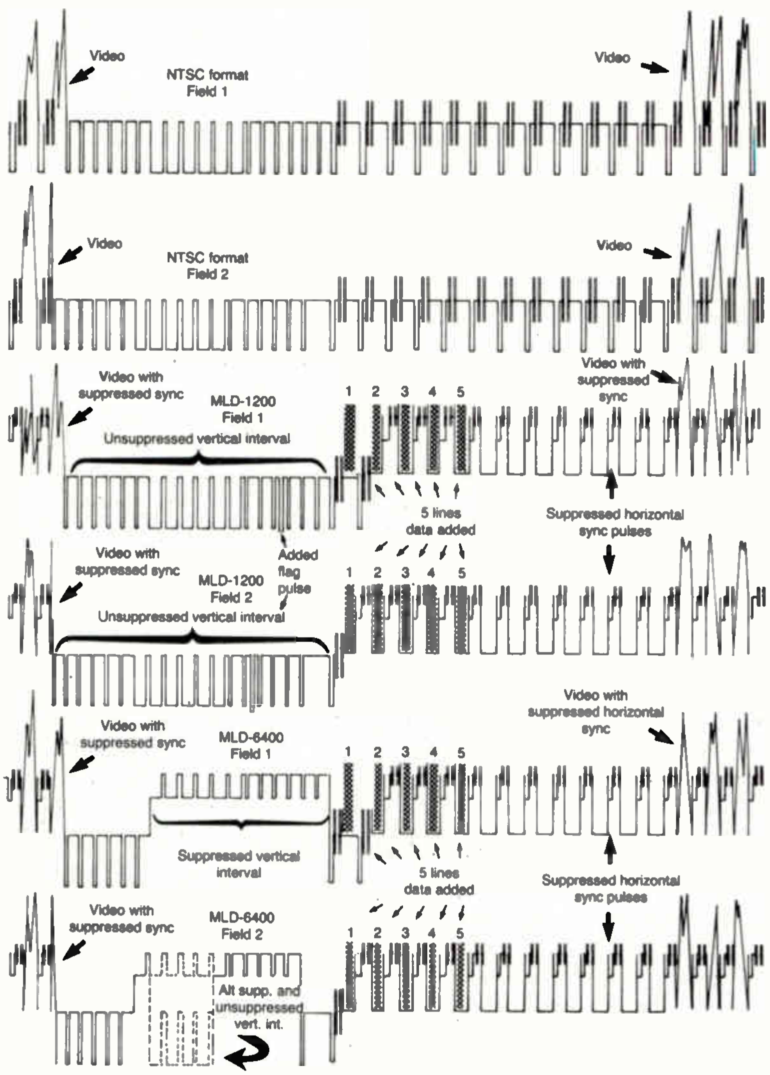
Inside an in-band RF addressable system

By Gaylord Hart
Software Engineer, Hamlin U.S.A.

Addressable encoding/decoding hardware has been around for years in the cable industry. Most systems have performed reliably and proved themselves technically and economically, for manufacturers and operators who have installed them. Others have not fared as well.

The decision to go addressable is not an easy one for a cable operator; however, the increased security and flexibility of a well-designed system make it attractive, especially now that pay-per-view (PPV) is gathering momentum among program suppliers and cable operators.

Figure 1: MLD-6400A video waveforms



The decision as to which system to install is more difficult. No operator wishes to be saddled to a system that cannot meet future, or even current, needs. At issue are such matters as the cost of the hardware, reliability, customer convenience (for the operator and the subscribers), security, stereo compatibility, flexibility, features, expandibility, picture quality, the ability to interface to a billing system and handle PPV, and compatibility with existing hardware. As well, there are numerous technologies and manufacturers of systems to choose from and, of course, each cable system has its own unique requirements.

The ideal hardware would be all things to all operators. This is not possible, and tradeoffs are necessary (e.g., television stereo vs. baseband technology). However, a carefully designed system can minimize some of the tradeoffs while maximizing performance in other areas.

Before Hamlin began work engineering an addressable system, four broad design goals were set: it had to be secure, flexible, reliable and economical. The objective was to optimize the design to meet these goals. Although we had no desire to re-invent the wheel, we decided to rethink some of the basic tenets of addressable design.

We began with a rigorous system definition, which was tempered by discussions with cable operators, a knowledge of those systems that went before us, and experience with our MLD-1200 programmable descrambling system. Furthermore, the new system had to operate in a compatible mode with our programmable system so that existing users could upgrade to addressability without losing their investment in programmable hardware. It also had to work in a noncompatible mode with random variations in the scrambling format for greater security for new users and MLD-1200 users who wanted complete addressability.

System overview

The MLD-6400A is an in-band addressable RF-gated sync suppression encoding/decoding system. The RF sync suppression approach was chosen for stereo compatibility, fewer components, lower cost, greater reliability and compatibility with our existing RF programmable system. The security of an RF system — provided sync recovery information is not placed on the sound carrier — is excellent if part of the scrambling format can be var-

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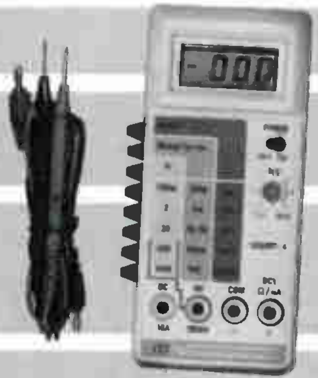

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ied randomly and the method of informing the decoder of these variations utilizes encryption. The MLD-6400A meets all these requirements. Gated sync suppression does not process any portions of the picture that are actually on-screen, and therefore does not have the noise and picture processing problems often associated with sine-wave suppression.

An emphasis was placed on replacing as much of the analog circuitry as possible with digital circuitry. This eliminates many problems associated with temperature drift, component aging, analog noise susceptibility and alignment of analog circuits. The decoder has only two adjustments, and these are preset at the factory.

Emphasis also was placed on putting all the digital circuitry in very large scale integration packages, using custom integrated circuits (ICs) where necessary. The logic section of the decoder contains only three ICs, totalling 132 pins. This not only reduces cost but increases reliability. Security also is enhanced, since a pirate copy of the decoder cannot be built with off-the-shelf parts. Also, the operation of the decoder is difficult to ascertain with most of the actual operations hidden within custom ICs. In addition, all the circuit connections between these ICs are dynamic in operation; thus, no combination of cut and jumpered connections will trick the decoder into descrambling when it is not authorized.

Within the digital realm itself, as many of the digital circuits as possible were replaced with software. A microcomputer in the decoder literally tracks the video signal in software in real time. If two logic levels were "ANDed" in software, then the corresponding hardware gate was removed. The move from hardware to software achieves a greater increase in the benefits derived from moving from analog to digital. The system becomes more flexible; design modifications and upgrades become software changes, not hardware modifications.

Software techniques also allow a high degree of error detection and correction to be implemented that would otherwise be too expensive or limited if implemented in hardware. Software can be written to recognize changes in the immediate environment and adapt to them — it has memory and decision-making capabilities.

In-band transmission of addressing data was chosen over the standard pilot-carrier technique, which uses a single data carrier in or near the FM band for addressing all decoders. MLD-6400A system data is placed in the vertical blanking interval by each encoder.

The advantages of in-band addressing are manifold. Valuable spectrum space is saved by eliminating the pilot carrier. The system works directly over microwave links without any special provisions for data transmission. Security is enhanced because the data stream may not be trapped out without losing the accompanying picture signal. Pilot-carrier systems normally use a time-out counter in the decoder. This monitors data reception to prevent subscribers from using an RF trap at the pilot-carrier frequency to withhold de-authorization information after a decoder has been fully authorized. The counter also prevents subscribers from detuning the data receiver or cutting the data lead from the pilot-carrier receiver output. As long as data is being received, the counter is kept at zero. If the data stream disappears, the counter begins to increment. When a predetermined value is reached the decoder shuts itself down. Such timers can be troublesome if the pilot-carrier transmitter fails at the headend, unless the time-out period is long; but a longer time-out period means lower security.

Such a timer is unnecessary in an in-band system since data and picture are integral. Furthermore, the MLD-6400A will not decode if data is absent since the data provides the video format information necessary to perform the decoding on that channel. Extensive error detection and correction techniques are used to assure that proper decoding is not interfered with by data errors. If the decoder is decoding it also is being addressed. The only way a subscriber can keep his box from being de-authorized on a particular channel is by not watching that channel, which in essence means he has de-authorized himself.

Another advantage is that a synchronous data format may be used for transmission, since video timing information may be used to establish the bit polling points of the incoming data. Pilot-carrier systems that use an asynchronous format send a start bit, eight data bits and a stop bit; the start and stop bits are used for synchronization. Thus, 10 bits must be sent to receive eight data bits. The MLD-6400A sends eight bits to receive eight data bits since the start/stop bits are unnecessary. The transmission format is more efficent and faster.

The synchronous format also adds to security. The data not only must be received properly, but with the proper timing relationship to the video stream it is placed within. Pirates who might easily succeed in providing TTL-level asynchronous data (generated by a home computer at the standard baud rates used in data transmission) instead of the pilot-carrier receiver data will find it difficult to provide the synchronous format and synchronize it with the incoming video.

Circuit simplification, which reduces cost and increases reliability, is another advantage of in-band data transmission. A pilot-carrier system decoder typically requires two receivers: one for removing video timing information from the sound carrier and another for receiving the pilot-carrier data. The MLD-6400A transmits both timing and data in the video. Therefore, the decoder requires only one receiver; a simple video detector is used to extract timing and data from the demodulated channel video.

In-band also allows distributed processing to be used at the headend in the encoders. Each encoder in the system is intelligent and generates its own data stream for its channel. It also locally stores the entire customer data base information for its channel. Unlike the pilot-carrier system, which can suffer a complete shutdown if the pilot-carrier transmitter goes dead, an MLD-6400A encoder failure will only affect a single channel. Distributed processing also allows faster system addressing. Instead of a single data stream, there are as many data transmitters as there are encoded channels. In addition to certain global commands, each encoder sends authorization information only for its channel. Time is not wasted trying to authorize a decoder for Channel 4 when it is tuned to Channel 7. The decoder receives only the data it requires for the channel currently tuned to.

System components

Aside from the hardware normally associated with cable transmission, the MLD-6400A system consists of six components: encoder, encoder battery backup unit, headend data multiplexer, prom programmer, stand-alone decoder, and converter with built-in decoder.

The system supports up to 128 encoded channels; at least one is unscrambled and used as a barker channel. Multiple barker channels may be defined. One encoder is required for each scrambled or barker channel. Data is transmitted in-band on the barker, as well as on scrambled, channels. Other channels do not require encoders.

Additionally, the scrambling format (Figure 1) may be defined on an encoder-by-encoder basis. The decoder determines the current format from the video data and responds accordingly. Each encoder is set to one of four formats (barker, 1200, 6400 or NTSC) by a front panel switch.

The headend configuration is shown in Figure 2. Program video is supplied to the encoder, which then strips all incoming sync pulses from the source. It replaces them with locally generated sync. This removes any irregularities on the incoming video sync pulses, as well as any noise that may have been added during transmission and reception at the headend. In addition, five lines of data are added to the video in each field. This processed video is then used to feed the modulator for the given channel.

The configuration uses a standard IF loop to suppress the RF sync pulses. No timing information or data is placed on the sound carrier. If the IF loop is placed before the sound and picture carriers are combined in the modulator, no telltale timing references will be placed on the sound carrier. This eliminates the possibility of a pirate decoder being built based on AM detection of the sound carrier.

To install the encoder, only three adjustments are necessary: IF loop delay, video output level and replacement sync level. The IF loop delay compensates for any internal delays of the modulator being used with the encoder. It also is used to center the horizontal blanking pedestal within the sync-suppression pulse generated in the IF loop. Once set, this adjustment need not be changed.

The video output and replacement sync-level adjustments are performed with two front-panel controls while levels are monitored on built-in LED bar graph meters. Since the metering is always active, level verification only requires a glance at the encoder. In addition, four status LEDs on the encoder front panel monitor the status of the encoder and provide output from the internal microcomputers' self-test diagnostics. These LEDs indicate 1) billing system computer off-line, 2) parity error in subscriber data memory, 3) subscriber data memory not initialized (indicates power loss occurred in memory), and 4) data transfer failure between the two microcomputers in the encoder.

If lit, the first LED requires that the operator locate the point where the data link is broken and take corrective action. The second and third LEDs do not require operator intervention. The encoder corrects the problem the next time it communicates with the billing system computer, requesting an update of either the memory containing the parity error or the entire data base if a power failure has occurred. The fourth LED indicates an internal hardware problem, which means a new encoder should be swapped in until the problem can be corrected.

Notably absent in the headend configuration is a slave computer serving as the interface between billing and the headend data transmitter. All encoders in the system are intelligent and communicate directly with billing, eliminating the need for an expensive headend computer and the possibility of its failing. Each encoder stores the entire subscriber data base authorization information for its channel (up to 114,624 subscribers, which may be expanded). The information is stored internally in random-access memory dynamic, (RAM), which utilizes parity checking for detecting memory errors. Should they occur, the errors are flagged for updating and are not passed on to the decoders.

Additionally, a battery backup unit protects the encoder's memory during power failures, using sealed gel cells that are constantly trickle charged. Each unit maintains eight encoders for one hour (or fewer encoders for a correspondingly longer period). The charge state of the batteries is indicated on the front panel by an LED bar graph. Since the rest of the headend is presumably also out of power during the power failure, the backup unit only maintains the internal RAM circuits of the encoder. As long as the power failure is shorter than the rating period of the backup unit, the encoder powers up with its RAM intact after a power failure and immediately begins addressing decoders.

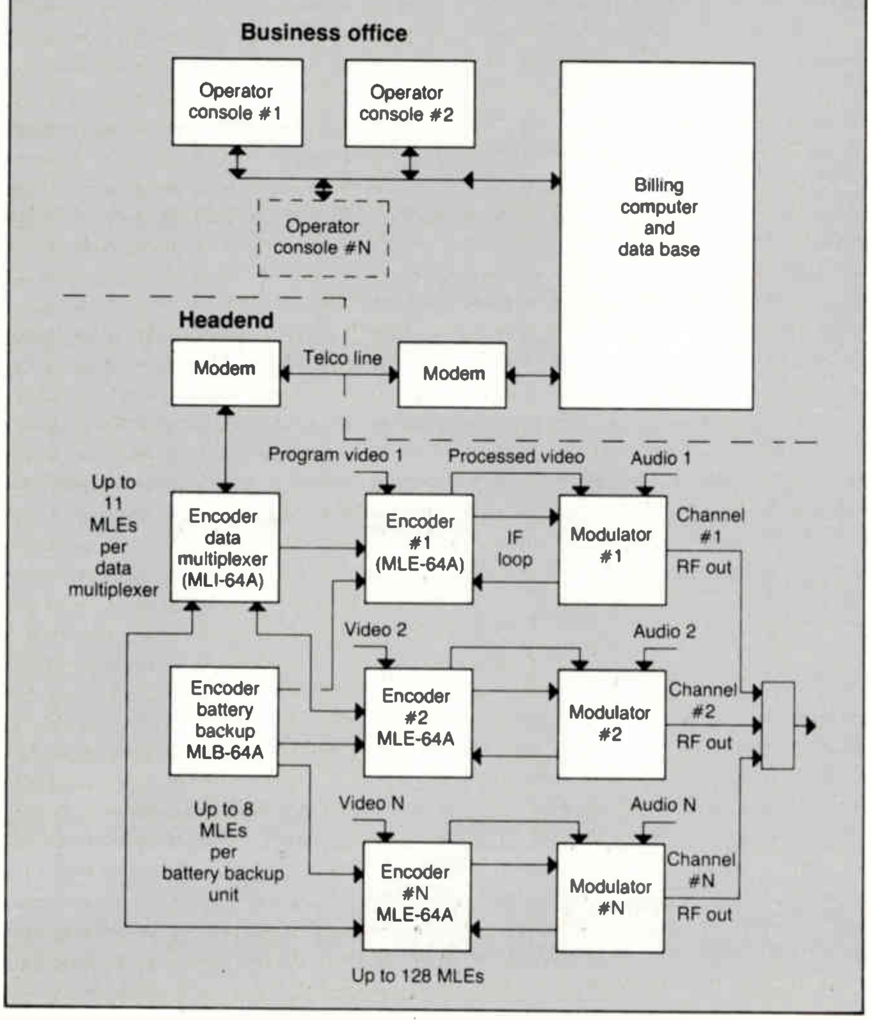
Should the failure exceed the period, the encoder powers up when power is restored, but indicates it has lost its memory by lighting one of the status LEDs previously mentioned. It also immediately begins addressing boxes, but sends each box an idle message instead of its authorization information. An idle tells the decoder to use the last status authorized for on this channel; the decoder retains in its own RAM all its authorization information. The encoder then requests a full memory refresh from the billing system the next time they communicate. This is performed transparently to the system and the subscribers.

The last piece of headend equipment is a data multiplexer, a dumb interface between the single RS232 line from billing and the individual RS232 lines that go to each encoder. Each multiplexer can support up to 11 encoders. If more lines are necessary, multiplexers may be placed in series (two provide 21 lines, three provide 31, etc.). Each multiplexer has several status LEDs on its front panel indicating the on-line status of each encoder and the billing system computer, as well as the transmit and receive line status of billing.

Communication between billing and encoders may be over modems connected to a telephone line or direct via a hardwired RS232 line. An asynchronous data format of eight data bits, no parity and one stop bit is used. Standard rates from 150 to 19,200 baud are supported at the encoder. If a cable system is not already tied to a billing computer, Hamlin offers a control system based on an IBM-XT.

The prom programmer is used to program the address IC in the decoder — both stand-alone and built-in models — and the non-volatile memory of the CR-7000A converter. The CR-7000A is programmed externally via the infrared receiver normally used for remote-control operation. The programmer sports a

Figure 2: Headend block diagram



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The last two components of the system are the subscriber devices: the stand-alone addressable decoder and the CR-7000A converter with built-in decoder. The stand-alone decoder will work behind any converter, provided the output channel of the converter matches the operating channel of the decoder. Thus, cable systems may go addressable without giving up the investment they already have in converters.

The decoder may be ordered with an operating channel of 2, 3 or 4. Since all addressing is handled in-band, no decoder loop-through for a pilot carrier is required before the converter. The decoder supports individual control of up to 128 channels, including PPV, parental control and jamming of the sound carrier on unauthorized or parental-control channels. Since the stand-alone decoder has no keypad, parental-control information is downloaded from the headend on a channel-by-channel basis. Parental control is turned on or off with an optional key switch on the side of the unit.

Four LEDs on the rear of the decoder provide a quick indication of operation that a subscriber can relay over the phone to the cable office should problems arise. When lit, the four LEDs indicate the following: 1) locked to video and receiving valid data, 2) receiving its address in the data stream, 3) authorized for the currently tuned channel, and 4) parental control set for the currently tuned channel. The same four LEDs are used to report the results of extensive self-test diagnostics built into the decoder's microcomputer. The diagnostic routines are started by shorting an internal test point to ground. These routines verify, among other things, the microcomputer RAM, read-only memory (ROM), timer, input/output (I/O) lines, a valid decoder address and basic video co-processor operations.

The converter with built-in decoder offers several standard features, many of which are controlled by data downloaded from the headend via the decoder and others that the subscriber has direct control of. The headend directly enables/disables the handheld remote-control unit, the converter itself and channel authorization for encoded channels. A disabled converter tunes to the barker channel, displays "00" as the channel, and will not allow other channels to be tuned. Tuning an unauthorized channel results in the converter tuning to the barker. Thus, audio jamming is not necessary for the built-in decoder.

Significant capabilities for downloading other information have already been designed into the system should future expansion require new features, such as control of a stereo decoder, etc. The CR-7000A tunes to the barker channel when the convenience outlet for the TV is turned off, so that addressing continues while the converter is not in use.

Several keyboard commands give the subscriber flexible control of the converter. Six favorite-channel memories are supported (recalling the channel and cable with a single key), as well as locally programmable parental control for 132 channels (66 channels per cable, dual cable, 450 MHz), and a subscriber-programmable, five-digit parental access code.

Another command allows quick determination via the two-digit LED display of which channels have been programmed for parental control. The subscriber always knows whether parental control itself is turned on or off by a separate LED in the display. Should the subscriber forget his five-digit access code, there is a command for giving a randomly generated encrypted readout of the code, which may be used by the cable office to determine the code without making a service call.

Should problems arise with the converter, another command allows the subscriber to run the self-test diagnostics of both the converter and decoder. Results of the tests are displayed via the LEDs and may be reported to the office over the phone.

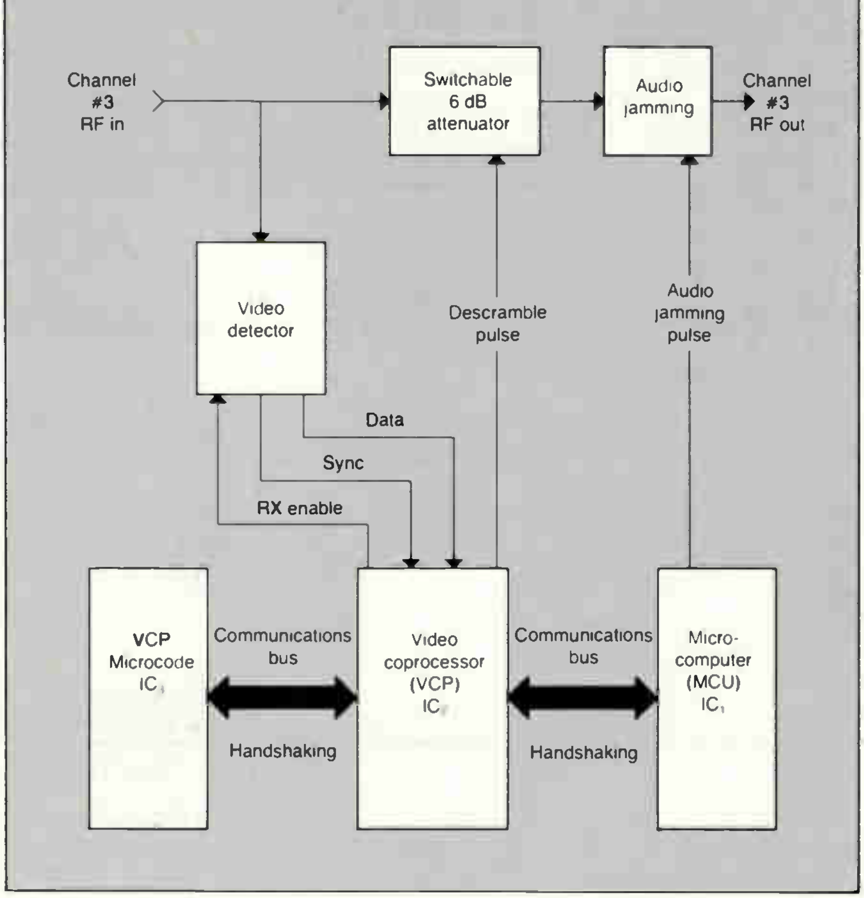
The converter also supports many features that are programmed into the converter via the infrared receiver associated with the remote-control unit. These include mapping or lockout for all channels, the tuning mode (STD, HRC, IRC), the barker channel number and other options. All options are programmed in this manner, so there are no internal jumpers to be cut or connected. To protect critical data from power failures, non-volatile memory is used to store channel mapping data, parental control, parental access code, tuning mode and other operational parameters.

Video formats and decoding process

Figure 1 shows three of the four video formats the encoder is capable of generating. The NTSC format is standard video. The MLD-1200 format is compatible with the Hamlin programmable decoder. The MLD-6400A format is unique to the Hamlin addressable decoder. However, this decoder also is compatible with the MLD-1200 format. Not shown is the barker channel format, which is identical to the NTSC format except that five lines of data are added to each field. This allows the decoder to address on an unscrambled channel.

In all four formats the encoder strips all incoming sync from the source video and inserts replacement sync before feeding the modulator. Data and replacement sync are generated at the video level. Any data present in the source video that may

Figure 3: Decoder block diagram



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very close the hardware. Without altering the hardware, virtually any video format may be defined by changing the software in the MCU and the microcode for the VCP. Generally speaking, the video and data processing are shared between the MCU and VCP. The MCU is responsible for the lower speed operations, and the VCP for the higher speed. Most of the time they provide each other with timing information and data, and track the video signal in real time.

The VCP and MCU begin by locating and locking to the first six equalizing pulses in the front porch of Field 1. Since lockup is digitally controlled, there are no analog timing adjustments to be made, and actual reference timing is established within one or two video frames. The VCP then extracts the data bits from the video stream, formats them and passes them over to the MCU (where they are stored for later processing). During the vertical period both devices are fully active in tracking and processing video information. The VCP then handles all video processing by itself until the vertical interval of Field 2, when both devices become fully engaged again in video processing. A complete message from the encoder consists of the combined data from each field. Thus, one message is transmitted per frame.

The MCU uses the few milliseconds between vertical intervals to process the incoming data and handle any local bookkeeping chores. Field lock and data are verified, addressing commands are executed, authorization is established, parental control is checked, the video format is determined, etc. Based on this, decoding is either begun or not. This process is repeated each video frame.

The operation of the decoder is fairly straightforward outside of the digital section. The VCP provides the properly timed descramble pulses necessary to drive the switchable attenuator and restore the suppressed sync. The MCU controls the audio jamming circuitry. The address of the decoder is programmed into registers within the VCP microcode IC. The address itself is stored in an encrypted format, which makes it extremely difficult for a pirate to invent a new address. If the MCU detects an illegally encrypted address, it refuses to decode and begins to scramble pictures not originally scrambled.

Upon first being tuned to a subscribed, encoded channel, the decoder must be addressed before it will decode. This takes less than 7 seconds maximum, average about 3.5 seconds, for a 10,000-subscriber system. Since authorization data is specific to the channel it is transmitted on, each encoded channel the customer subscribes to must be authorized in the same fashion the first time.

All channel authorization and parental-control information is stored locally in the decoder's RAM. Once a decoder has been authorized for a channel, it locks to it immediately upon subsequent tuning. The decoder begins decoding within three or four video frames after it is tuned to a channel already authorized, taking about 100-150 milliseconds. The customer never is aware that the channel is scrambled.

To provide noise immunity and protection from data errors, the MCU maintains several counters and tables in its internal RAM. These enable it to function in the presence of data errors by using past video history to make decisions about the current frame should an error occur. Time averaging and frame redundancy detect and correct data errors. Once the MCU has locked to the incoming video, it turns the receiver off during those periods when it is not actively looking for sync or data. This protects the digital circuits from falsing to noise pulses and prevents the receiver AGC from being upset by them.

Extensive lab testing for immunity to impulse and broadband white noise showed the decoder to be virtually immune. Impulse noise tests used a switchable oscillator tuned to the picture carrier and 20 dB above it. This is much like the signal generated by high-level sweep systems to evaluate cable transmission. Both the width of the carrier pulses and their repetition rate could be varied.

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Testing with worst-case widths and rates showed that the television AGC and sync circuits failed before the decoder refused to decode. Although the decoder took occasional "hits" under these circumstances, decoder recovery time was typically only one or two video frames. This caused only a momentary flash of the picture, difficult to detect since the noise itself virtually destroyed the picture. Under normal high-level sweep operation within a system, the decoder will have no problems. Additional testing was performed in an actual cable system over an AML link followed by a 60-amplifier cascade. The decoder locked immediately with no data errors or timing difficulties.

System data communications

Data communications begin with the billing system and work downward to individual decoders. There are several phases of communication between the original message sent from billing and the message received by the decoder. The first link is between billing and the encoders, direct and bidirectional. As mentioned previously, several baud rates may be used, and transmission is asynchronous.

Each message from billing contains 34 bytes: two message synchronization bytes, a checksum for error detection, an encoder number and the message proper. There are several types of messages that can be sent to an encoder, including status checks, subscriber updates and PPV control. Subscriber updates may be performed on an individual decoder or group basis. Group updates allow efficient high-speed updating, since 144 decoders are updated with a single 34-byte message from the billing system.

All encoders are essentially wired in parallel by the data multiplexer, and each encoder receives all messages sent by billing. Once a message is verified, only that encoder whose number is contained in the message will respond to it. The response consists of executing the encoder message and sending a reply message back to billing. All return messages are seven bytes long, being similar to the messages sent to the encoder. The return message indicates whether the communication between the computers was successful, as well as the current encoder status.

The encoder can request billing to take specific actions to correct errors that may have arisen, such as a complete power failure at the encoder. These operations are transparent to the system operator, except that billing notifies a terminal operator if communications with an encoder is impossible. This allows prompt, corrective action for a situation requiring operator intervention.

Encoder communications do not place a real-time demand on the billing system computer. Billing need not communicate with an encoder except to change decoder authorization levels. This could be set up to occur as infrequently as once a day or once a week. The typical system is set up to communicate more frequently, perhaps every 5 or 10 minutes, or as changes are made to the subscriber data base at billing. Frequent communication is more desirable because it allows rapid updates of decoder authorization, as well as frequent checks of each encoder's status.

Once an encoder has the decoder authorization it needs for its channel, it begins to address those decoders. The encoder contains two microcomputers, one to maintain the data base and the other to encode the signal and transmit the in-band addressing data. Once per frame, the first computer passes on to the second the data to transmit. The primary commands sent on the barker channel relate to systemwide functions, e.g., remote-control or decoder authorization. A decoder must be authorized for system operation as well as individual channel operation. An encoded channel sends parental control, PPV and channel authorization, as well as system authorization.

(Continued on page 65.)

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(Continued from page 50.)

All addressing and system data is transmitted in-band in Lines 10-14 of the vertical blanking interval (Fields 1 and 2). Each video line contains 24 bits of data, each bit being 2 µs. Thus, 240 bits of data are sent per frame, averaging 7,200 bits per second (BPS). This may seem slow, but by optimizing the addressing format a very high addressing rate may be achieved. The system actually addresses 4,320 decoders per second (259,200 per minute). Since three different commands are sent on an encoder at any given time (e.g., parental control, channel authorization and decoder authorization on an encoded channel), the actual total update rate is 1,440 boxes per second. The fast addressing rate is achieved by updating a group of 144 decoders with each message. The total address space of the system is 9,437,040 decoders.

The message a decoder receives contains, among other things, channel number, encryption key, video format information, a command, group address and decoder authorization field. Certain data bytes in the message are currently undefined and reserved for future expansion. Upon receiving a message, the decoder checks for data errors and takes corrective action if necessary. The decoder then uses the video format data and the encryption key to set up for decoding the next frame. Then the transmitted group address is tested for a match with the decoder's group address. If they match, the decoder verifies that the command byte and the channel number are valid. It then executes the command based on the specific portion of the decoder authorization field which applies.

To prevent data errors that might not be detected from momentarily denying service to authorized viewers, de-authorization messages must be received twice before being acted upon. Authorization is achieved with a single message. Any errors that may occur on a channel not currently tuned will have no effect on the decoder, since in-band addressing is used.

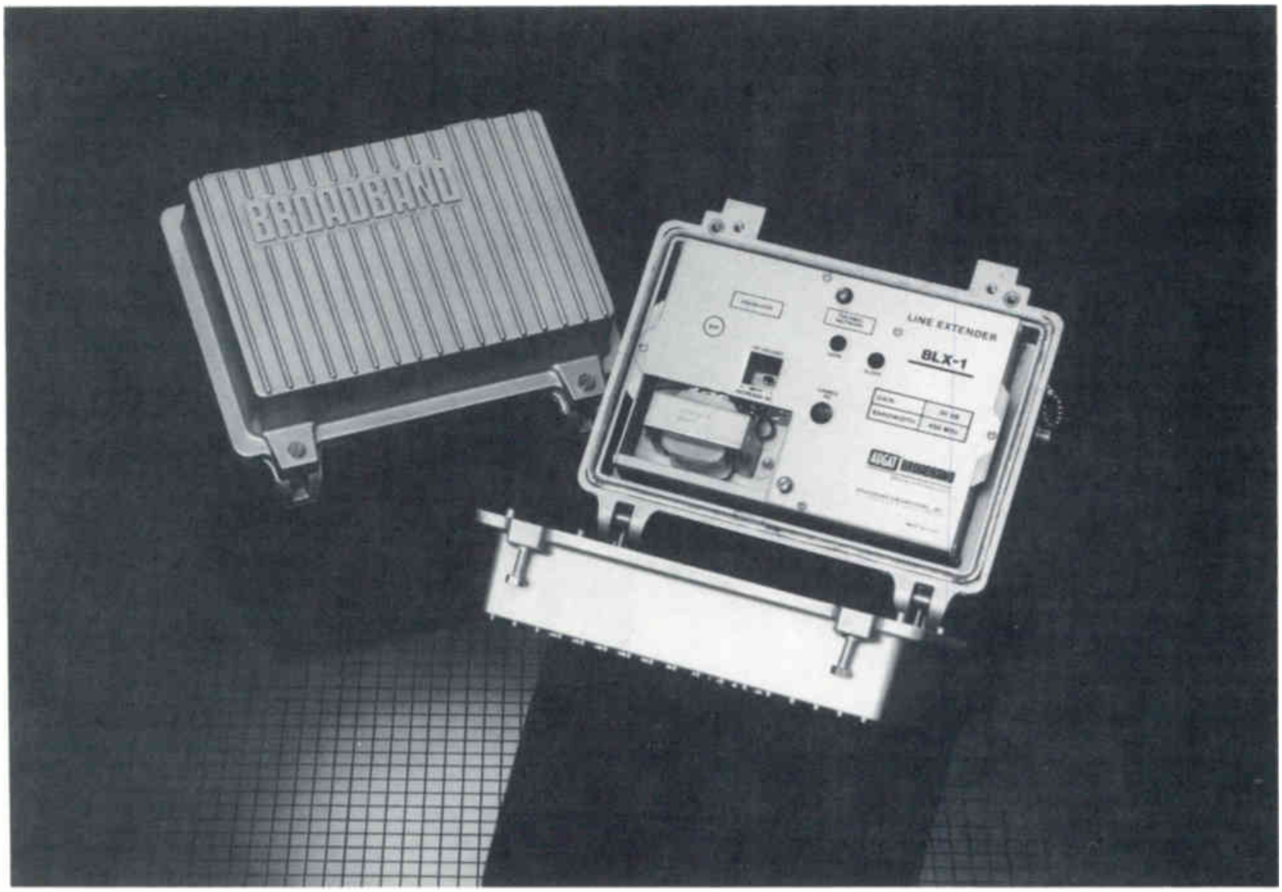
The entire data communications system has been designed to be fail-safe. Should billing go off-line, the encoders will continue to address the system from the data base in their internal RAM. Should power fail at the headend, the battery backup unit will maintain this data base in the encoder memory. Should the backup fail, the encoder will recognize its loss of memory upon power restoration and send idle messages to all the decoders.

The encoder also will transparently request a full data base refresh from billing after power is restored. Upon receiving an idle, provided the decoders themselves have not lost power, the decoders will continue to operate on the service levels already stored internally in their RAM. Should the data base computer in the encoder itself suffer a hardware failure, the second encoder microcomputer will begin sending idles on its own. All of the devices in the data chain have status monitoring LEDs for quickly detecting problems, and most of these devices have provisions in hardware/software for dealing with various failure modes and data errors.

Conclusion

To justify itself, an addressable system must provide a cable operator with greater opportunities for profit than he would otherwise have by not going addressable. Toward this end, an addressable system must aim at reducing operating expenses while increasing revenue. By its very nature, addressability eliminates service calls to change levels of subscriber service and allows new marketing strategies to be used through PPV. And since the billing system controls subscriber service levels, it will always reflect actual authorization.

The initial system installation cost must be reasonable and the ongoing maintenance must be minimal. Reliability and security are essential, since signal theft represents lost revenue. The system must be efficient, for the operator and the subscribers, and flexible. It must offer features demanded by today's subscribers and be capable of expansion as the need arises.



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Reader Service Number 41.

Dynamic switched sync suppression scrambling

By Harley Jones
Application Engineer Supervisor, Scientific-Atlanta

Several methods, both mechanical and electrical, exist for securing special services in cable television today. Originally, existing low-band channels were popular for transmitting premium services, due to their good propagation and the availability of mechanical filters, or traps, which kept the signals from customers not subscribing to the service. Traps, however, had to be placed at the homes of all nonpremium subscribers.

Later, as channel capacity of distribution plants expanded, operators moved some of these services to the mid-band region of the spectrum, out of reach of the television tuner. Only revenue-generating subscribers had to be equipped with some form of converter. However, as televisions became more sophisticated and tuned these channels without aid, a more secure method of transmitting the programming was required.

Next, interfering carriers were added on top of the premium signal, rendering it unpleasant to watch. The carrier was then notched out at the subscriber's home with a mechanical trap, which often took video information along with the interfering signal, or drifted away from its intended frequency.

Scrambling systems were devised to provide a high level of security for premium program delivery. The term *scramble* is a misnomer, since all we actually do is suppress the synchronization pulses at the transmission site. The signal only appears to be scrambled because the television cannot properly reconstruct it without these hidden pulses. The set-top terminal contains the circuitry to recover these sync pulses and present the complete signal to the television set.

Square-wave sync suppression scrambling systems typically switch on an attenuator during the time sync occurs, reducing the sync level by 6 dB. The descrambler must amplify this exact interval by precisely the same amount it was suppressed. Extremely accurate timing relationships must exist between the headend scrambler and the remote descrambler. To properly convey the necessary timing information, communications between the two must be established.

While a few out-of-band techniques using separate discrete data carriers persist, this data is normally carried within the channel bandwidth. This in-band timing

'The term scramble is a misnomer, since all we actually do is suppress the synchronization pulses at the transmission site'

information is placed either in the video signal itself, or more commonly, it is merged with the sound carrier of the affected channel. Scientific-Atlanta systems utilize the frequency-modulated sound carrier as the transmission medium for this data. Amplitude-modulated timing pulses are added to the sound carrier of the scrambled channel. They are received by the descrambler and used to trigger the sync amplification.

Some scrambling systems use a timing pulse, which occurs at the beginning of the horizontal blanking interval. Once the pulse is detected, the descrambling amplifier is turned on for 12 to 13 microseconds, and the sync is restored. The descrambler for this type of system is quite simple, requiring only pulse detection and timing networks to be successful in descrambling. This "on-time" method often falls victim to piracy, due to the ease of the pulse detection and the predictability of the timing interval.

A timely advance

A much more secure scrambling method is one that advances in time the relationship of the audio pulse to the horizontal blanking interval. In order to utilize these pulses, the descrambler must delay the sync restoration by a precise amount. A delay accuracy of about 2 percent must be maintained for an acceptable picture. Set-top terminals employing this technology use custom digital electronics and a precision crystal oscillator. Pirates' boxes with limited accuracy will not deliver totally descrambled pictures. The other alternative is to build a complex digital circuit using discrete integrated circuits, which is quite expensive and unwieldy.

An improvement in security may be had by dynamically varying the position of the recovery pulses with respect to the horizontal blanking interval. In the Scientific-Atlanta patented system, the pulses are transmitted at random times prior to the blanking interval.

For example, the pulses are transmitted at a time advancement of 25 microseconds, followed by advancement of 40 microseconds, followed by advancement of 15 microseconds, and so forth. The scrambler controls the system by generating a random sequence of timing offsets, which change on a field-to-field basis. During the current field, the scrambler transmits the offset information pertaining to the next field. This information is relayed to the descrambler by a separate set of encoded audio pulses and decoded by a custom microprocessor.

In the absence of these encoded pulses, the descrambler reverts to a fixed timing mode that will decode the on-time types of scrambling, providing multi-vendor compatibility in one terminal. A third mode of operation allows the descrambler to decode systems that place restoration information in the vertical interval. The addition of a Scientific-Atlanta scrambler to the existing channel provides duplicate decoding information on both the vertical interval and on the audio carrier simultaneously. Since the entire timing process is digital, there are few setup adjustments initially, and practically no periodic maintenance is required at the scramblers.

In-band flexibility

This intelligent, proprietary in-band data transmission between the headend and the descrambler provides additional flexibility. On-time, vertical interval and dynamic scrambling may be mixed in the same system and decoded by a single terminal. PROM programmable terminals also utilize this dynamic descrambling, but require slightly different information from the scrambler. This prevents programmable terminals from descrambling addressable channels unless the operator specifically chooses to set the scrambler for mixed operation.

An additional mode of operation prevents piracy by decoders that reconstruct sync while ignoring the audio information altogether. This requires the use of a special scrambler at the headend, but no changes need to be made to the converters. They simply obey commands given over the in-band data channel.

An added benefit of offset timing is realized when BTSC stereo is added to the scrambled signal. Since the timing pulses occur well away from sync, they are not amplified by the descrambler and do not interfere with the stereo signal.

Satellite scrambling: The Microdyne/VC II interface

Microdyne, a producer of satellite communications and telemetry equipment, has been supplying the cable industry with satellite receivers since the beginning of satellite-delivered television. With thousands of various models of Microdyne receivers in operation throughout the country, the interfacing of particular models with the new scrambling standard of VideoCipher II (VC II) has created some challenges. In many cases, Microdyne receivers will mate with a VC II descrambler unit without any problems. But depending on the amount of system margin or input signal strength, the model of receiver and variation thereof, problems may be encountered when the program uplink throws the scramble switch.

By Brett L. Swigert
Sales Engineer, Microdyne Corp.

Provided that the signal level input to the satellite receiver is above threshold, almost all Microdyne receivers are fully compatible with the VC II system without any modifications or additions. The only receivers that have to be field modified are the Models 1100 X1(S), 1100 TVRM, 1100 X(24) and those receivers with the 104-042 demod board installed. However, even with a large system margin and compatible model receiver, the cable operator may want to go ahead and make the modifications anyway, in order to avert the potential disaster of a lowered signal input due to problems at the uplink, inclement weather or any other possible disruptions.

Antenna peaking

One way to ensure the best possible signal input to the satellite receiver is to occasionally check the peaking of the antenna. High winds, ground settlement and even movement of the satellite can cause a dish to receive less signal over time. If the receiver has an accessible automatic gain control (AGC) test point, a DC voltmeter can be used to check the antenna's positioning. Simply adjust the azimuth and elevation of the antenna mount for the strongest signal level on the voltmeter.

If the receiver has an IF test point, the following process may be followed to test antenna peaking: First, find an unscrambled video transponder on the satellite of choice. Next, place the receiver in manual gain mode and connect a power meter, microwattmeter or millivoltmeter to the 70 MHz or 600 MHz IF test point. Select the 0 to -10 dB range on the power meter and adjust the manual gain on the receiver to

Figure 1: Normal hook-up with de-emphasis

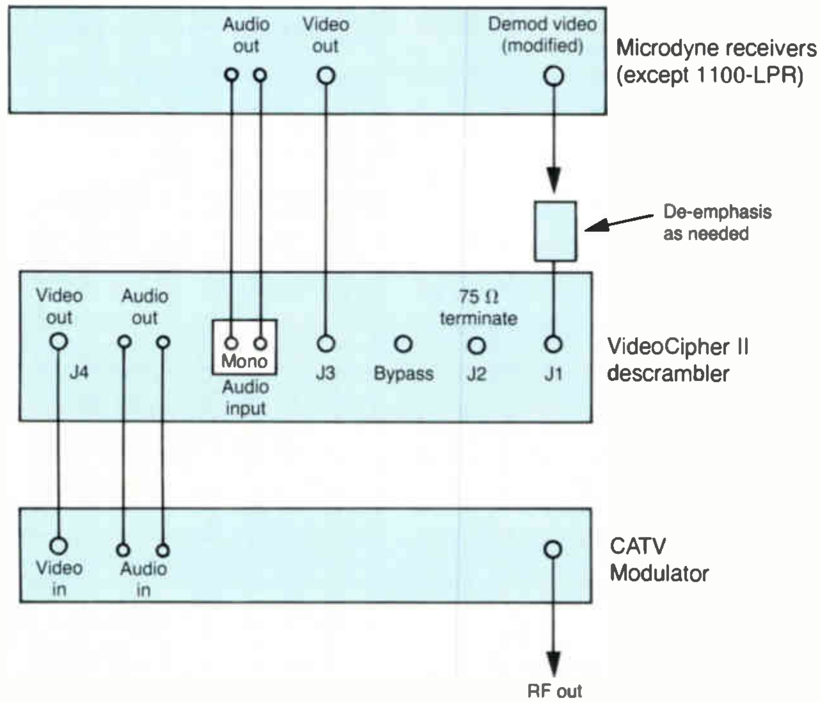
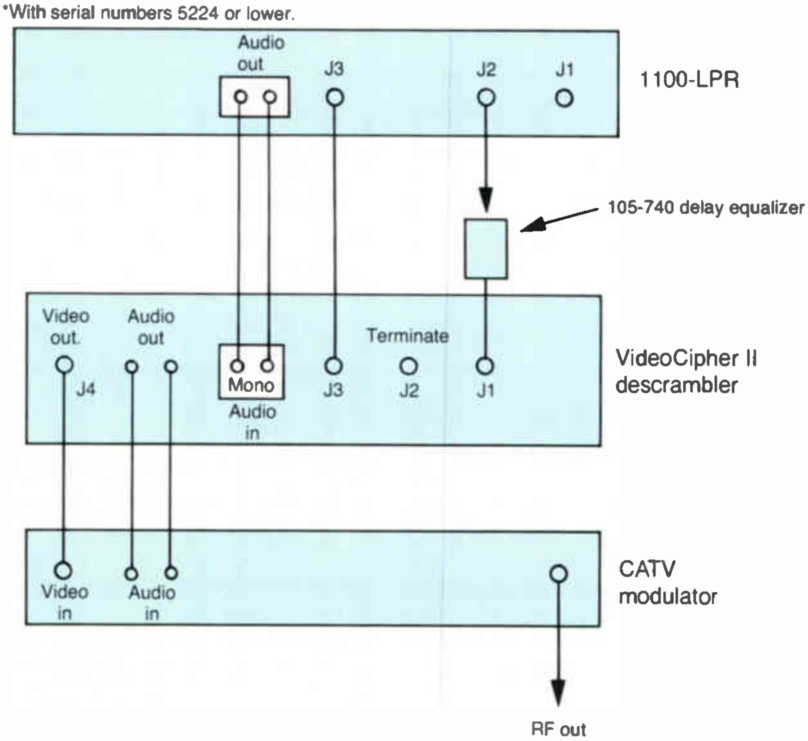


Figure 2: Hook-up for Model 1100-LPR*

*With serial numbers 5224 or lower.



-7 dB (-13 dBm for 600 MHz IF). Now, adjust the azimuth and elevation of the antenna mount for a maximum power meter reading. Find the optimum position by passing through a maximum power reading, then back to that reading, and adjust azimuth and elevation levels twice or more to ensure that adjustments are consistent with one another. If no test equipment is available, an operator may want to test antenna peaking by making minor adjustments in azimuth and elevation with a visual check on the monitor.

After the antenna is peaked, make certain that feed polarity adjustments are accurate. The simplest technique is to twist the feed clockwise until the picture is degraded slightly, then twist the feed counterclockwise until the picture is equally degraded. Split the difference in rotation distance and secure the feed.

'High winds, ground settlement and movement of the satellite can cause a dish to receive less signal over time'

There are many other points in the satellite system to check for best receiver signal input. Are cable connectors clean and dry? Are Type "N" connectors' center pins flush with end of connector for proper mating (i.e., pins too short — no contact; pins too long — damaged components)? Is there proper drive voltage to DC-powered LNAs? Is there proper signal level input to the receivers (i.e., 4 GHz receiver starved for signal or block-downconverter receiver overdriven or starved)?

If the pictures look great, why go through all the trouble of repeaking the system? Maybe a few words about how the VideoCipher II technology operates will answer that question. First, for our purposes, VC II operates in the two modes of global command and individual address. Global command means that all VC II descrambler units are authorized to receive. Individual address means that an ID code for each VC II descrambler must lie in the data stream being transmitted within the video signal for that unit to operate.

The signal transmitted from the VC II scrambler has been modified by replacing the front porch and sync area of every horizontal blanking interval with a digital signal composed of digitized audio channels and security address data. The back porch and chroma (color) burst of the horizontal blanking interval have been shifted in DC level to a point approximately centered within the peak-to-peak video signal. The video lines of visible picture information have been inverted and their amplitude has been increased by 40 percent. The normal NTSC vertical interval has been replaced by full amplitude sync, half of which is inverted from the other half. The sync inversion point represents the normal vertical sync timing and the DC levels of the blank lines between the horizontal timing establishes what appear to be the peak black and white references for the video AGC built into the VC II.

Since most video receivers have a low-pass filter or traps to reduce the amplitude of audio subcarriers, the effect of chroma delay through these components could be a problem to the VC II descrambler. And if timing error of the chroma and luminance components of the receiver's video signal exceeds ±25 nanoseconds, distortion of the digital signals during horizontal blanking could increase the bit error rate of the digital information. An excessive bit error rate could prevent the VC II from receiving its authorization code. At the very least, a marginal bit error rate can cause pops and clicks in the audio signal. As long as the VC II authorizes and descrambles, a poor bit error rate will not affect the viewed video quality. This phenomenon occurs because the video portion of the signal is transmitted as an analog FM carrier.

If group delay or chroma vs. luminance timing is not the problem, then the remaining source of bit error rate is poor carrier-to-noise ratio (C/N). With a poor

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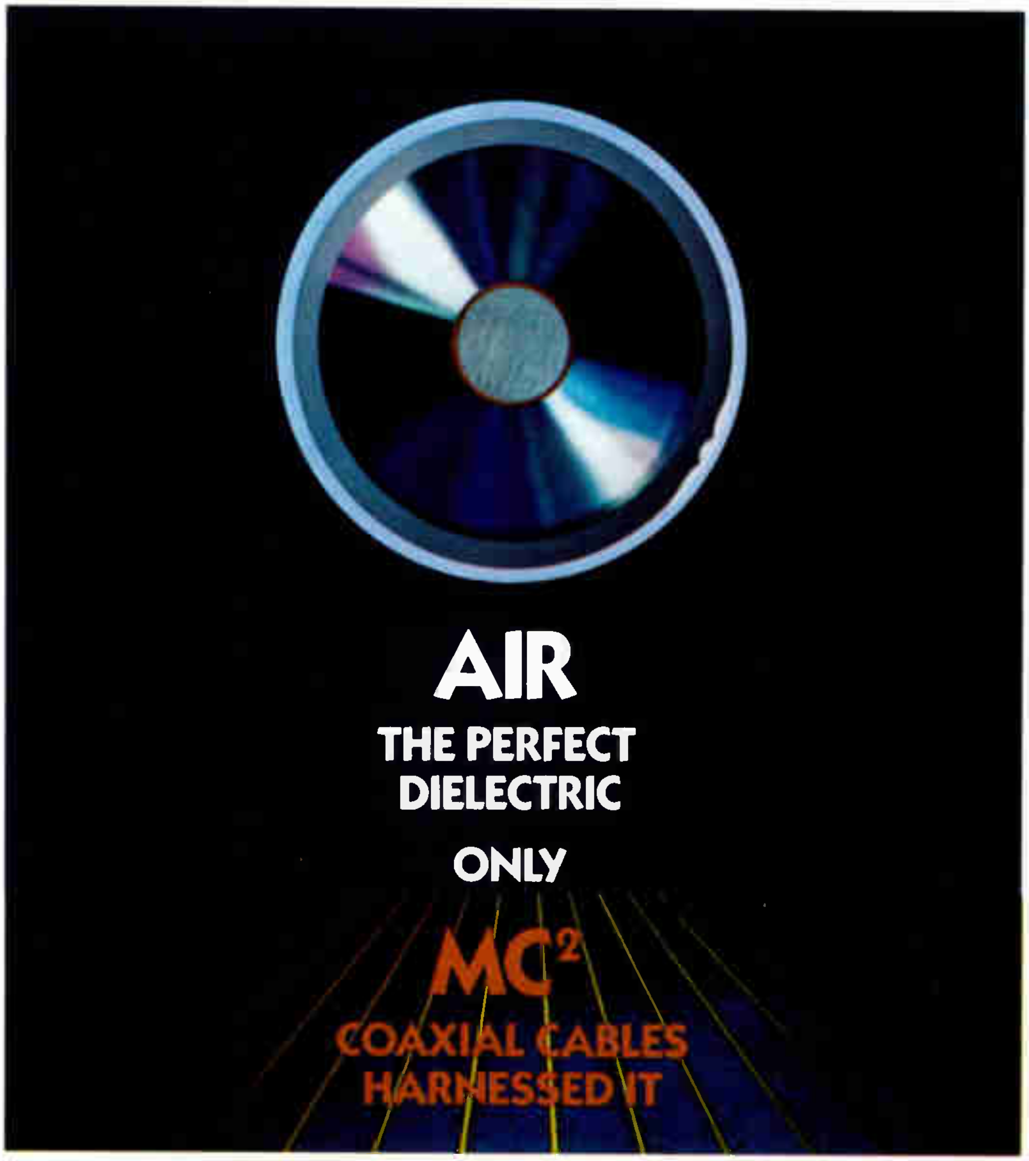

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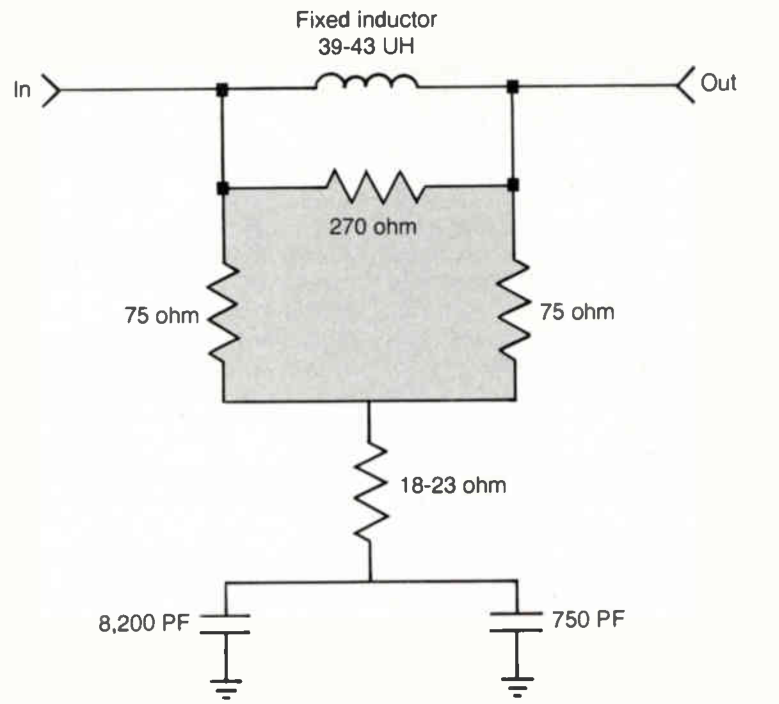
Figure 3: De-emphasis network



Note: This device must have a 75 ohm source and a 75 ohm load to function properly.

C/N or low signal input to the receiver, the receiver will be the source of "sparkles" in the video. This added impulse noise not only increases the bit error rate of the digital signal, but also causes clamper problems within the VC II descrambler.

When the video from the receiver is clamped and the clamper is reacting adversely to the digital signal within the video, the bit error rate will increase. The clamper within the VC II descrambler can overwork itself to correct the receiver clamper errors and the result will be streaks in the video. A high system margin or signal level input to the receiver could prevent most, if not all, of the problems associated with interfacing to a VC II unit.

Whenever hooking up a Microdyne receiver to a VideoCipher II, you should be sure to have an instruction manual to guide the progress. Manuals are available at no charge through either Microdyne or M/A-COM. Even though the actual hook-up is fairly simple (see Figures 1 and 2), various models of receivers may require an internal or external modification of one kind or another. For example, some later versions of receivers may require a minor internal modification to provide a DC coupled video output. In addition, an external de-emphasis network may be needed. This exists in all receivers to restore the proper gain vs. frequency characteristics in an FM transmission system after demodulation of the video or audio signal.

Various models of receivers were built with the de-emphasis network outside of the loop for VC II hook-up and therefore require an external unit. This external unit may be purchased through M/A-COM or built by any electronics technician (see Figure 3). Also, the 1100-LPR receiver with serial numbers of 5224 or lower may require the addition of an external delay equalizer unit. This corrects any timing discrepancy between receiver chroma and luminance components and VC II descrambler requirements. The units, Model #150-740, are available either through Microdyne or authorized distributors. Again, an operator will not have to make these modifications as long as the system margin and signal input to the receiver is sufficiently high.

Solving the problem

The VideoCipher II integration has surely been and will probably continue to be a problem for many operators and vendors as well. Having produced thousands of various models of satellite receivers, Microdyne is by no means immune from difficulties with this new attachment. Now that all the VideoCipher II requirements are known and it has become the standard of the CATV industry, Microdyne has incorporated the appropriate engineering into its latest model receivers.

Digital data communications on microwave

Many corporations and new communication services are using coaxial cable and microwaves to move large volumes of digital data such as computer-to-computer communications, telephone services, high-speed facsimile, etc., on wide area nets, metropolitan nets and local area nets (WANS, MANs and LANs). Many of these services classically have been supplied by the telephone company. These services are not only long distance but are being provided for the short haul — intracity, the "local loop." Microwaves are attractive for bypassing the local loop, particularly with DTS. This article discusses engineering design considerations, governmental regulations and presents a survey of available equipment related to microwaves used for digital data communications.

By Lawrence W. Lockwood
President, TeleResources

The frequencies used for microwave transmission of digital data are 2 through 40 GHz. The most common bands for common carrier long-haul communications (e.g., relay towers are typically 20-30 miles apart) are the 2, 4 and 6 GHz bands. With increasing congestion at these frequencies, the 11 GHz band is now being used more frequently. The FCC has reserved parts of the 10 and 18 GHz bands for local data distribution, called the digital termination service (DTS). CATV uses frequencies in the 12 and 18 GHz band for community antenna radio service (CARS). Higher frequency microwaves are being used for short point-to-point links (e.g., between buildings). Typically the 18 and 23 GHz bands are used. The higher frequencies are less useful for longer distance because of increased attenuation, but are quite adequate for shorter distances. In addition, at the higher frequencies, antennas are smaller and cheaper.

There are two methods of using microwave for digital data communications. They are: point-to-point and point-to-multipoint (DTS services).

Table 1 shows the authorized frequency bands as regulated by the FCC. The frequencies allocated by the FCC (Part 21.701) for common carrier use of point-to-point, fixed station microwave are noted in the table with a (C). The maximum bandwidths authorized for each of the common carrier point-to-point frequency bands are also listed. The list does not include frequency allocations outside the purview of this paper, i.e., no aeronautical, maritime, mobile or amateur allocations are shown.

System design considerations

Whether for point-to-point or point-to-multipoint, the following system design considerations must be addressed. For digital transmission the FCC imposes a minimum transmission efficiency. Part 21.122 of the rules requires that any digital radio transmissions below 15 GHz shall have at least the efficiency of 1 bit per hertz. As an example, equipment transmitting at a 20 MBPS rate must not require a bandwidth of greater than 20 MHz. The high efficiencies are accomplished by the use of combinations of various types of phase modulation.

In addition, the FCC imposes limitations on path lengths in Part 21.710 of the rules. These limitations and FCC mandated minimum digital data rates are shown in Table 2.

An important part of system design is a power budget analysis for the equipment/path under examination. The equipment gains/losses (e.g., transmitter power, receiver sensitivity, waveguide losses, etc.) may be obtained from equipment specifications. The free-space loss of a signal leaving an isotropic antenna (an ideal antenna with a reference gain of 1 [0 dB], radiating equally in all directions, i.e., perfectly omnidirectional) may be calculated from the following commonly accepted formula:

$$L_{dB} = 36.6 + 20 \log D + 20 \log f$$

where:
L_{dB} = path loss in dB
D = path distance in miles
f = frequency of transmission in MHz

Figure 1: Antenna gain nomogram

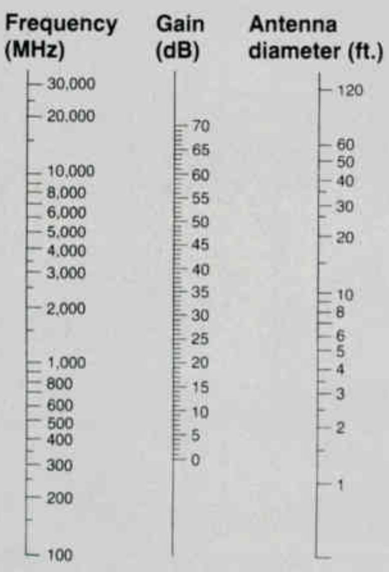


Figure 2: Propagation conditions for multipath fading

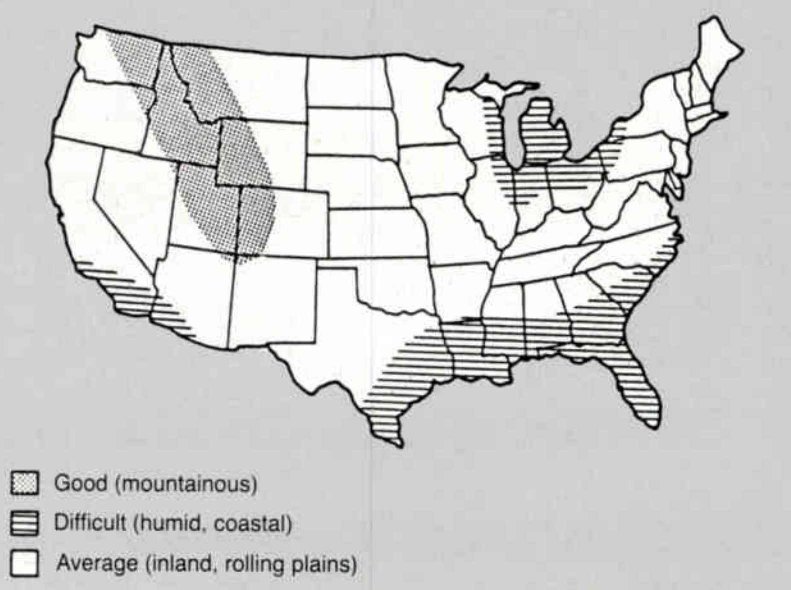


Table 1: Frequency allocations

Frequency (MHz)	Available bandwidth (MHz)	Maximum usable bandwidth/channel (MHz)
1,990- 2,110[74]	120	
2,110- 2,130 (C)[1,3,7]	20	3.5
2,130- 2,160[94]	30	
2,160- 2,180 (C)[1,2,5]	20	3.5
2,180- 2,200[94]	20	
2,200- 2,390[16]	190	
2,500- 2,655[74]	155	
2,655- 2,690[74,94]	35	
3,700- 4,200 (C)[5,8]	500	20.0
4,400- 4,990[16]	590	
5,925- 6,425 (C)[5,6,8,25]	500	30.0
6,425- 6,525[21,74]	100	
6,525- 6,875[16,94]	350	
6,875- 7,125[16,74]	250	
7,125- 8,500[16]	1,375	
10,550-10,680[21]	130	5.0
10,700-11,700 (C)[8,9]	1,000	40.0
11,700-12,200[21,25]	500	
12,200-12,700[94,100]	500	
12,700-13,200[74,78,94]	500	
13,200-13,250 (C)[4,94]	50	25.0
14,200-14,500[25]	300	
14,400-15,350[16]	950	
17,700-18,580 (C)[5,10,15]	880	220.0
18,580-18,820 (C)[5,10,15]	240	20.0
18,820-18,920[21,74,78,94]	100	10.0
18,920-19,160 (C)[5,10,15]	240	20.0
19,160-19,260[21,74,78,94]	100	10.0
19,260-19,700 (C)[5,10,15]	440	220.0
21,200-22,000 (C)[4,11,12,13]	800	100.0
22,000-23,600 (C)[4,11,12]	1,600	100.0
25,250-27,500[16]	2,250	
27,500-29,500 (C)[5]	2,000	220.0
31,000-31,300 (C)[15]	200	25.0 or 50.0
36,000-37,000[16]	1,000	
37,000-38,600[16,21,94]	1,600	
38,600-40,000 (C)[4]	1,400	50.0

[1] Frequencies in this band are shared with control and repeater stations in the domestic public land mobile radio services and with stations in the international fixed public radio communication services located south of 25°30' north latitude in Florida and U.S. possessions in the Caribbean. Additionally, 2160-2162 MHz is shared with stations in the multipoint distribution service.

[2] Except upon a showing that no alternative frequencies are available, no new assignments will be made in the band 2160-2162 MHz for stations located within 50 miles of the coordinates of the cities listed in Part 21.901.

[3] Television transmission in this band is not authorized and radio frequency channel widths shall not exceed 3.5 MHz.

[4] Frequencies in this band are shared with fixed and mobile stations licensed in other services.

[5] Frequencies in this band are shared with stations in the fixed-satellite service.

[6] These frequencies are not available for assignment to mobile earth stations.

[7] Frequencies in the band 2110-2120 MHz may be authorized on a case-by-case basis to government or non-government space research earth stations for telecommand purposes in connection with deep space research.

[8] This frequency band is shared with station(s) in the local television transmission service and, in the U.S. possessions in the Caribbean, with stations in the international fixed public radiocommunication services.

[9] The bands 10.95-11.2 and 11.45-11.7 GHz are shared with space stations (space-to-earth) in the fixed-satellite service.

[10] This band is co-equally shared with stations in the fixed services under Parts 21, 74 (auxiliary broadcasting), 78 (cable television relay) and 94 (private operational fixed microwave) of the FCC's rules.

[11] Frequencies in this band are shared with government stations.

[12] Assignments to common carriers in this band are normally made in the segments 21.2-21.8 GHz and 22.4-23.0 GHz and to operational fixed users in the segments 21.8-22.4 and 23.0-23.6 GHz. Assignments may be made otherwise only upon showing that no interference-free frequencies are available in the appropriate band segments.

[13] Frequencies in this band are shared with stations in the earth exploration satellite service (space-to-earth).

[15] Stations licensed as of Sept. 9, 1983, to use frequencies in the 17.7-19.7 GHz band may, upon proper application, continue to be authorized for such operation.

[16] Reserved for government, fixed.

[21] Domestic, public fixed. Specifics in Part 21 of the rules.

[25] Satellite communications. Specifics in Part 25 of the rules.

[74] Auxiliary broadcasting. Specifics in Part 74 of the rules.

[78] Cable television relay (CARS). Specifics in Part 78 of the rules.

[94] Private operational fixed microwave. Specifics in Part 94 of the rules.

[100] Direct broadcast satellite. Specifics in Part 100 of the rules.

The gain of a directional antenna may be obtained from the nomogram in Figure 1 (where a 55 percent efficiency is assumed for the antenna).

Beamwidths are narrow with high-gain directional (parabolic reflector) antennas (see Table 3). Because of this it is evident that considerable accuracy is required in pointing the antennas.

For a point-to-point system, a path profile must be determined to ensure that the transmitter and receiver antennas are high enough that they are able to "see" each other. Factors such as the curvature of the Earth, the Fresnel zone clearance

Table 2: Path lengths/data rates

Frequency (GHz)	Minimum path length (km)	Minimum digital data rate
2.110 - 2.130	5	No minimum
2.160 - 2.180	5	No minimum
3.700 - 4.200	17	10 MBPS
5.925 - 6.425	17	10 MBPS
10.700 - 11.700 (20 MHz bandwidth or less)	5	5 MBPS
10.700 - 11.700 (bandwidth more than 20 MHz)	5	10 MBPS

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Table 3: Antenna beamwidths

Gain (dB)	Half-power beamwidth
30	5°
35	3°
44	1°

and, of course, any obstacle in the line of sight path must be considered.

Fading

In addition to factors such as transmitter power, transmitter and receiver antenna gains, waveguide losses, etc., a fade margin must be considered. When a receive level varies from the free-space calculated level for a given far-end transmitter output, the result is called fading. There are two general types of fading — multipath and power.

Multipath fading is due to interference between a direct wave and another wave, usually a reflected wave. Multipath fading may display fades in excess of 30 dB for periods of seconds or minutes. The principal type of fading below 10 GHz is multipath fading. The International Consultive Committee for Radio (CCIR) Report 784 states that: "Multipath effects due to atmosphere increase slowly with frequency, but more rapidly with path length (the deep fading probability follows an approximate law f x $d^{3.5}$, where f is the carrier frequency and d is the distance)." Multipath fading in its extreme conditions approaches a mathematically defined relation in statistics called a Rayleigh distribution.

Power fading is a change in the power transmission on the microwave path between the transmitter and receiver due to several factors, the most significant being an intrusion of atmospheric layers into the propagation path (diffraction fading). Power fading is characterized by marked decreases in the free-space signal level for extended time periods. Diffraction may persist for several hours with fade depths of 20-30 dB.

A good approach to determine the fade margin is to simply assume what is often considered the *worst* fading condition on a single radiolink hop. This is the familiar Rayleigh fading, which can be summarized as shown in Table 4.

For other propagation reliability values, simple interpolation can be used. For instance, for a hop where 99.95 percent reliability is desired, the fade margin required for Rayleigh fading would be 33 dB.

Here is an example of a very cursory treatment of a link power budget analysis, using the factors described: Assume a transmitter of 2150 GHz with a power output of 20 dBm (100 mW), a path length of 17 miles, 8-foot dishes at each end, 2 dB for total line losses for both ends of the link (waveguide/transmission line losses) and a receiver sensitivity of –79 dBm for an unfaded bit error rate (BER) of 10^{-9}. From the formula for L_{dB}, the path loss is 127.8 dB. From the antenna gain nomogram, the antenna gain is 32 dB. Thus:

Transmitter power	+	20
Transmitter antenna gain	+	32
Transmitter waveguide loss	–	1
Path loss	–	127.8
Receiver antenna gain	+	32
Receiver waveguide loss	–	1
Receiver sensitivity	+	79
		33.2 dB margin

If the fade margin is 33.2 dB the reliability is 99.95 percent and the outage will be 44.8 seconds/day (average).

Rainfall is an important factor in fading, especially above 10 GHz. A map showing typical CONUS (continental United States) rainfall effects is shown in Figure 2.

A useful nomogram for estimating loss due to rainfall is shown in Figure 3. We are interested here not with the total quantity of rain but with periods of heavy intensity. One short cloudburst can cause more outage than weeks of a light drizzle.

It is good practice to add a miscellaneous loss margin to the derived fade margin. This additional is required to account for minor antenna misalignment and system gain degradation (e.g., waveguide corrosion, transmitter output and receiver noise factor degradations due to aging). The Defense Communications Agency of the U.S. Department of Defense recommends 6 dB for this additional margin.

Fading is countered with diversity reception, which is based on the fact that radio signals arriving at a point of reception over separate paths may be in a condition of fade on one path while the identical signal on another path may not be in a fade.

Separate paths

What are separate paths and how "separate" must they be? According to CCIR Report 376, the separation may be in:

- frequency,
- space (including angle of arrival and polarization),
- time (a time delay of two identical signals on parallel paths) or
- path (signals arrive on geographically separate paths).

The most common forms of diversity in radio link systems are those of frequency and space. A frequency diversity system utilizes the phenomenon that the period of fading differs for carrier frequencies separated by 2-5 percent. Such a system employs two transmitters and two receivers with each pair tuned to a different frequency (usually 2-5 percent separation, since the frequency band allocations are limited). If the fading period at one frequency extends for a period of time, the same signal on the other frequency will be received at a higher level, with the resultant improvement in propagation reliability. Besides the expense of the additional equipment, the use of additional frequencies without carrying additional traffic is a severe disadvantage in frequency diversity, especially when frequency assignments are even harder to get in highly developed areas where demand for frequencies is the greatest.

One of the main attractions of space diversity is that no additional frequency assignment is required. In a space diversity system, if two or more antennas are spaced many wavelengths apart in the vertical plane, multipath fading will not occur simultaneously at both antennas. The goal in space diversity is to make the separation of diversity antennas such that the reflected wave travels a half-wavelength farther than the normal path. Any spacing between 100 and 200 wavelengths is usually found to be satisfactory (e.g., approximately a 5-foot spacing for a 20 GHz system).

Generally speaking, equipment operating in the approximately 2-11 GHz range is applied to requirements of longer paths than equipment of the higher frequencies. They also have a high digital modulation efficiency (many in the range of 3-4 bits/Hz) and therefore have higher digital throughput rates than the bandwidths they use for modulation. Thus, this equipment is expensive, in the region of $85,000 with hot standby, and requires digital transmission rates near their maximum capabilities to warrant their costs. (Hot standby is the provision of a parallel equipment configuration such that it can be switched in nearly instantaneously on the failure of operating equipment. The switch-over takes place usually in microseconds, often less than 10.)

For shorter paths, and particularly for applications in local area digital data communications, point-to-point digital radio equipment has been developed and is widely used in both the 18 GHz and the 23 GHz bands (17.7-19.7 GHz and 21.2-23.6 GHz). The uses in these bands are regulated in Parts 21 and 94 of the FCC regulations.

Currently, in mid-1986, three companies that are typical large providers of 23 GHz equipment are General Electric (GE recently sold its line to Motorola), M/A-COM and the Digital Microwave Corp. The General Electric (Motorola) equipment is called Gemlink. It is AM modulated and the Model LSV-112 has a transmission power rate of 2-T1 (the T1 rate is a Bell standard and is 1.544 MBPS) with a transmitter power of 14 dBm (25 mW). GE claims operating distances of 5-7 miles. A

Table 4: Multipath fading

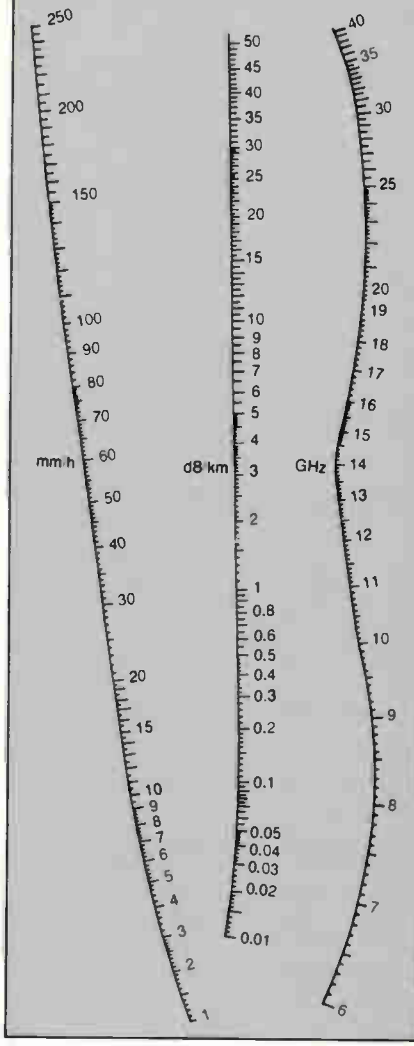
Fade margin (dB)	Single-hop propagation reliability (percent)	Amount of outage: Percent	Per year	Per month (avg.)	Per day (avg.)
8.0	90.0	10.0	876.0 hrs.	73.0 hrs.	2.4 hrs.
18.0	99.0	1.0	87.6 hrs.	7.3 hrs.	14.0 mins.
28.0	99.9	0.1	8.8 hrs.	44.0 mins.	1.4 mins.
38.0	99.99	0.01	53.0 mins.	4.4 mins.	8.6 secs.
48.0	99.999	0.001	5.3 mins.	26.0 secs.	0.9 secs.

Table 5: DTS frequency assignments

	Ch.	Local node to subscriber	Subscriber to local nodes
Extended	Ch. 1	10,565.0 to 10,570.0 (5.0)	10,630.0 to 10,635.0 (5.0)
	2	10,570.0 to 10,575.0 (5.0)	10,635.0 to 10,640.0 (5.0)
	3	10,575.0 to 10,580.0 (5.0)	10,640.0 to 10,645.0 (5.0)
	* 4	10,580.0 to 10,585.0 (5.0)	10,645.0 to 10,650.0 (5.0)
Limited	Ch. 5	10,600.0 to 10,602.5 (2.5)	10,665.0 to 10,667.5 (2.5)
	6	10,602.5 to 10,605.0 (2.5)	10.667.5 to 10,670.0 (2.5)
	* 7	10,605.0 to 10,607.5 (2.5)	10,670.0 to 10,672.5 (2.5)
	8	10,607.5 to 10,610.0 (2.5)	10,672.5 to 10,675.0 (2.5)
	* 9	10,610.0 to 10,612.5 (2.5)	10,675.0 to 10,677.5 (2.5)
	10	10,612.5 to 10,615.0 (2.5)	10,677.5 to 10,680.0 (2.5)
Ch. (Note 2)	19/20	10,585.0 to 10,590.0 (5.0)	10,650.0 to 10,655.0 (5.0)
	* 21/22	10,590.0 to 10,595.0 (5.0)	10,655.0 to 10,660.0 (5.0)
	* 23/24	10,595.0 to 10,600.0 (5.0)	10,660.0 to 10.665.0 (5.0)
Extended and limited	†Ch. 25	18,820.0 to 18,830.0 (10.0)	19,160.0 to 19,170.0 (10.0)
	† 26	18,830.0 to 18,840.0 (10.0)	19,170.0 to 19,180.0 (10.0)
	† 27	18,840.0 to 18,850.0 (10.0)	19,180.0 to 19,190.0 (10.0)
	† 28	18,850.0 to 18,860.0 (10.0)	19,190.0 to 19,200.0 (10.0)
	† 29	18,860.0 to 18,870.0 (10.0)	19,200.0 to 19,210.0 (10.0)
	Ch. 30	18,870.0 to 18,880.0 (10.0)	19,210.0 to 19,220.0 (10.0)
	31	18,880.0 to 18,890.0 (10.0)	19,220.0 to 19,230.0 (10.0)
	32	18,890.0 to 18,900.0 (10.0)	19,230.0 to 19,240.0 (10.0)
	33	18,900.0 to 18,910.0 (10.0)	19,240.0 to 19,250.0 (10.0)
	34	18,910.0 to 18,920.0 (10.0)	19,250.0 to 19,260.0 (10.0)
		Internodal	**Internodal**
Extended and limited	Ch. 11	10,550.0 to 10,552.5 (2.5)	10,615.0 to 10,617.5 (2.5)
	12	10,552.5 to 10,555.0 (2.5)	10,617.5 to 10,620.0 (2.5)
	13	10,555.0 to 10,557.5 (2.5)	10,620.0 to 10,622.5 (2.5)
	14	10,557.5 to 10,560.0 (2.5)	10,622.5 to 10,625.0 (2.5)
	15	10,560.0 to 10,561.25 (1.25)	10,625.0 to 10,626.25 (1.25)
	16	10,561.25 to 10,562.5 (1.25)	10,626.25 to 10,627.5 (1.25)
	17	10,562.5 to 10,563.75 (1.25)	10,627.5 to 10,628.75 (1.25)
	18	10,563.75 to 10,565.0 (1.25)	10,6628.75 to 10,630.0 (1.25)

* These channels are also allocated for private users in Part 94.189 of the rules.
† These channels are allocated for private users only in Part 94.189 of the rules.
1) All frequencies in MHz.
2) Channels 19-24 originally each had 2.5 MHz in each direction. At present, two channels of 2.5 MHz can be grouped together to make a single channel of 5 MHz. After April 16, 1986, the 5 MHz channels may be divided into two 2.5 MHz channels.

Figure 3: Attenuation due to rain



transmitter/receiver system is approximately $21,000. In a hot standby configuration it will be over $40,000.

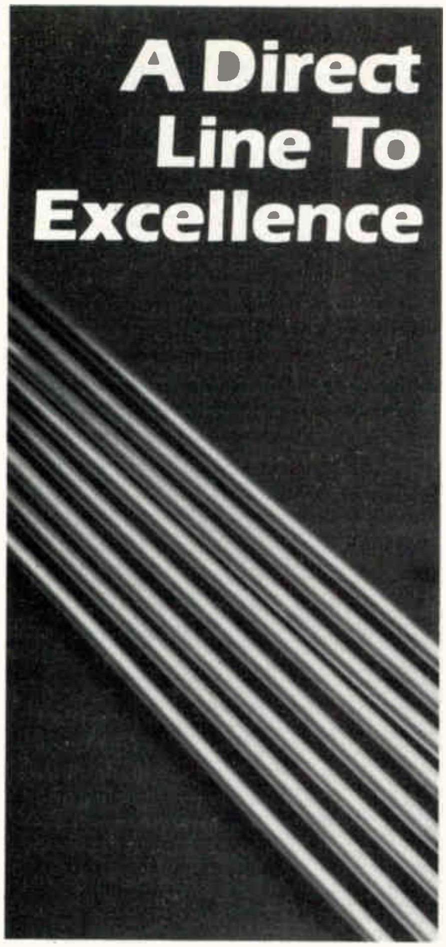
The M/A-COM equipment (Models 23DR and 23DR 12T) has transmission rates up to 12 T1 (18.5 MBPS) with a transmitter power of 18 dBm (66 mW). Modulation is frequency shift keying (FSK). M/A-COM claims operating distances up to 15 miles with a 99.99 percent reliability and an unfaded BER of 10^{-12}. A system with hot standby costs about $49,000.

The Digital Microwave Corp. 23 GHz equipment (Model DMC 23) has transmission rates up to 8 448 MBPS with a claimed range up to 10 miles. The system with a one T1 configuration is between $30,000 and $35,000.

Representative of the 18 GHz equipment is the Digital Microwave's Model DMC 18. It has transmission rates up to 28 T1 (45 MBPS) with a transmitter power of 23 dBm (200 mW). Modulation is minimum shift keying (MSK). In the past, noncoherent detection was commonly used with FSK modulation. Today, more and more interest is being shown in certain modified versions of FSK, particularly those with coherent detection. A major constraint on limiting the bandwidth of FSK systems is the abrupt phase change when shifting from one frequency to the other. The modified FSK techniques are based on the idea of continuous phase, often denoted by CP-FSK. MSK is a subset of CP-FSK. With a system gain exceeding 100 dB, the claim is for a reliable point-to-point range up to 15 miles. The system costs between $120,000 and $150,000 depending upon the configuration.

Digital termination service

An important part of local area digital

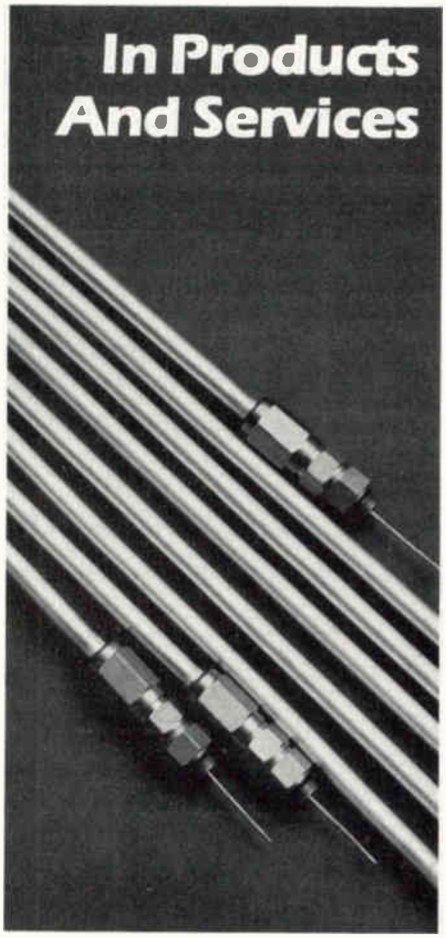


data microwave communications is the DTS service. The digital electronic message service (DEMS) is defined in the common carrier part of the FCC rules (Parts 21.500-21.512) as "two-way domestic end-to-end fixed radio service utilizing digital termination systems (DTS) for the exchange of digital information. In addition, this service may make use of point-to-point microwave facilities, satellite facilities or other communication media." Also, Part 94, Sections 181-199 of the rules permits licensing of DTS systems to private users. The digital termination systems are wideband microwave local loops.

DTS is a legacy of Xten, the wideband digital communications service proposed — and later dropped — by Xerox. In filing for the Xten service, Xerox asked the FCC to allocate space in little-used portions of the frequency spectrum for intra-city communications (10.55 to 10.68 GHz and 19.21-19.26 GHz). Xerox planned to use the new frequencies for a digital microwave radio link between rooftop antennas within a city, or between the rooftop antennas and a nearby satellite earth station. In January 1981, the FCC approved the request and, although Xerox withdrew, many other firms have subsequently filed to offer digital electronic message service based on the use of DTS local loops.

DTS systems can be configured in two fundamental ways: point-to-multipoint or point-to-point. If user requirements call for it, a system can combine both patterns, as seen in Figure 4.

The point-to-multipoint DTS is applicable when information is to be exchanged between a central point (local node) and several locations (subscribers), which are positioned within the coverage area of the local node. The local node station transmits and receives to and from all subscribers located in its area. Requirements for the exchange of information between two points in a geographically proximate area can be met with a point-to-point DTS system.



In its rulemaking, the FCC established two types of DTS networks: extended and limited. An extended network carrier must provide service in a minimum of 30 cities or standard metropolitan statistical areas (SMSAs). Limited network carriers can provide service in one city or as many as 29 SMSAs.

A 30-city base for an extended system indicates a large operation, while the limited service can be used in much more modest operations. Even some of the regional phone companies have filed for DTS operations to bypass their own current facilities, which have limited digital data transmission capabilities.

Each extended DTS network is allocated either two 5 MHz or two 10 MHz channels: one channel for transmission from the central station to subscribers and the other channel for use by the subscribers when sending information and data to the central station. The assigned channel width for each limited DTS network operator is either two 2.5 MHz, two 5 MHz or two 10 MHz channels: one channel for central-subscriber operations and the other channel for subscriber-central station operations.

In DTS common carrier operations only, four channels of 1.25 MHz and four channels of 2.5 MHz are available for internodal communications for both extended and limited operations. For DTS common carrier extended networks the FCC allocated 170 MHz for local distribution and 30 MHz for internodal links, and for limited networks the allocations are 160 and 30 MHz respectively, as shown in Table 5.

Presently there are several manufacturers of DTS equipment. M/A-COM and NEC are large suppliers. Both companies' equipment operate with the same data rates (to 2.1 MBPS). The NEC equipment uses quadrature phase shift keying (QPSK) modulation and the M/A-COM uses four-level FSK modulation. NEC claims a BER of 10^{-8} at 15.2 dB carrier-to-noise (C/N) ratio for central to subscriber path and 17.5 dB for the sub-

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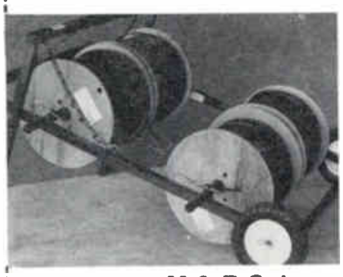

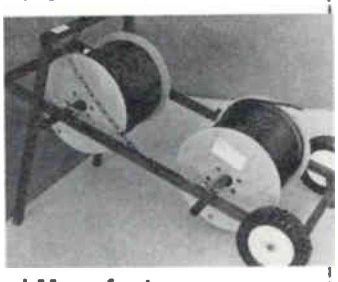

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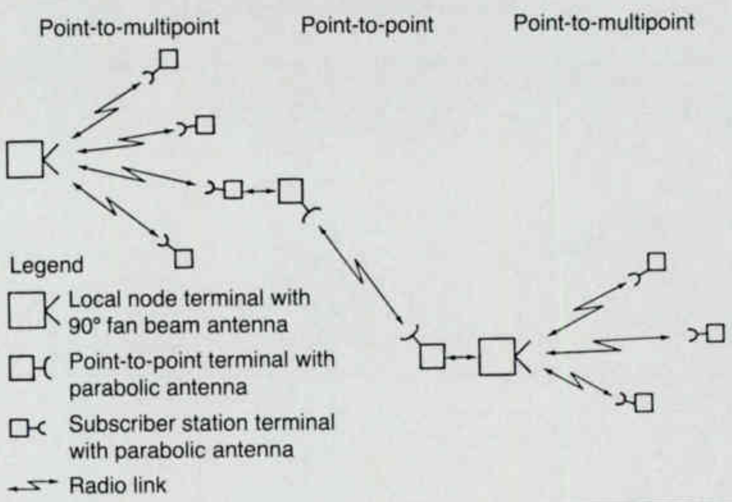
scriber to central path (16 dBm = 40 mW transmitter powers). M/A-COM claims a BER of 10^{-8} at C/N ratios of 22 dB for both paths (transmitter powers: central to sub 24 dBm = 250 mW and sub to central 19 dBm = 8 mW). Both companies claim about the same range capabilities; 6-12 miles point-to-multipoint and 15-20 miles point-to-point. Their costs are comparable, depending on configurations: about $50,000 for central to subscriber path (with hot standby) and about $20,000 for subscriber to central path (with hot standby).

Figure 4: DTS system configurations



Adequate availability

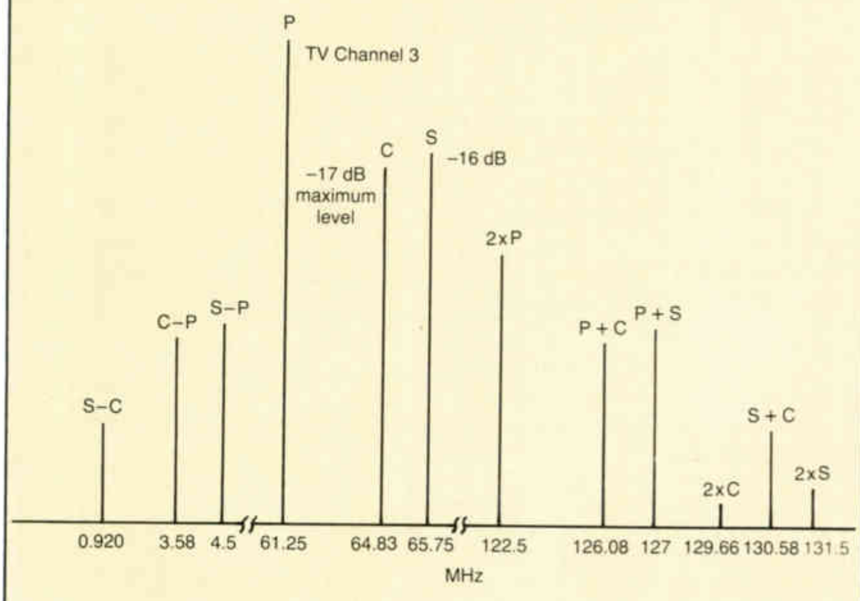
Of the 2 GHz to 40 GHz frequencies used for digital data transmission, the bands in the 2 to 11 GHz region are commonly used for medium to long hauls (e.g., relay towers are typically 20-30 miles apart), and the short hauls (e.g., intra-city) are more frequently in the 18 or 23 GHz bands. The DTS bands of 10 and 18 GHz are also in wide use for the short haul (particularly for telephone bypass). Although transmission efficiencies are possible at higher amounts, the typical transmission efficiency on the medium/long haul circuit is 3-4 bits/Hz. It is quite often as low as approximately 1 bit/Hz for the higher frequency short haul circuits. Although multipath fading may not be as significant a factor in the higher frequency/shorter haul systems, rainfall attenuation is much more important at these frequencies, and higher fade margins (to overcome rainfall) may be required to achieve the desired reliability. The higher fade margins are usually obtained by either increasing transmission powers or by decreasing path lengths where possible (e.g., relay path lengths).

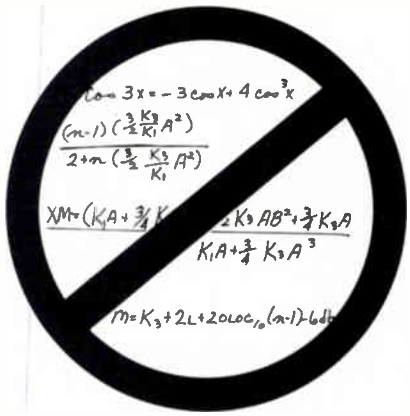
Frequency and equipment availability appears more than adequate to meet the near-term requirements for the anticipated explosion of short path, long path, networking, internetworking, telephone bypass and the myriad other types of microwave digital data transmission. ■

References

1. FCC Rules and Regulations.
2. *Reference Data For Radio Engineering*, Sixth Edition, Howard Sams & Co., ITT, 1977.
3. *Telecommunication Transmission Handbook*, Second Edition, Roger L. Freeman, John Wiley & Sons, Inc., 1981.

Figure 1: Second order intermodulation





Intermod distortion simplified

By Ray St. Louis
President, R.F. St. Louis Associates

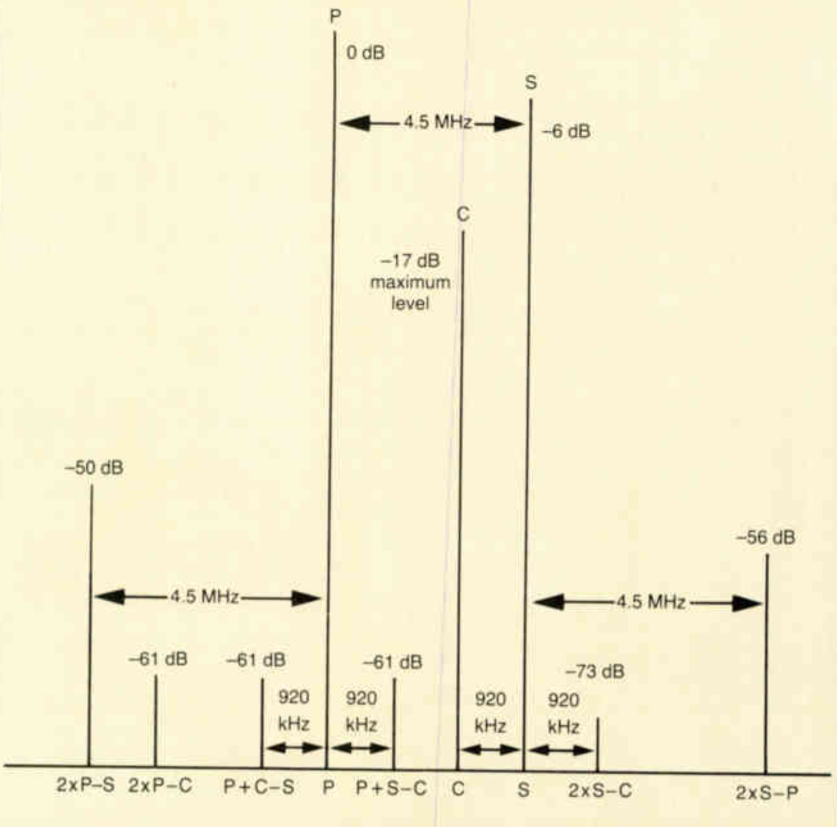
Don't let complex formulas scare you away from a clear understanding of Intermodulation (IM). Determining the frequencies where IM will fall is as easy as adding and subtracting the frequencies that are involved in generating it. Even the relative levels of the intermod beats can be determined by using the rules of IM behavior.

IM is not a phenomenon that suddenly appears at a certain operating level. This is the definition of *visible* IM distortion and the point where we become concerned with the interference that it causes to other signals. The fact is, IM is always present in any active (non-linear) device, even though it may not be measurable. An amplifier with an output capability of 50 dBmV for –60 dB third order IM has a capability of 0 dBmV for –160 dB third order intermod. Even with no input signal, IM between thermal noise will be present in the amplifier at a level of perhaps 400 dB below the thermal noise level.

Intermodulation also can be present in devices not usually thought of as active devices, such as multitaps and splitters that use ferrite transformers, or in corroded connectors and coax center conductors that contain a residue of the dielectric.

This is seldom seen, but can be a problem in an instance where a headend is de-

Figure 2: Third order intermodulation



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'Intermodulation also can be present in devices not usually thought of as active devices, such as multitaps'

livering 54 dBmV in the downstream path to a directional coupler headend combiner and is trying to receive return signals of 0 dBmV in the upstream path. If the IM generated in the combiner by the downstream signals (f_1-f_2) fell on the frequency of the upstream signal, and was 90 dB below the 54 dBmV downstream level, it would only be 36 dB below the upstream signal level.

Second and third order IM

In CATV we are basically concerned with second and third order IM because these are the first to be seen in the TV picture, usually before the higher order beats (such as fourth and fifth order) can even be measured on a spectrum analyzer.

Second order intermodulation (see Figure 1) is generated by:

1) Two times frequency #1 (called $2f_1$ or one tone second order IM, or more commonly, second harmonic). Behavior: One tone second order IM varies 2 dB for each 1 dB change in f_1 level.
2) Frequency #1 plus (or minus) frequency #2 (called $f_1 \pm f_2$ or two tone second order IM). Behavior: Beat varies 2 dB for each 1 dB change of both f_1 *and* f_2 and 1dB for each 1dB change in f_1 *or* f_2. With carriers of equal level, $f_1 \pm f_2$ will be 6 dB stronger than $2f_1$.

Examples of one and two tone second order IM are beats caused by low- and high-band falling in mid- and super-band and beats caused by mid- and super-band falling in low- and high-band.

Third order intermodulation (see Figure 2) is generated by:

1) Three times frequency #1 (called $3f_1$, one tone third order IM or third harmonic). Behavior: Varies 3 dB for each 1 dB change in f_1.
2) Two times frequency #1 ± frequency #2 (called $2f_1 \pm f_2$ or two tone third order IM). Behavior: Varies 3 dB for each 1 dB change of both f_1 and f_2; 2 dB per dB for change in f_1; and 1 dB per dB for change in f_2.

Examples of one and two tone third order IM are beat interference from lower adjacent sound and beats 4.5 MHz below picture and 4.5 MHz above sound in channel processor or modulator.

3) Frequency #1 ± frequency #2 ± frequency #3 (called $f_1 \pm f_2 \pm f_3$ or three tone third order IM, or commonly called in CATV, *triple beat*). Behavior: Varies 3 dB for each 1 dB change in all three carriers, 1 dB per dB change in any individual carrier.

Examples of three tone third order are triple beat in broadband distribution systems and 920 kHz beat in single TV channel devices. With carriers of equal level, $f_1 \pm f_2 \pm f_3$ will be 15.6 dB stronger than $3f_1$.

Cross-modulation (see Figure 3) is three tone third order intermodulation generated by frequency #1 ± frequency #2 ± frequency #3 ($f_1 \pm f_2 \pm f_3$), where f_1 and f_2 are carriers and f_3 is the modulation sidebands of these carriers. Since the sync modulation of the TV channel generates the strongest sidebands, sync cross-modulation is usually the first to be seen in the TV picture.

Cross-modulation will change 2 dB for each 1 dB change in both f_1 and f_2. f_3 is the modulation sidebands of f_1 or f_2 and can only be changed by changing the modulation level. Changing by 1 dB will reduce the cross-mod by 1 dB, but this would be ineffective because the modulation to interfering cross-modulation ratio would remain unchanged.

Intercept point

Intercept point (IP) is a term widely used to denote the intermodulation figure of merit of a device. It is the calculated


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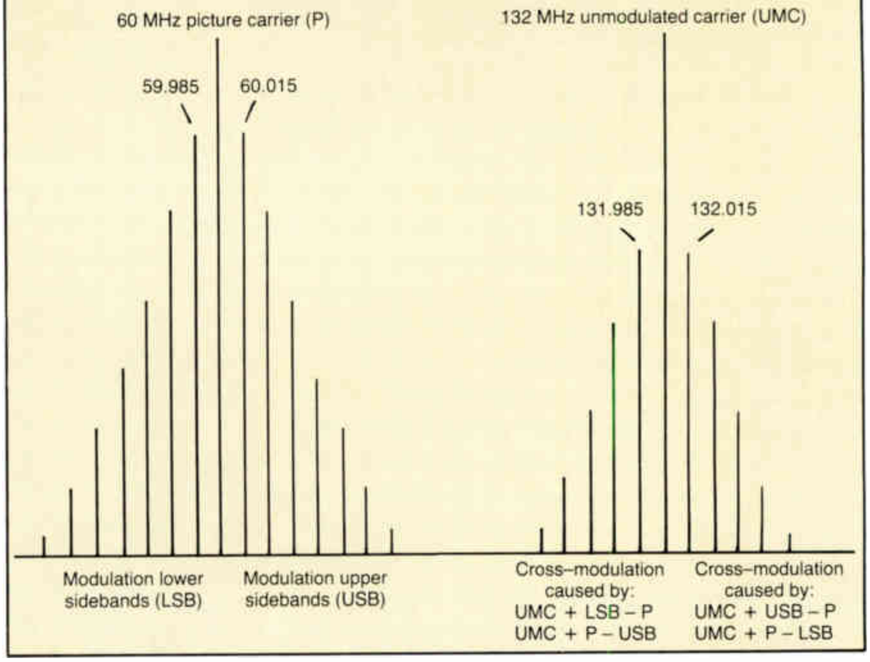
level at which the IM level equals (or intercepts) the level of the signal(s) that generated the IM. IP must be calculated as it cannot be measured, because gain compression occurs in the device under test before these levels become equal, and a change in dB in input level does not result in an equal change in dB in output level of the signals generating the IM. IP is calculated by measuring the IM performance of a device at a level well below the gain compression point and then scaling up to the IP by using the IM behavior rules.

In like manner, you can use these rules to scale the IP down to any desired signal level and any type of IM within the same order. As an example, let's say that you want to determine how much triple beat IM you have with 50 dBmV into a mixer that is specified to have a 20 dBm (68.75 dBmV) two tone third order input IP. The only rules we need are:

1) Two tone third order IM decreases 3 dB for each dB reduction in the level of the two tones.
2) Triple beat is 15.6 dB – 9.6 dB = 6 dB stronger than two tone third order IM.

	68.75 dBmV	two tone third order input IP
–	50.00 dBmV	input signal level
	18.75 dB	lower input signal than the IP spec resulting in a 3 x 18.75 dB decrease in IM = 56.25 dB lower IM than the 68.75 dBmV IP, or 12.5 dBmV IM level.

Figure 3: Cross-modulation



Remember, we must add 6 dB to the IM level, because triple beat is 6 dB stronger than two tone third order, which will give us a total of 18.5 dBmV IM, or referenced to the 50 dBmV input signal, 32.5 dB down.

This might appear to be very high. But if we were using the mixer for high level conversion of a single TV channel, our tones would be picture, color and sound. So we can reduce this 32.5 dB number by 16 dB if the sound carrier is down 16 dB, and by 17 dB because the color subcarrier only peaks as high as 17 dB below picture carrier. The new IM level will be a clean 65.5 dB down.

Ray St. Louis has spent 24 years in the cable industry and is president of R.F. St. Louis Associates, an Essex Fells, N.J., electronic design consulting firm serving the cable industry since 1978.

The answers are:

1) The beat is caused by 2 times color minus picture and would fall at a frequency 920 kHz below the 2 times sound minus picture beat.
2) 5 dB.
3) False, $f_1 + f_2 - f_3$ is 15.6 dB stronger than $3f_1$.
4) Lower adjacent sound beat is caused by 2 times channel picture minus lower adjacent channel sound. Reducing the lower adjacent sound carrier from its off-air level of 6 dB below picture to 16 dB below picture reduces the beat by 10 dB.
5) Using the –56 dB beat caused by 2 times sound minus picture as a reference, we know that the 2 times color minus picture in Question #1 will be weaker because the color subcarrier is 11 dB weaker than the sound carrier. Since the color subcarrier is the 2 times carrier, we know from the rules for third order IM that the IM will be reduced 2 dB for each 1 dB level reduction of this subcarrier. Thus the beat is 22 dB weaker than the –56 dB level, or –78 dB.
6) Using the highest IM level as a reference (2 times picture minus sound, –50 dBmV), we first want to determine the level of this beat if the picture and sound carriers that generated it were equal to each other in level. If we add 6 dB to the sound carrier to equalize it with the picture carrier the beat will increase to –44 dBmV. The behavior rules tell us that if we increase the picture and sound each by 1 dB the beat will increase 3 dB. To determine the IP, the point where the beat will be equal to the carriers that caused it, we would have to increase the carriers by 22 dB to a level of 22 dBmV. The beat would increase 66 dB to a level of 22 dBmV. This tells us that this amplifier has a two tone third order output IP of 22 dBmV.

Test your knowledge

Read this article again and try your skills at answering these questions:

1) Figure 2 is missing one 920 kHz beat that falls in the upper adjacent channel. What combination of signals causes this beat?
2) How many dB is the two tone third order beat caused by $2f_1 - f_2$ attenuated when the $2f_1$ frequency is attenuated 2.5 dB?
3) True or false: Three tone third order IM generated by $f_1 + f_2 - f_3$ is 9.6 dB stronger than the one tone third order IM generated by the third harmonic $3f_1$.
4) A beat in a TV channel caused by lower adjacent channel sound is caused by what combination of signals?
5) What is the relative level of the beat in Question #1?
6) Using a picture carrier of 0 dBmV, what is the two tone third order output intercept point of an amplifier with the output IM performance shown in Figure 2?

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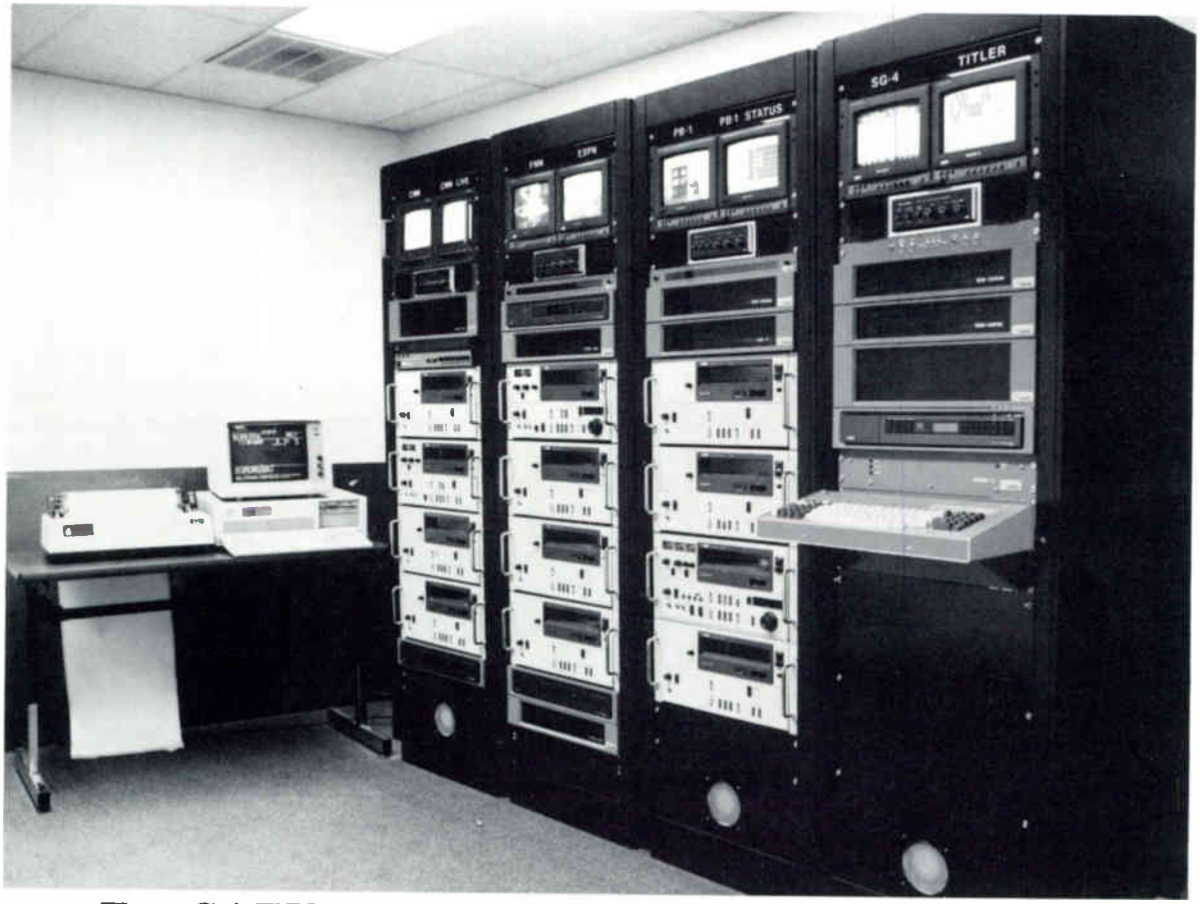

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Reader Service Number 54.

Test system expedites satellite network development

By Bill Davidson
Lead Engineer, Harris Satellite Communication Division

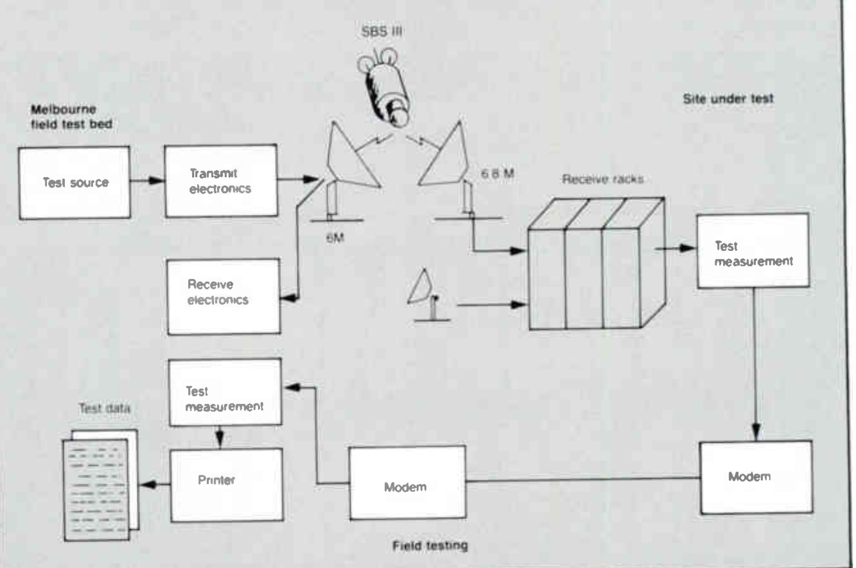
Major television networks are rushing to develop bypass distribution systems to reduce expense and to improve marginally adequate quality of present land line networks for video service. Satellite transmission appears to be a natural medium for these bypass networks. In addition to offering higher bandwidths, naturally widespread coverage and continually decreasing transmission costs as more specialized common carriers enter the marketplace, the flexibility of originating TV productions from both coasts and from mobile remotes is a major advantage.

To find a modern alternative to its present distribution system, NBC-TV selected Harris Corp.'s Satellite Communication Division to design a Ku-band satellite transmission network. Using existing Comsat facilities, the system will distribute all NBC-TV programming to network affiliates. Transponders on the Space Shuttle-launched SBS III satellite are to be used for widespread distribution of network TV programming.

Due to the new system's complexity and widespread coverage, system designers faced interesting problems in the development of a test system for initial acceptance testing and for regular maintenance. Transmission can originate from one of two master sites, New York City and Los Angeles, or from one of six portable remotes. Network control is centralized in New York. There are presently 170 receive-only network affiliates in the continental United States. NBC is rushing completion of the $100 million system for an obvious competitive advantage: The new Ku-band system, with its improved performance, could establish an industry standard for TV coverage if introduced quickly.

System evaluation and customer acceptance depended upon complete audio and video transmission testing of the satellite link and comprehensive data collection. Initial testing could be performed manually, but a quicker, automated test system was needed to keep costs down and maintain tight test schedules when field installation crews were sent out.

Figure 1: Basic system configuration



Instrumentation needs

Harris turned to various instrumentation suppliers for assistance in developing a custom, fully automated system to speed test procedures, and to provide centralized data collection and formatting for the volume of data that was expected. An important consideration was to find a supplier that could provide software support as well as a completely integrated hardware package.

Video equipment was required to test the satellite circuits per EIA RS250B video transmission standards with NBC and Satcomm supplying some of the specific test parameters. An audio source had to be found that could supply a +18 dBm, 1 kHz output with low residual distortion to accurately test peak audio program level distortion.

All instrumentation was to be remotely controllable from a Harris field test facility located in Melbourne, Fla. The two ends of the satellite link could be as much as 3,000 miles apart. And since most links would be set up as one-way, simplex transmission links, control of the testing would be a complex problem. In addition, both local and remote reporting of the test data were required. It also was necessary to have both a real-time graphics display of test information as well as a hard copy printout in a format specified by Harris.

Transportability was a must. All test equipment and its associated power supplies had to fit in a normal-sized van for transportation to the various field sites. There would be up to 10 field teams operating simultaneously to complete the system test.

Tektronix involvement

Discussions with Tektronix concerning test instrumentation began in the winter of 1982. The broad scope of the requirement for equipment drew across three Tektronix product lines: instruments, television and portable spectrum analyzers (RF). It indicated the necessity for a coordinated effort, which included software as well as hardware support. Tektronix was awarded the contract for instrumentation based on its ability to supply the total hardware package and provide suitable prewritten applications packages for the automated test routines.

Software modifications to customize existing Tektronix programs took several months. Phase 1 testing began in the fall of 1983 with 20 field sites. This testing proved the viability of the satellite link as well as the test equipment. After customer review of the data, Phase 2 testing began in the spring of 1984 to check the remaining 150 field sites and the six mobile TV remotes to be commissioned in Florida.

Transmission at Ku-band is affected more by precipitation than earlier C-band links. Preliminary measurements indicated that this outage was less than expected partially as a result of the large fade margins designed into the system and the ability to reroute transmission from the central network control.

System configuration

The system is basically a simplex audio and video transmission system (see Figure 1). A channel on one of the satellite's transponders is reserved for testing. Tests are initiated and controlled from Harris' field test facility, which excites the transponder channel with video and audio test signals. The signal is beamed to the SBS III satellite, which rebroadcasts it for general U.S. coverage. Each receiving site has four receivers to be tested.

A field test team travels to a remote receive station with the instrumentation van and when ready, calls the Melbourne facility over regular phone lines to schedule a test. This line is used for voice communications throughout the test session. Melbourne then calls back on another land line that is used for data transmission.

At the transmitting end a programmable audio oscillator continuously outputs a 1 kHz test tone that is used to confirm that the path is operational before starting any testing. A programmable video test set is used as an exciter for the video testing. At the receiving end of the satellite link, an audio analyzer measures the signal-to-noise ratio (S/N), frequency response and harmonic distortion. An automatic video measurement set is used to measure the RSB250B parameters. A spectrum analyzer is used for making the various carrier-to-noise density ratio (C/N) measurements.

Test sequencing is controlled by a standard instrumentation controller at each end of a link. During testing, the two controllers operate in a master/slave mode with the Melbourne end controller as the master. Controllers communicate in handshaking mode using 1,200-baud modems over the second dial-up land line. Audio and video test routines, resident in the slave controller PROMs, are initiated upon command from the master controller.

These routines are part of the large Tektronix library of packaged applications programs. Written in Tektronix 4041 BASIC, the programs are easily customized by end users. However, the software for the overall control of site tests from the master controller at Melbourne maintenance center had to be written specifically for this job. This was the first application of a two-controller master/slave, remote-controlled test/data collection application. A second test bed at Melbourne was used to develop the initial system, which then was turned over to manufacturing for other duties.

Video tests are performed first; the instrumentation is then manually patched over and the audio tests are performed. Data is sent back to Melbourne via a land line data link for display and printing. This configuration supports centralized data collection, yet enables local test technicians to view the results in real time. In the event data is lost or garbled in transmission, there is back-up available at the remote field site so the tests do not have to be rerun.

Instrumentation used

Figure 2 lists the instrumentation used at the transmit end at Melbourne and Figure 3 the receive end in the field test vans. All test equipment except the Tektronix Answer video measurement set uses the IEEE 488 general purpose interface bus (GPIB). The Answer set uses EIA RS232C ports to interface with the outside world. Digital control circuitry on all programmable test equipment permits remote setting and reading of front panel controls and indicators on all test equipment.

All instrumentation is controlled by a Tektronix 4041 system controller in each test bed. The 4041 contains three microprocessors, the CPU being the powerful 16-bit Motorola MC68000. The controller can be configured with from 32K bytes to 512K bytes of memory. A 20-character alphanumeric LED display, a DC100 cassette drive, and a 20-character thermal printer are provided for input/output requirements. Two IEEE 488 and two RS232 ports are also available, eliminating the need for extra interface units. Up to 14 GPIB instruments can be connected to each IEEE 488 bus. If mass storage is required, a mass storage interface and extra RS232 port are available.

There are two modes of operation, a program development mode and an operate-only mode. A detachable keyboard and set of program development ROM packs turns an operate-only controller into a development unit. In the operate-only mode, the programs are protected against accidental modification. Programmed front panel user prompts and 10 user-definable function keys simplify operation for operators of all skill levels.

The Tektronix SG 5010 signal generator and AA 5001 audio analyzer used for audio tests are products in the Tektronix TM 5000 Series of modular, programmable test equipment. These instruments feature high output power and low internal noise and distortion for performing audio frequency response and distortion measurements.

Video measurements are made using a Model 1980 Answer automatic video measurement set at the remote end of the link. This set is programmed for a wide range of video measurements and operates with a remote terminal over telephone lines, making it ideally suited for our application. Microprocessor-assisted controls and digital circuitry yield consistent measurements and high repeatability. Application programs are available for the 1980 to make most NTSC and PAL video broadcast measurements.

At the field site end, the video carrier and other signal components are displayed at RF on the Tektronix 492P fully programmable spectrum analyzer. This spectrum analyzer can be configured to cover the range from 50

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GENERAL INSTRUMENT

Reader Service Number 55.

Figure 2: Melbourne test facility equipment configuration

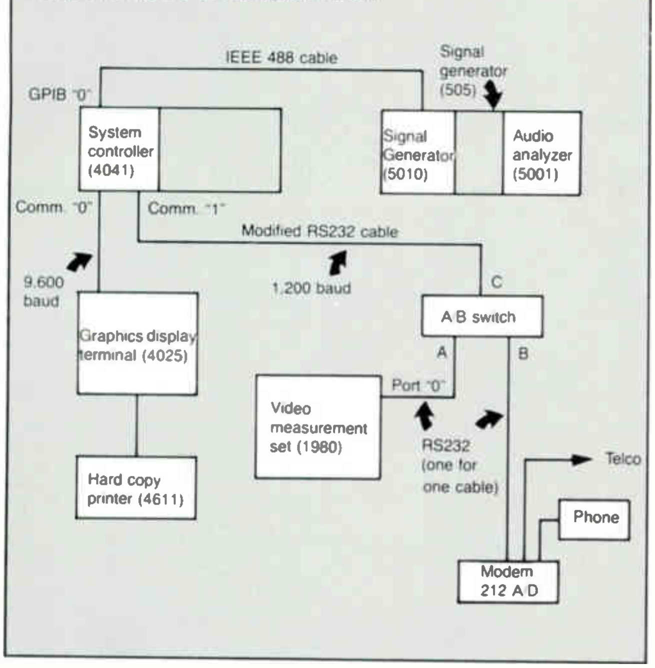
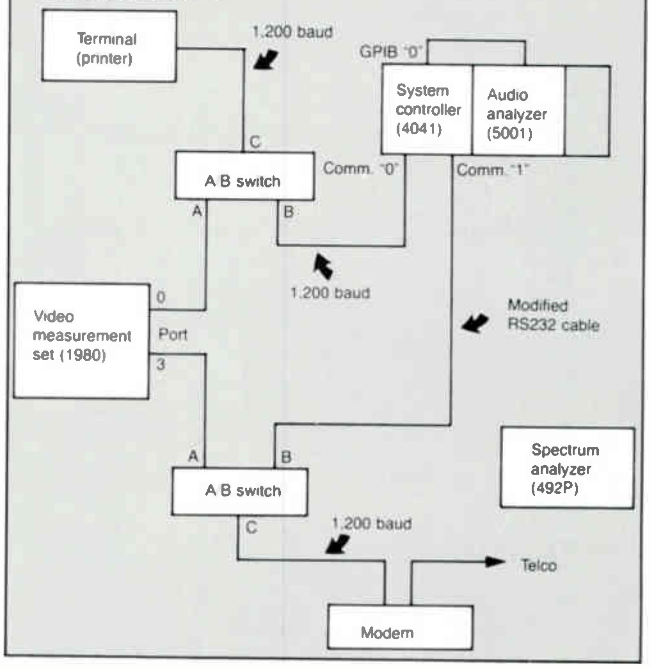


Figure 3: Field test equipment configuration



kHz up to 220 GHz. The 492P can be remotely configured over the IEEE 488 bus and instructed to send the digitized spectra in ASCII or binary format to a controller and/or recording device.

Formatted test results are displayed in Melbourne on a Tektronix 4025 graphics display terminal. This terminal is equipped with 16K memory to allow data buffering, scrolling and split-screen display. With its optional character set for forms ruling and plotting, easy-to-read, high-quality tabulated data forms are generated. Hard copy for official test results submission comes from a Tektronix 4611 hard copy printer at the field test facility.

Evaluation of test system

During Phase 1, the equipment performed all tests satisfactorily with no additional modifications or changes. Testing all four receivers at each site takes only two hours excluding travel and set up. This rapid test cycle allowed us to cut the number of field teams from 10 to five and still remain on schedule.

Local processing and printout of test data is a major benefit for the field team. If a path outage or system malfunction occurs, the team is immediately aware of it and can remain in place to perform corrective maintenance and rerun another test cycle. In fact, if the line printer malfunctions, a thermal printer built into each 4041 system controller can be used as back-up. The system produces easily interpreted documentation of test results to assist in the system sign-off required by NBC.

Customer benefits

A single supplier for all hardware and software greatly assisted in the implementation of the satellite test system. The unique application would not have been possible without the standardization throughout the product lines. An example is the use of the IEEE 488 GPIB and use of standard operating codes within the Extended BASIC instruction set, which facilitated program development, equipment interconnect and overall test control.

The number of tests to be performed, coupled with the number of field teams operating simultaneously and the large amount of data to be collected, made an automated system mandatory. Encoding the analog test data immediately at the receiving site permits local formatting, digital transmission, high accuracy and repeatable performance. Furthermore, the system is collectively small enough and rugged enough to be transported by van.

1,000-watt UPS

Nifepower 1000, a new on-line 1,000-watt uninterruptible power system (UPS) and AC power conditioner from SAB NIFE, has been designed to meet the functional and aesthetic needs of today's office environment. The Nifepower is 17 inches high, weighs 130 pounds, can be moved around easily, and plugs into a 120 VAC wall outlet, eliminating the need for special field wiring.

To ensure optimum protection of data and computer equipment in professional offices, UPS and power conditioning systems of 1,000 watts or larger are often required. Such systems were generally bulky, stationary and normally mounted in industrial-style racks.

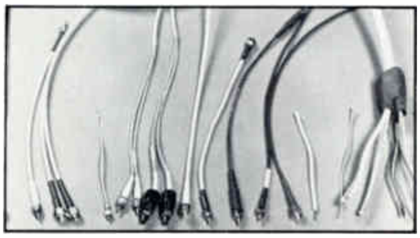
According to the company, this product does not buzz or hum excessively. The unit's transistorized inverter (DC-to-AC current converter) is said to provide exceptionally quiet, efficient and reliable operation.

For more information, contact SAB NIFE Inc., Dept. 837, P.O. Box 100, George Washington Hwy., Lincoln, R.I. 02865.

Channel tuner

Universal Security Instruments Inc. has announced the availability of its wireless remote-control TV/cable channel tuner, the Model V-7109. The product is a 109-channel tuner, including mid- and super-band cable channels, as well as standard UHF/VHF channels. It includes a full-function remote-control and remote-signal source switching from two different input sources. It is said to incorporate unlimited favorite channel memory and stereo MPX output.

For more information, contact Universal Security Instruments Inc., 10324 S. Dolfield Rd., Owings Mills, Md. 21117, (301) 363-3000.



Fiber-optic assemblies

Customized fiber-optic cable assemblies for short-distance data communications are now offered by S.I. Tech. The patch cord assemblies for use between instruments and patch panels or wiring closets range in length from 5 to 50 feet (3 to 10 m). They also can serve to extend too-short existing fiber-optic cable assemblies using couplers. According to the company, connectors on either end can be mixed or matched to make diverse equipment completely compatible.

Selection of components from a specification menu-guide provides several hundred tailor-made choices. Users can specify fiber core size; type of buffer, cable and connector; cable attenuation; manufacturer of cable and connector; and if needed, a breakout kit. Single-sourcing of fiber-optic cable assemblies is said to save users the time and effort associated with in-house component purchasing and assembly.

For more information, contact S.I. Tech, P.O. Box 609, Geneva, Ill. 60134, (312) 232-8640.

Model improvements

Progressive Electronics Inc. has announced two new improvements in its Model 501, an RF-type cable locator for tracing the path and finding the depth of cables, wires and pipes underground, as well as in walls, floors and ceilings. The 501 now includes a speaker in the receiver for listening to the tracking tone. With this addition, the headphones no longer are needed. The carrying case now contains molded compartments for each part of the product.

For more information, contact Progressive Electronics, Inc., 325 S. El Dorado, Mesa, Ariz. 85202, (602) 966-2931 or (800) 528-8224.

Fiber-optic systems

By Bradley Elkins
Project Manager, Fiber-Optic Systems
Times Fiber Communications Inc

Preventive maintenance (PM) is not a new term in the communications network business, whether the field is telco, CATV or data transmission. What *is* new is that PM has become a more crucial segment of the business as these networks become more sophisticated and load bearing.

Fiber, in particular, requires an intensified PM program because of the greater capacity that it carries today. The fiber systems of a few years ago, having bandwidths of several hundred megahertz, now are being replaced with systems capable of 1 gigahertz or more of usable bandwidth. Such increased-capacity systems actually have fewer maintenance points, yet they require more critical specifications for operation and maintenance.

Design and installation

Establishing the criteria for a PM program for a fiber network begins at the design stage. The margin built into the system must be known and must represent some percentage of the minimum operating parameters of the network. Economic selection studies usually define the comparison between components and the costs associated with the amount of margin. The manufacturers' specifications will dictate the expected life and degradation curve for the particular equipment being used.

Once the equipment is selected, the loss budgets are defined and the theoretical margin then is known. Next, the installation is critical since the objective is to achieve the design margin.

The installation plays a major role in the PM program because, in theory, the system should never perform better than the day it was installed. Accurate documentation at this stage is vital, including:

- List of test equipment/date of calibration.
- Optical power levels at all transmit and receive locations.
- Actual losses from fiber, splices and connectors. Optical time domain reflectometer (OTDR) display tapes should be given for each fiber.
- AC and DC voltages that supply all optical components, i.e., laser bias, cooler, shunt and diode, where accessible.
- Comparison of design to actual.
- RF and distortion levels at proof of performance.

The system should be completely documented to provide a comprehensive reference for its performance over time. The original record should be transcribed onto periodic maintenance forms that have spaces available for new entries.

'Establishing the criteria for a PM program... begins at the design stage'

Generally, a loose-leaf binder works nicely. This document should contain: a system description (block diagram), OTDR traces of each fiber, initial set-up levels, and periodic maintenance sheets specifying levels and voltages at each location.

Figure 1 is a sample of a broadband video network evaluation sheet. This sheet then would be modified for the periodic maintenance checks recommended by the manufacturer.

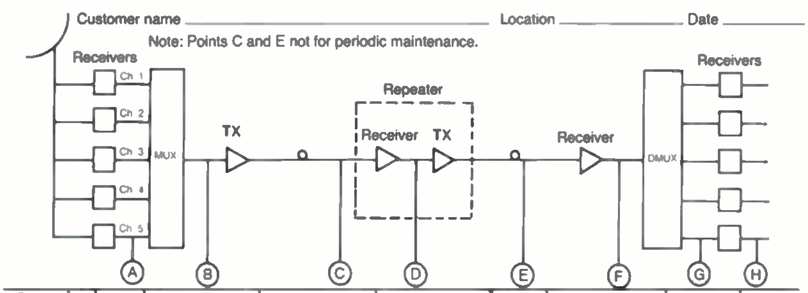
Typically, a system presents one or both of the following situations: Either it is impossible to conduct direct optical power measurements without degrading the system, or the system is on-line and would cause disruption of service to test the RF data. Therefore, DC power and RF measurements of the optical components are the only effective means of monitoring the system's condition. Once the system is turned on and operating, the risk of performance degradation is minimal and disruption of the optical path should be the last resort for PM program monitoring. Usually, disruption of the connectors causes some degradation or requires extensive alignment procedures. Performance degradation can occur because some of the mating interfaces are "contacting," fluid coupled or tuned.

Inexperienced observers like to "see the light" and therefore cycle the connectors in an optical system. *One should not disrupt the connection for this purpose.* It is a very dangerous practice that could result in retinal damage.

No mystique

Optical systems contain no mystique. They require monitoring, just as other networks do. The RF data and DC test points provide all the information required to properly maintain a system. New technologies, such as alarm circuits and remote monitoring, will make this task easier. But, while innovation may continually add services and "load" these high-bandwidth systems, it is important to remember that the corresponding PM program must be more intensive.

Figure 1: Sample evaluation sheet



Fiber no.		(A) RF level (dBm)	(B) RF level (dBm)	(C) Optical power (µW)	(D) Level-C N (dBm dB)	(E) Opt Pwr (µW)	(F) Level-C N (dBm dB)	(G) RF level (dBm)	(H) Level-S N (V dB)
Ch. 1									
Ch. 2									
Ch. 3									
Ch. 4									
Ch. 5									
			TX S/N ____ Pwr. ____ Bias ____ Clr. ____	Rcvr. S/N ____ AGC ____ HV ____ IAPD (test) ____ IAPD (oper.) ____	TX S/N ____ Pwr. ____ Bias ____ Clr. ____		Rcvr. S/N ____ AGC ____ HV ____ IAPD (test) ____ IAPD (oper.) ____		

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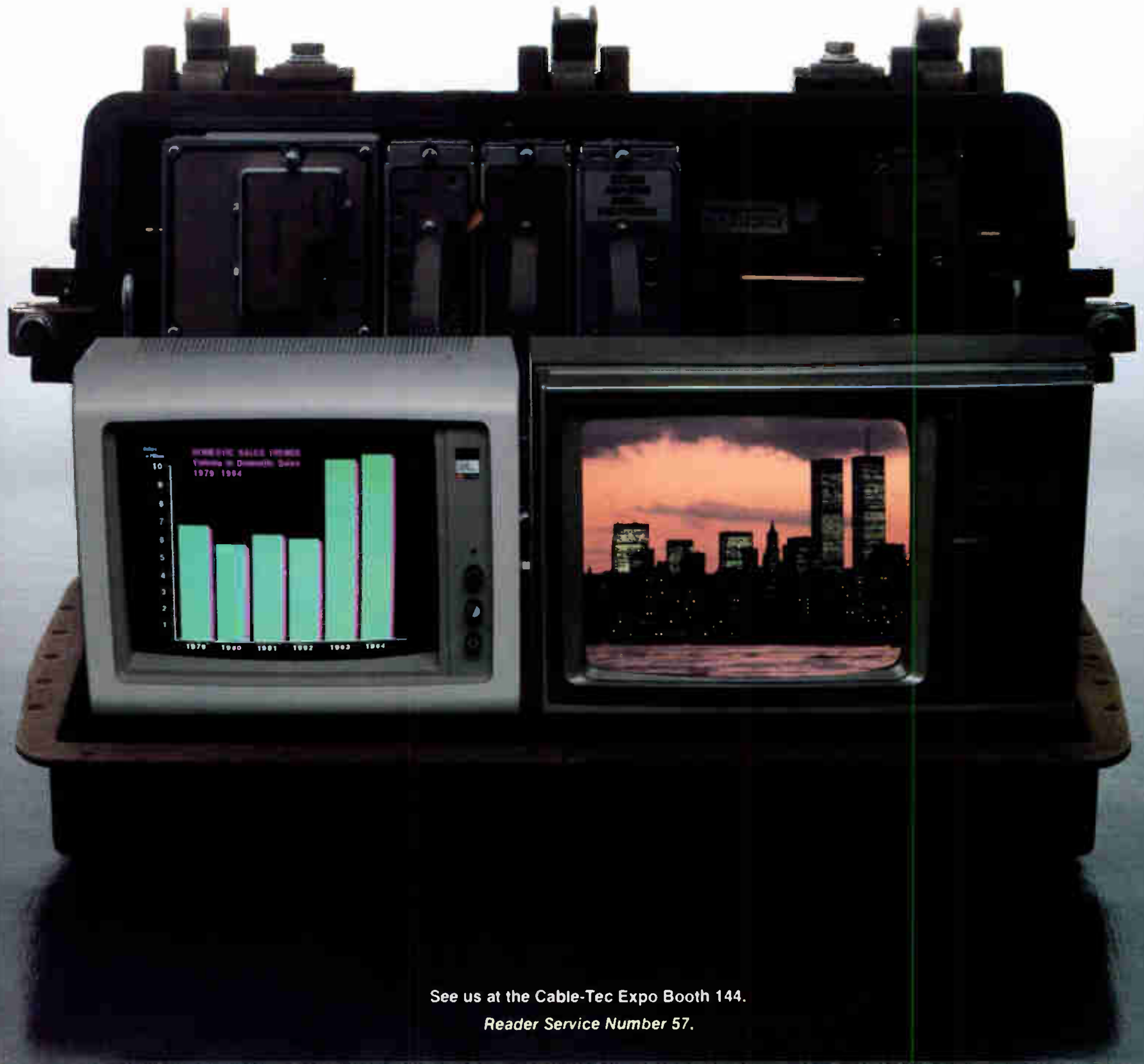

Fiber-optic splicing

This article focuses primarily on multi-mode optical fibers, since it is the predominant form used in LANs and cable television systems. Single-mode fiber has similar requirements but to a much more critical degree. The alignment tolerances are much finer because of the smaller core diameter of single-mode fiber.

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Fiber-optic communications is continuing to develop into a mature technology that is finding a valuable use in local area networks (LANs), cable TV and long-haul telephone systems. Beyond all of the detailed technical discussions looms the question of what type of splice to use for connecting two fibers together. The type and quality of fiber splices often has a great impact on the system cost.

Splices fall into three categories: fusion, mechanical and elastomeric. Fusion splicing uses an electrical arc to literally weld the two fibers together. Light is transmitted along a continuous run of fiber with only a slight discontinuity at the splice. Mechanical and elastomeric splicing each use a physical connector housing to butt the ends of the fiber together. While there is some discontinuity at the splice, index matching fluid is used to minimize the light loss.

The preparation

The first step to making an optical fiber splice is to break out the individual fibers from the cable bundle. While most LAN cables have only two fibers, there can be anywhere from six to over 100 fibers in a cable. Virtually half of a technician's time is spent breaking out the fibers.

After the individual fibers have been separated, the end of each fiber must be cleaned. This is commonly done with either acetone or alcohol. Alcohol is preferred from both safety and performance standpoints. In some fibers the dyes used to color code the fibers are dissolved by the acetone and get dragged across the glass fiber during the cleaning process. Alcohol does not dissolve the dyes and still provides as clean an end as acetone. One exception to this is gell-filled cables, which can require the use of acetone to remove the flooding compound.

To achieve the maximum transfer of light energy through the splice requires that the end faces of the fibers be very smooth and perpendicular to the axis of the fiber. This is accomplished by cleaving the fiber where the splice is to be made. In this step a cleaving tool is used to lightly drag a diamond tip across the fiber. The technician then snaps at the excess length of the fiber and it separates at the cleave, ideally leaving a smooth, perpendicular end face. For multi-mode or single-mode fibers, hand cleaving is quickest and with experience it can be as good as mechanical cleaving.

The steps up to this point simply have been the preparation of the fibers for splicing. An experienced technician should be able to break out and prepare two 48-fiber cables in only one to two hours. But properly preparing the fibers is as important as any of the other steps. After cleaning the fiber again we are now ready to perform the actual splicing of the fibers.

'The type and quality of fiber splices often has a great impact on the system cost'

The splicing process

As stated earlier, fusion splicing uses an electrical arc to heat the fiber ends and weld them together. Each fiber is first inserted into the fusion splicer and pre-fused at a low energy level. Pre-fusing warms the fiber and removes any moisture or particulate matter from the end of the fiber.

Pre-fusing should leave the end of the fiber smooth and flat and *not* rounded (as many of us were originally taught). Splices having less than 0.1 dB of loss can be consistently obtained by not rounding the fiber end. Finally, using a higher energy level, the fusion of the two fibers is made to complete the splice.

Fusion splicing is the most reliable and offers the greatest integrity of any type of splice. In fact, if one tries to break a fusion splice, it is more likely that the fiber itself will break before the splice does. It also offers the lowest loss of various splices. The major drawback of this method of splicing is that a fusion splicer is very expensive and not cost-effective to purchase if you have only a few splices to do.

A mechanical splice uses a solid plastic or metallic body to couple the fibers together. The coupling itself is spring loaded to maintain as small a distance as possible between the two fibers to minimize the splice loss. To further reduce the energy loss, an index matching fluid is placed into the coupling between the two fibers.

The cost of a mechanical splice varies anywhere from $70 to $350. Some require that the fiber ends be polished, while cleaving is satisfactory for others. An experienced technician may spend from 20 to 40 minutes polishing the fibers.

The last type of splice available is the elastomeric splice. This consists of memory plastic that surrounds and grips the fibers after they are inserted into the splice body. The index matching fluid used to reduce the splice loss produces a hydraulic effect that causes the fiber to draw out of the splice body. It is generally recommended only for emergency or temporary splices until a mechanical or fusion splice can be made.

By Ron Hranac and Bruce Catter
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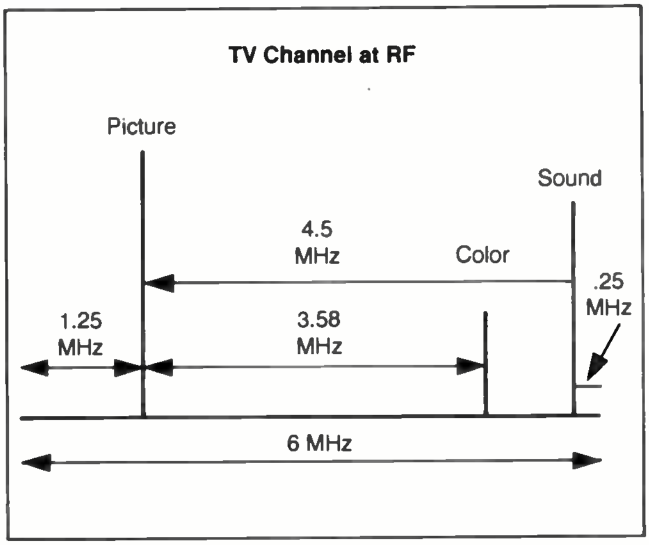
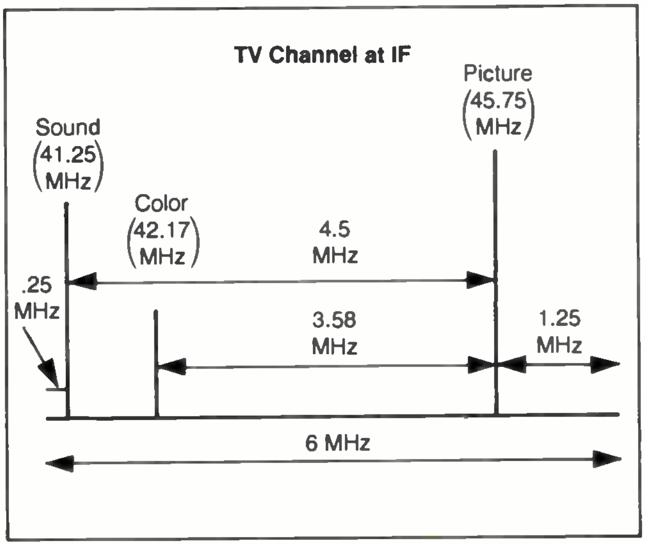
North American television channel frequencies





Off-air channels (MHz)

Channel no.	Channel boundaries	Picture	Color	Sound	Receiver/ processor local oscillator
	VHF television frequencies (low band)				
2	54-60	55.25	58.83	59.75	101
3	60-66	61.25	64.83	65.75	107
4	66-72	67.25	70.83	71.75	113
5	76-82	77.25	80.83	81.75	123
6	82-88	83.25	86.83	87.75	129
	(high band)				
7	174-180	175.25	178.83	179.75	221
8	180-186	181.25	184.83	185.75	227
9	186-192	187.25	190.83	191.75	233
10	192-198	193.25	196.83	197.75	239
11	198-204	199.25	202.83	203.75	245
12	204-210	205.25	208.83	209.75	251
13	210-216	211.25	214.83	215.75	257
	UHF television frequencies				
14	470-476	471.25	474.83	475.75	517
15	476-482	477.25	480.83	481.75	523
16	482-488	483.25	486.83	487.75	529
17	488-494	489.25	492.83	493.75	535
18	494-500	495.25	498.83	499.75	541
19	500-506	501.25	504.83	505.75	547
20	506-512	507.25	510.83	511.75	553
21	512-518	513.25	516.83	517.75	559
22	518-524	519.25	522.83	523.75	565
23	524-530	525.25	528.83	529.75	571
24	530-536	531.25	534.83	535.75	577
25	536-542	537.25	540.83	541.75	583
26	542-548	543.25	546.83	547.75	589
27	548-554	549.25	552.83	553.75	595
28	554-560	555.25	558.83	559.75	601
29	560-566	581.25	564.83	565.75	607
30	566-572	587.25	570.83	571.75	613
31	572-578	573.25	576.83	577.75	619
32	578-584	579.25	582.83	583.75	625
33	584-590	585.25	588.83	589.75	631
34	590-596	591.25	594.83	595.75	637
35	596-602	597.25	600.83	601.75	643
36	602-608	603.25	606.83	607.75	649
37	608-614	609.25	612.83	613.75	655
38	614-620	615.25	618.83	619.75	661
39	620-626	621.25	624.83	625.75	667
40	626-632	627.25	630.83	631.75	673
41	632-638	633.25	636.83	637.75	679
42	638-644	639.25	642.83	643.75	685
43	644-650	645.25	648.83	649.75	691
44	650-656	651.25	654.83	655.75	697
45	656-662	657.25	660.83	661.75	703
46	662-668	663.25	666.83	667.75	709
47	668-674	669.25	672.83	673.75	715
48	674-680	675.25	678.83	679.75	721
49	680-686	681.25	684.83	685.75	727
50	686-692	687.25	690.83	691.75	733
51	692-698	693.25	696.83	697.75	739
52	698-704	699.25	702.83	703.75	745
53	704-710	705.25	708.83	709.75	751
54	710-716	711.25	714.83	715.75	757
55	716-722	717.25	720.83	721.75	763
56	722-728	723.25	726.83	727.75	769
57	728-734	729.25	732.83	733.75	775
58	734-740	735.25	738.83	739.75	781
59	740-746	741.25	744.83	745.75	787
60	746-752	747.25	750.83	751.75	793
61	752-758	753.25	758.83	757.75	799
62	758-764	759.25	762.83	763.75	805
63	764-770	765.25	768.83	769.75	811
64	770-776	771.25	774.83	775.75	817
65	776-782	777.25	780.83	781.75	823
66	782-788	783.25	786.83	787.75	829
67	788-794	789.25	792.83	793.75	835
68	794-800	795.25	798.83	799.75	841
69	800-806	801.25	804.83	805.75	847
70	806-812	807.25	810.83	811.75	853
71	812-818	813.25	816.83	817.75	859
72	818-824	819.25	822.83	823.75	885
73	824-830	825.25	828.83	829.75	871
74	830-836	831.25	834.83	835.75	877
75	836-842	837.25	840.83	841.75	883
76	842-848	843.25	846.83	847.75	889
77	848-854	849.25	852.83	853.75	895
78	854-860	855.25	858.83	859.75	901
79	860-866	861.25	864.83	865.75	907
80	866-872	867.25	870.83	871.75	913
81	872-878	873.25	876.83	877.75	919
82	878-884	879.25	882.83	883.75	925
83	884-890	885.25	888.83	889.75	931

CATV channels (MHz)

Std. channel no.	EIA/NCTA channel no. (IS-6)	Standard			HRC			IRC		
		Picture	Color	Sound	Picture	Color	Sound	Picture	Color	Sound
T-7		7	10.58	11.5						
T-8		13	16.58	17.5						
T-9		19	22.58	23.5						
T-10		25	28.58	29.5						
T-11		31	34.58	35.5						
T-12		37	40.58	41.5						
T-13		43	46.58	47.5						
2	2	55.25	58.83	59.75	54	57.58	58.5	55.25	58.83	59.75
3	3	61.25	64.83	65.75	60	63.58	64.5	61.25	64.83	65.75
4	4	67.25	70.83	71.75	66	69.58	70.5	67.25	70.83	71.75
A-8	1	—	—	—	72	75.58	76.5	73.25	76.83	77.75
5*	5	77.25	80.83	81.75	78	81.58	82.5	79.25	82.83	83.75
6*	6	83.25	86.83	87.75	84	87.58	86.5	85.25	88.83	89.75
A-5	95	91.25	94.83	95.75	90	93.58	94.5	91.25	94.83	95.75
A-4	96	97.25	100.83	101.75	96	99.58	100.5	97.25	100.83	101.75
A-3	97	103.25	106.83	107.75	102	105.58	106.5	103.25	106.83	107.75
A-2	98	109.25	112.83	113.75	108	111.58	112.5	109.25	112.83	113.75
A-1	99	115.25	118.83	119.75	114	117.58	118.5	115.25	118.83	119.75
A	14	121.25	124.83	125.75	120	123.58	124.5	121.25	124.83	125.75
B	15	127.25	130.83	131.75	126	129.58	130.5	127.25	130.83	131.75
C	16	133.25	136.83	137.75	132	135.58	136.5	133.25	136.83	137.75
D	17	139.25	142.83	143.75	138	141.58	142.5	139.25	142.83	143.75
E	18	145.25	148.83	149.75	144	147.58	148.5	145.25	148.83	149.75
F	19	151.25	154.83	155.75	150	153.58	154.5	151.25	154.83	155.75
G	20	157.25	180.83	161.75	156	159.58	160.5	157.25	160.83	161.75
H	21	163.25	166.83	167.75	162	165.58	166.5	163.25	186.83	167.75
I	22	169.25	172.83	173.75	166	171.58	172.5	169.25	172.83	173.75
7	7	175.25	178.83	179.75	174	177.58	178.5	175.25	178.83	179.75
8	8	181.25	184.83	185.75	180	183.58	184.5	181.25	184.83	185.75
9	9	187.25	190.83	191.75	186	189.58	190.5	187.25	190.83	191.75
10	10	193.25	196.83	197.75	192	195.58	196.5	193.25	196.83	197.75
11	11	199.25	202.83	203.75	198	201.58	202.5	199.25	202.83	203.75
12	12	205.25	208.83	209.75	204	207.58	208.5	205.25	208.83	209.75
13	13	211.25	214.83	215.75	210	213.58	214.5	211.25	214.83	215.75
J	23	217.25	220.83	221.75	216	219.58	220.5	217.25	220.83	221.75
K	24	223.25	226.83	227.75	222	225.58	226.5	223.25	226.83	227.75
L	25	229.25	232.83	233.75	228	231.58	232.5	229.25	232.83	233.75
M	26	235.25	238.83	239.75	234	237.58	238.5	235.25	238.83	239.75
N	27	241.25	244.83	245.75	240	243.58	244.5	241.25	244.83	245.75
O	28	247.25	250.83	251.75	246	249.58	250.5	247.25	250.83	251.75
P	29	253.25	256.83	257.75	252	255.58	256.5	253.25	256.83	257.75
Q	30	259.25	262.83	263.75	258	261.58	262.5	259.25	262.83	263.75
R	31	265.25	268.83	269.75	264	267.58	268.5	265.25	268.83	269.75
S	32	271.25	274.83	275.75	270	273.58	274.5	271.25	274.83	275.75
T	33	277.25	280.83	281.75	276	279.58	280.5	277.25	280.83	281.75
U	34	283.25	286.83	287.75	282	285.58	286.5	283.25	286.83	287.75
V	35	289.25	292.83	293.75	288	291.58	292.5	289.25	292.83	293.75
W	36	295.25	298.83	299.75	294	297.58	298.5	295.25	298.83	299.75
AA	37	301.25	304.83	305.75	300	303.58	304.5	301.25	304.83	305.75
BB	38	307.25	310.83	311.75	306	309.58	310.5	307.25	310.83	311.75
CC	39	313.25	316.83	317.75	312	315.58	316.5	313.25	316.83	317.75
DD	40	319.25	322.83	323.75	318	321.58	322.5	319.25	322.83	323.75
EE	41	325.25	328.83	329.75	324	327.58	328.5	325.25	328.83	329.75
FF	42	331.25	334.83	335.75	330	333.58	334.5	331.25	334.83	335.75
GG	43	337.25	340.83	341.75	336	339.58	340.5	337.25	340.83	341.75
HH	44	343.25	346.83	347.75	342	345.58	346.5	343.25	346.83	347.75
II	45	349.25	352.83	353.75	348	351.58	352.5	349.25	352.83	353.75
JJ	46	355.25	358.83	359.75	354	357.58	358.5	355.25	358.83	359.75
KK	47	361.25	364.83	365.75	360	363.58	364.5	361.25	364.83	365.75
LL	48	367.25	370.83	371.75	366	369.58	370.5	367.25	370.83	371.75
MM	49	373.25	376.83	377.75	372	375.58	376.5	373.25	376.83	377.75
NN	50	379.25	382.83	383.75	378	381.58	382.5	379.25	382.83	383.75
OO	51	385.25	388.83	389.75	384	387.58	388.5	385.25	388.83	389.75
PP	52	391.25	394.83	395.75	390	393.58	394.5	391.25	394.83	395.75
QQ	53	397.25	400.83	401.75	396	399.58	400.5	397.25	400.83	401.75
RR	54	403.25	406.83	407.75	402	405.58	406.5	403.25	406.83	407.75
SS	55	409.25	412.83	413.75	408	411.58	412.5	409.25	412.83	413.75
TT	56	415.25	418.83	419.75	414	417.58	418.5	415.25	418.83	419.75
UU	57	421.25	424.83	425.75	420	423.58	424.5	421.25	424.83	425.75
VV	58	427.25	430.83	431.75	426	429.58	430.5	427.25	430.83	431.75
WW	59	433.25	436.83	437.75	432	435.58	436.5	433.25	436.83	437.75
XX	60	439.25	442.83	443.75	438	441.58	442.5	439.25	442.83	443.75
YY	61	445.25	448.83	449.75	444	447.58	448.5	445.25	448.83	449.75
ZZ	62	451.25	454.83	455.75	450	453.58	454.5	451.25	454.83	455.75
	63	457.25	460.83	461.75	456	459.58	460.5	457.25	460.83	461.75
	64	463.25	466.83	467.75	462	465.58	466.5	463.25	466.83	467.75
	65	469.25	472.83	473.75	468	471.58	472.5	469.25	472.83	473.75
	66	475.25	478.83	479.75	474	477.58	478.5	475.25	478.83	479.75
	67	481.25	484.83	485.75	460	483.58	484.5	481.25	484.83	485.75
	66	487.25	490.83	491.75	486	489.58	490.5	487.25	490.83	491.75
	69	493.25	496.83	497.75	492	495.58	496.5	493.25	496.83	497.75
	70	499.25	502.83	503.75	498	501.58	502.5	499.25	502.83	503.75

*Channel 5 and Channel 6 (HRC/IRC only) also are referred to as A-7 and A-6 respectively.

Measuring scrambled signals

By Marcus Stewart
Technical Writer, Wavetek Indiana Inc.

Today many premium channels use signal scrambling to help deter piracy. Scrambling rearranges the structure of a modulated waveform to prevent reception by unpaying customers. Without special detection circuitry, the incoming scrambled signal cannot be displayed. This rearrangement of the video modulated carrier can create problems for the service technician using a signal level meter to measure the scrambled signal. These problems may be more than just an inaccuracy in level measurement. Fluctuations in meter movement may be drastic enough to render a measurement impossible.

There are several methods of scrambling practiced in the industry. Horizontal and vertical sync suppression are common methods that directly affect the accuracy of a signal level measurement. In a typical unscrambled signal (Figure 1) the peak carrier amplitude is the top of the horizontal and vertical sync tip pulses. These sync pulses are detected, converted to an average DC level and displayed on the meter.

Horizontal sync suppression (Figure 2) hides the horizontal sync pulses by attenuating the video signal during the time interval of the pulse. Descrambling is accomplished by turning on an amplifier in the set-top converter during the sync pulse interval. For proper descrambler operation, a timing reference must be provided to the converter. Amplitude modulating the audio subcarrier with this timing reference is common in the industry.

Some scrambling systems incorporate both horizontal and vertical sync suppression. In this mode there are no horizontal or vertical sync tips to be recognized by the meter. The video picture information will be the peak of the AM envelope and will vary in amplitude depending on the presence of white or black information being present (black being maximum level and white, minimum level).

Figure 1: Unscrambled signal

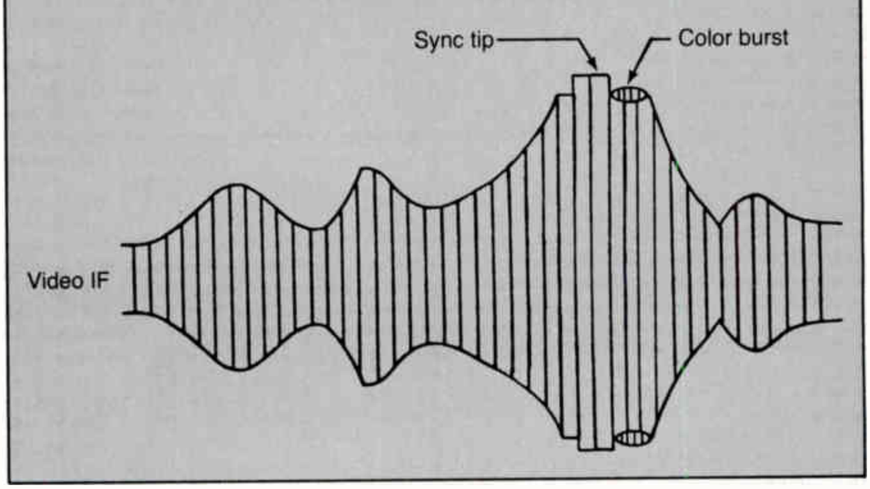
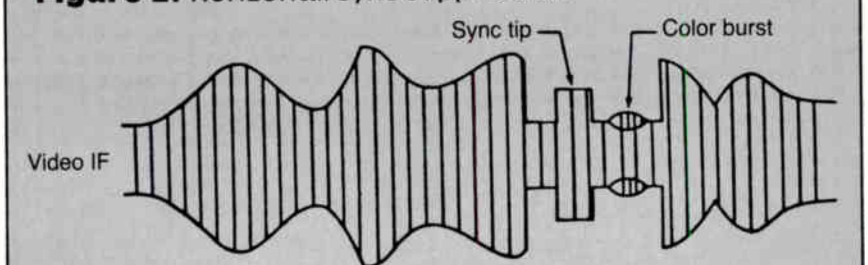


Figure 2: Horizontal sync suppression



The signal level meter

Signal level meters (SLMs) are essential tools for every cable technician. In order to better understand how scrambled signals are measured, the basic principle of how the SLM detects and displays incoming signal levels should be considered. The meter uses a peak detector to detect the incoming signal. Detector specifications are an important consideration when comparing the accuracy of various meters. Not all detectors have the same parameters. In Figure 3, during the positive half cycle the diode is forward biased, connecting the source directly across the capacitor and allowing it to charge to the amplitude of the input signal (minus the forward diode drop of approximately .7 volts).

As the input drops in amplitude, the diode turns off, allowing the capacitor to discharge through the meter load resistance. The effect of the capacitor charging and discharging creates a DC ripple voltage that is supplied to the meter deflection circuitry (Figure 4). The meter itself is set up to display the average DC level of this ripple voltage. The ripple factor is therefore proportional to the RC time constant of the RF detector.

The shorter the time constant the greater the ripple and, likewise, the longer the time constant the lower the ripple. Changes in peak amplitude of the input will be detected and cause the average DC voltage to change the meter deflection. The amount of time it takes the meter to change is determined by the RC time constant of the detector. Remember that horizontal sync suppression is accomplished by attenuating the horizontal pulses to a much lower level than the video information. The detector recognizes this decrease in peak input level and generates a relative decrease in voltage to the meter. Since the RC time constant is relatively short in most meters, the meter will fluctuate randomly with the other components of the modulated signal. Thus, it will be difficult to arrive at a truly accurate measurement. It is easy to see that detectors with a very short time constant will have a greater ripple factor and will be less accurate when measuring scrambled signals.

Detecting scrambled signals

To remedy this inaccuracy, SLMs that incorporate a peak detector containing an

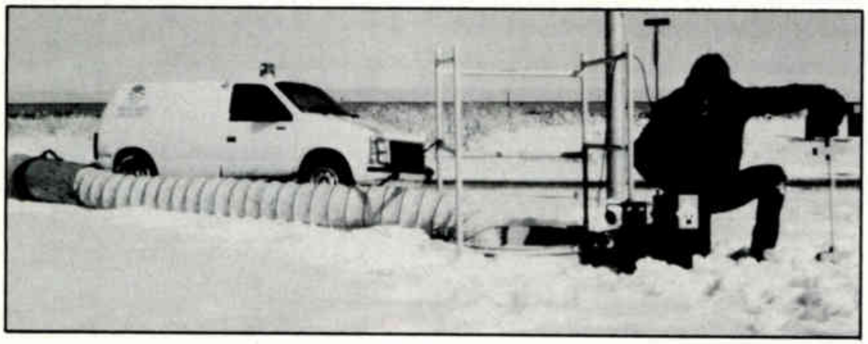


Figure 3: Peak detector

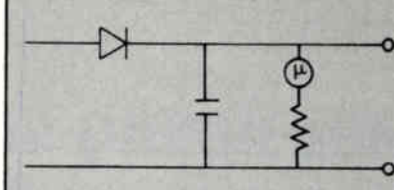
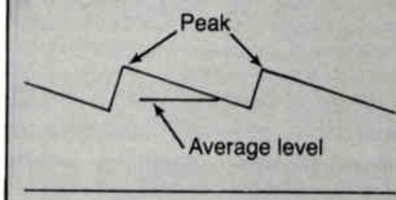


Figure 4: DC ripple voltage



Op-Amp buffer between the detector capacitor and the meter load can be used. The Op-Amp has a high characteristic input impedance that creates a very long discharge time of the capacitor. This increases the RC time constant of the detector. Additionally, the method of feedback designed into the Op-Amp results in a much more stable meter deflection. Although the horizontal sync pulse is attenuated, this detector can recognize the peak of the vertical sync tips.

Because the capacitor discharges at a much slower rate, the average DC meter deflection voltage will not drastically decrease between vertical sync pulses. When measuring signals that suppress both the horizontal and vertical sync, this type detector will respond to *relative* changes in the video information. The meter changes with this detector are quite small, compared to drastic fluctuations in standard SLMs. The operator can make relative comparisons between the scrambled signal and an adjacent channel that is not scrambled, or the suppression momentarily can be stopped long enough to achieve an accurate comparison.

One of the first indications of major system malfunctions — other than numerous phone calls from irate customers — are drastic changes in signal levels at various test points throughout the cable network. If the meter is responding only to relative changes in video information, an absolute level is not always obtainable. In this case, reading actual level in dBmV is unattainable and the necessity of the meter to consistently deliver constant readings is of prime importance. Accuracy can be achieved by reducing drastic fluctuations in meter movement and providing a stable reference for measuring scrambled signals. ■

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Reader Service Number 60.

Donley International, a Houston-based distributor of commercial and home satellite equipment, has announced the appointment of **J. D. Thomas** as president. Thomas has been vice president of Donley for the past several years.

Also, **Vic Castro** has joined Donley's sales staff. Most recently he has focused on developing Caribbean, Mexican and Central American accounts. Castro was formerly with Cable TV Supply. Contact: 7720 Blankenship, Houston, Texas 77055, (713) 956-2984.

Dr. Peter Clark has been appointed vice president and general manager of **TRW Microwave.** Clark joined TRW in 1977 as the director of the systems group research staff in Redondo Beach, Calif. His most recent assignment was manager of the electronics and technology operations for the Military Electronics Division. Prior to joining TRW, he held research management positions with Hughes Aircraft and the Defense Advanced Research Projects Agency. Contact: 825 Stewart Dr., Sunnyvale, Calif. 94086, (408) 732-0880.

Tele-Wire Supply Corp. has announced the addition of **Tom Pearman** to its Iron Mountain, Mich. warehouse location, and **Jim Bell** to its Sarasota, Fla., location. Pearman comes from Klugness Electronic Supply, and Bell from Cable TV Supply, where he worked as a senior account executive. Contact: 701B Stephenson Ave., Iron Mountain, Mich. 49801, (906) 774-4111; and Garden Industrial Park, Porter Rd., Bldg. #1, Sarasota, Fla. 33532, (813) 371-3447.

Hightower

Robert Hightower has joined **LeCroy Corp.** as product manager. He will be responsible for a new line of instruments to be announced at a later date. Hightower's 10 years at Tektronix were spent in marketing. His background also includes positions with John Fluke Manufacturing Co., Wavetek and Summation Inc. Contact: 700 S. Main St., Spring Valley, N.Y. 10977, (914) 578-6084.

Scientific-Atlanta Inc. has appointed **George Bell** general manager of the Digital Video Systems Division (DVS) in Toronto. Bell comes from M/A-COM where he was vice president, sales and marketing, for the Cable Home Group. Prior to joining M/A-COM in 1980, he held various engineering and marketing positions at Microdyne and Pan American Airways.

Also at Scientific-Atlanta, **John Buckett** has been appointed to the position of national sales manager for the company's Broadband Communications Division. Buckett has been with S-A for more than four years as account manager in the company's Washington, D.C., office.

Contact: 1 Technology Parkway, Box 105600, Atlanta, Ga. 30348, (404) 441-4000.

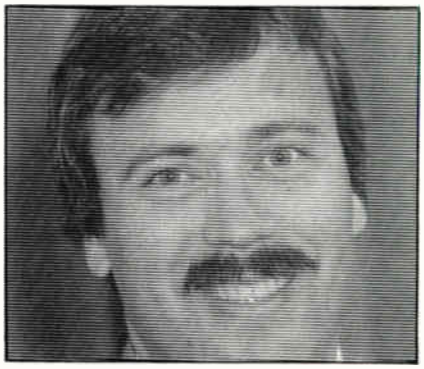
Avtec Industries has appointed **John Stefanick** service manager for field and in-house maintenance and repair. Stefanick was most recently with Group W Satellite Communications in Stamford, Conn., where his duties included the upkeep of the company's technical plant. Contact: 5 Audrey Pl., Fairfield, N.J. 07006, (201) 882-0890.

R. Alan Communications Inc. has promoted **Tim Meschke** to district salesman. His territory will include Illinois, Kentucky, Kansas and Missouri, coordinating all representative and distribution sales in these areas. He began at R. Alan in May 1985. Contact: 8120 Knue Rd., Suite 106, Indianapolis, Ind. 46250, (317) 849-7572.

Texscan Corp. has announced the appointment of **Thomas Zimmerman** as director of software engineering for its Salt Lake City division. Zimmerman will be responsible for the software development and maintenance of commercial insertion and character generator products. Prior to this, he served as engineering manager for Comtel MSI in 1980 when Texscan acquired MSI and has served the Salt Lake division in various positions in the past. Contact: 3855 S. 500 West, Suite S, Salt Lake City, Utah 84115, (801) 262-8475.

Amplifier power packs and circuit protection

By Fred Rogers
President, Quality RF Services Inc.



Power pack efficiency and system reliability may be 1986's best bottom-line investment for cable. Power pack efficiency reduces electrical bills or allows improved technologies such as power doubling, parallel hybrids and feedforward to be added without additional power demands.

At least three manufacturers plan to offer 85 to 90 percent efficient, highly reliable, transformerless power packs for reduced system power consumption in existing amplifiers.

The power efficiency is accomplished with newly designed electronics that will retrofit or replace existing power packs. Coupled with now standard circuit protection devices, total system downtime also can be drastically reduced. Less system downtime means less overtime, less equipment wear and tear, and higher customer satisfaction, resulting in more bottom-line profits.

Circuit protective devices

"There are three different types of circuit protective devices plus fuses which can be used for different applications. These devices can absorb, without damage, thousands of times the transient surges (voltage and current) that signal transistors or diodes can. Such devices are beginning to be used widely in most modern electronic equipment. With a good, comprehensive understanding of these devices, older equipment can be modified to incorporate more protection."[1] These devices and fuses are shown in Table 1.

"The gas discharge device is used widely on cable signal lines. In its static condition it displays almost infinite resistance and low capacity. When it fires (arcs) due to over voltage it displays very low resistance and can carry several hundreds of amperes of current over a short period of time. It is a crowbar-type circuit protection device going to a near short circuit, as long as enough current is available. Its main shortcomings are that it takes over 1 microsecond for it to arc and, after it fires, it can become so hot that it will not release when used on low impedance power supply lines such as line powered amplifiers. This effect is sometimes referred to as 'follow on current.'"[1]

Although gas tubes (gas-filled surge voltage protectors) have been used in cable systems for years, the improved ruggedness of modern-day hybrid amplifiers and DC power packs may have made obsolete the need for them. If a system has customer outages due to shorted gas tubes, one possible solution would be heavier duty parts, for example the Siemens A71-A150.[3] The A71-A150 replaces the BG145L and BC145 while offering twice the surge current capability (10 kA) and 50 amp peak AC follow current at 60 volts RMS (root mean square).[2] Field experience has indicated a minimum of 90 percent reduction in shorted gas tubes when using the A71-A150.

"The avalanche surge zener (transzorb) has a sharp clamp knee. Its internal design is somewhat different than conventional zener diodes and a larger device (e.g., 50 watt) is put in a smaller package (e.g., 5 watt size). For short periods of time, these devices can handle large surges of power. For instance, a 5 watt unit can handle 1,200 watt peaks for 1 millisecond. Its failure mode, due to overdissipation, is to internally weld to a short condition. This is a good failure mode during transient conditions because it still protects transistor circuitry even though the device has to be replaced."[1]

Due to its large internal capacitance a transzorb cannot be used on signal lines. Its main use is for low-voltage DC power supply lines, i.e., protecting the DC supply voltage to CATV hybrids.

"In most applications, the transient suppressor device is placed in parallel with the equipment or component to be protected. In this situation, there is a time delay associated with the capacitance of the device and an overshoot condition associated with the inductance of the device and the inductance of the connection method. The capacitive effect is of minor importance in the parallel protection scheme because it only produces a time delay in the transition from the operating voltage to the clamp voltage.

'Power pack efficiency reduces electrical bills or allows improved technologies. . . to be added without additional power demands'

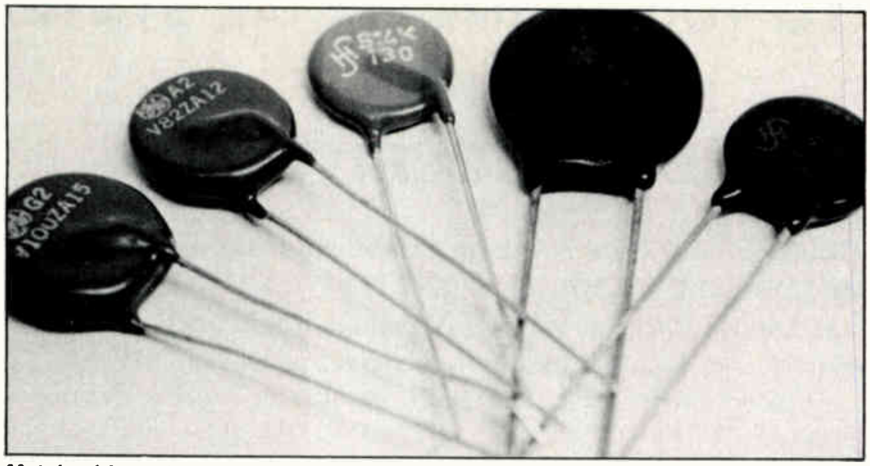
"The inductive effects in the device are due to actual turn-on time (time required for the device to go from zero current to full current) and lead inductance. This inductive effect produces an overshoot in the voltage across the equipment or component being protected. Minimizing this overshoot is very important in the application, since the main purpose for adding a transient suppressor is to clamp voltage spikes. The 1N 6267 series has very good response time, typically 1 nanosecond and negligible inductance. However, external inductive effects could produce unacceptable overshoot. Proper circuit layout, minimum lead lengths and placing the suppressor device as close as possible to the equipment or components to be protected will minimize this overshoot."[4]

Some input impedance, represented by Z-in, is essential to prevent overstress of the protection device. This impedance should be as high as possible, without restricting the circuit operation.[3]

"Metal oxide varistor (MOV) devices

Table 1: Circuit protective devices and fuses

Device	Type	Use
Gas discharge	Crowbar	Signal lines
Avalanche diode	Clamp	Power supply lines
Metal oxide varistor	Clamp	AC power lines
Slo-blo and Normal blo	Fuse	Overload protection



Metal oxide varistors.

are not semiconductors. They are rather a soft clamp device for AC power lines of 4 to 2,800 volts. They can, however, dissipate extremely high energy transients without damage."[1]

MOVs are used in applications requiring transient suppression caused by internal switching, surges, fuse arcing, lightning, accidental shorting, stray pickup, start-up transients and loss of regulation. Transients are momentary surges of electrical energy in AC power, CATV lines and other electrical circuitry. MOVs provide cost-effective insurance to prevent the loss and destruction of expensive equipment or componentry.[5,6,7]

The MOV must operate under steady state and transient conditions. Ratings allow a selection of the proper size device to ensure reliable operation. The selection process requires a knowledge of the electrical environment. When the environment is not fully defined, some approximations can be made.[6]

For most applications, selection is a five-step process:

1) Determine the necessary steady state voltage rating (working voltage).
2) Establish the transient energy absorbed by the varistor.
3) Calculate the peak transient current through the varistor.
4) Determine power dissipation requirements.
5) Select a model to provide the required voltage-clamping characteristic.

To determine working voltage, use the secondary side of the power transformer at maximum secondary voltage for a transformerless design and measure the maximum raw unregulated DC voltage. CATV voltages are square wave and must be adjusted for RMS values by using peak-to-peak voltages or DC voltage specifications.

References

[1] Hansel Mead, *Lightning and CATV Systems*, Q-Bit Corp., handout pamphlet.
[2] Siemens, *Standard Duty SVPs with Leads*, specifications sheet, 10/78-S129.
[3] Lumex Opto/Components, *Gas Tubes*, catalog 83-1.
[4] Motorola Semiconductors, *Zener Overvoltage Transient Suppressor*, specifications sheet for 1N 6267 Series, 1979, DC 7052.
[5] Stetron International Inc., MNR Varistors (metal oxide type), specifications pamphlet.
[6] General Electric, *Transient Voltage Suppression*, Fourth Edition, Electronic Data Library, publication number 400.3.
[7] Panasonic, *ZNR Transient/Surge Absorbers*, specifications pamphlet, 20M8-61/10M.

In the conclusion of this article next month, fuse ratings and guidelines for implementing them will be covered.

Hamlin 6400 System:

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MLE 64A Encoder

MLD 6400A Descrambler

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CALENDAR

June

June 12-15: SCTE Cable-Tec Expo, Convention Center, Phoenix, Ariz. Contact Bill Riker, (215) 363-6888.

June 13: Wavetek system sweeping seminar, the Wavetek factory, Beech Grove, Ind. Contact Steve Windle, (317) 788-5980.

June 15-17: Oregon Cable Communications Association annual convention, Embarcadero Resort Hotel & Marina, Newport, Ore. Contact Mike Dewey, (503) 362-8838.

June 15-17: Virginia Cable Television Association 20th annual convention, Pavilion Tower Hotel, Virginia Beach, Va. Contact (804) 780-1776.

June 18: SCTE Delaware Valley Chapter meeting on signal processing centers with BCT/E exams on video and audio signals and systems, Williamson Restaurant, Horsham, Pa. Contact Bev Zane, (215) 674-4800.

June 23-25: SCTE and **New York State Cable TV Commission** Northeast cable television technical seminar, Roaring Brook Ranch, Lake George, N.Y. Contact Bob Levy, (518) 474-1324.

June 24-26: C-COR Electronics technical seminar, Baltimore. Contact Debra Cree, (800) 233-2267 or (814) 238-2461.

Planning ahead

July 15-17: Community Antenna Television Association annual convention, MGM Grand Hotel, Reno, Nev.

July 20-22: Eastern Show, Merchandise Mart, Atlanta.

Sept. 23-25: Great Lakes Cable Expo, Hyatt Convention Center, Columbus, Ohio.

Oct. 28-30: Atlantic Show, Convention Hall, Atlantic City, N.J.

Dec. 3-5: Western Show, Convention Center, Anaheim, Calif.

AD INDEX

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Reader Service Number 67.

Data net standards

By Lawrence W. Lockwood
East Coast Correspondent

The Institute of Electrical and Electronic Engineers (IEEE) 802 committees have had recent developments of interest to those in CATV and data communications.

The committee and its groups — 802.3, 802.4, 802.6 and 802.7 — are setting, and in some cases already have set, standards for data communications on local area nets (LANs). The groups noted all have standards regarding utilization of CATV-type (broadband) systems.

Draft C of the 802.7 proposed standard is currently in general committee review and will be voted on in a May letter ballot. Then it will be sent to the IEEE TCCC for acceptance in July. Upon acceptance, it will become the 802.7 standard and then an ANSI standard.

The 802.7 standard is a general definition of requirements for a broadband transmission system for use in a data LAN. Its scope as defined in Draft C is:

"This document recommends the physical, electrical and mechanical practices for a properly designed IEEE 802.7 broadband coaxial medium. The criteria and specifications are intended as the minimum acceptable parameters for the design, implementation and operation of an IEEE 802.7 broadband coaxial medium. This document also provides guidance to design, test and maintain broadband coaxial systems.

"Users and LAN manufacturers are provided with a common set of specifications to ensure compatibility, co-existence among present and future information systems as it pertains to the physical medium. Both single- and dual-cable systems are covered, as well as how this set of recommended practices relates to existing IEEE 802.3 and IEEE 802.4 broadband standards."

The reference model as defined in Draft C is:

- Radius from headend — 10 km
- Maximum outbound amplifier cascade — 16 amplifiers
- Maximum number of inbound amplifiers — 128
- Channel boundaries — 6 MHz
- Channel energy (power) — NCTA TV standard

Typical applications might be in the other LAN protocols, i.e., 802.3—CMSA/CD Ethernet; 802.4 — token bus; 802.6 — metropolitan area net (MAN) and General Motors' manufacturing automation protocol (MAP).

This 802.7 standard recommends a mid- or high-split configuration for existing systems but a high-split for new systems. The sub- and high-split configuration specifications in the current 802.4 are:

- Sub: 5-30 MHz inbound, 54 MHz and up outbound.
- Mid: 5-108 MHz inbound, 162 MHz and up outbound.
- High: 5-174 MHz inbound, 234 MHz and up outbound.

However it should be noted that the IEEE 802.4 "preferred" standard is mid-split.

The wording regarding the split configurations in 802.7 Draft C is: "The following frequency limits for the two transmission formats are recommended:

Mid-split

Inbound lower limit: 5 MHz; upper limit: not less than 108 MHz.

Outbound lower limit: not greater than 174 MHz; upper limit: not less than 300 MHz.

High-split

Inbound: lower limit: 5 MHz; upper limit: not less than 174 MHz.

Outbound: lower limit: not greater than 264 MHz; upper limit: not less than 400 MHz.

"System frequency limits for dual-cable plant. The following limits are recommended: Inbound and outbound lower limit: not greater than 40 MHz; upper limit: not less than 300 MHz."

Of corollary interest are proposed actions in the 802.4 and 802.6 committees.

802.4 and 802.6

The use of the carrier-band scheme in MAP may produce a slight modification in the modulation techniques in the single-channel standard in 802.4.

The MAP protocols are centered on the 802.4 standard. However, using all the powers of broadband technology to link the many work cells in an automated factory would not be cost-effective. To drive the cost of connections down while maintaining data speeds, MAP specifies the use of single-channel portion of the 802.4 standard, calling it *carrier band*. The single-channel portion of 802.4 uses a single channel with data (at 5 MBPS and 10 MBPS) frequency shift keyed (FSK) directly onto the cable (not FSK'd onto an RF carrier). The FSK frequencies are 5 MHz and 10 MHz for the 5 MBPS data rate and 10 MHz and 20 MHz for the 10 MBPS data rate. The control protocol, of course, remains token passing.

Such a technique eliminates the requirements for a headend, thus reducing

the complexity and expense of the small carrier-band system. The MAP concept is to have a broadband backbone net (with many channels and thus a high data rate capability) linked to many "cells," each using the carrer-band scheme. Thus the high expense and extensive capabilities are limited to the backbone and the lower expense and more limited capabilities are allocated to the carrier-band cells.

A word on the term *carrier band:* It was consciously originated by the 802.4 group to reduce confusion among some who had more computer-intensive than communications-intensive backgrounds. Systems using multiplexed, data-modulated RF carriers universally are understood as broadband. But the use of the 802.4 FSK single-channel method started to be referred to by some as baseband. To strongly differentiate the method (it indeed is not baseband, but truly not broadband either) *carrier band* was coined.

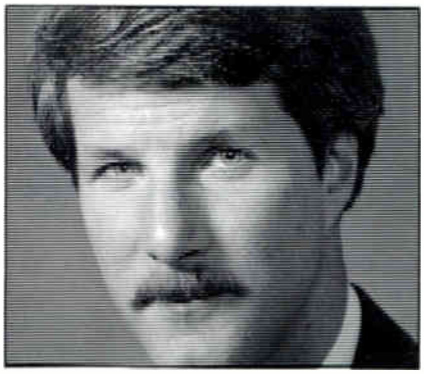
The establishment of the MAN protocol is somewhat further off, probably at least a year. The current network concepts would encompass larger areas — up to 25 miles and at three data rates (about 11 MBPS, 44.7 MBPS and between 200 and 250 MBPS) — and will use fiber-optic links for its high-speed backbone.

Another fiber-optic high-speed standard is still being formed — the fiber distributable data interface (FDDI) — by the ANSI x3T9.5 committee. This standard is for a 100 MBPS rate.

It is apparent that the standards coordination of the higher data rates, particularly when fiber optics gets involved, is still a bit fuzzy.

It is apparent that CATV techniques with broadband schemes (including carrier band) are being, and increasingly will be, used for data transmission. Because of many factors — not the least of which are the recommended frequency splits — the increased activities will utilize CATV equipment but not the common sub-split CATV industry-type system. The window of opportunity for data business may exist for a little while longer for the CATV systems that have, or are willing to install, at least a mid-split institutional net.

For installers only



By Robert A. Luff
Senior Vice President, Engineering
United Artists Cablesystems Corp.

The cable industry is well on its way toward voluntary certification of cable technicians and engineers. This program was asked for by the technicians and engineers themselves. They worked out a way to help improve their everyday skills that can so easily get out of date in a fast-moving industry. I would like to hear your views on what you, as an installer, think about a separate, voluntary certification program just for installers. Would you be for or against it?

Before you decide, here are some thoughts about how such an industrywide program might be set up and how it may help you.

Proposal for installers

Since the Society of Cable Television Engineers (SCTE) is a "people" organization oriented mainly to serve cable TV installers and technical folks, it stands to reason that the SCTE would be the logical choice to develop and administer any final, voluntary, self-certification program for installers.

If the SCTE would accept the task, the advantages to installers are numerous. First, SCTE already is well aware of installers' diverse responsibilities. It is a respected household organization with both installers and their companies, coast to coast. It would provide early confidence, fairness and accuracy in any installer-generated program for installers. Also, SCTE has experience in such self-help, countrywide programs through its successful BCT/E certification for technicians and engineers. This is an important point, since there are very few other organizations that would understand the installers' jobs and be readily available to assist their needs in every state.

That brings us to the next point. SCTE is a national cable organization with over 23 local meeting groups and chapters, and more developing rapidly. The goal is to have a local SCTE meeting group for every 90-mile-radius zone where there are cable systems. These groups meet six to 12 times a year to ensure regular stimulating programs, discussions and skill development training on topics asked for by the local installers and technicians themselves.

Why installer self-certification?

Why should installers want a certification program, like the BCT/E, for themselves? Answer: a better career and more money!

Most cable companies are beginning to realize just how valuable a good installer workforce is to maintain cost-effective operations. However, most installers, perhaps you, were hired "cold turkey" off the street. Most installers have no previous installation or technical background. After a brief training period, the installer usually is unsupervised most of the workday. He drives a very visible company vehicle and enters 1,500 homes a year. National averages show that installers come in contact with 90 percent of the system's subscriber base every three years. Therefore, companies are realizing that installers can, and that some already do, play a far more important role as the *ambassadors* of cable TV. In many systems today, installers are being given an opportunity to cross-train as salesmen and given a full commission on all non-pay conversions and new basic and pay units sold.

Additionally, installers drill through the walls of $200,000-plus homes; attach grounding straps to power risers, water or explosive gas pipes; double check for RFI; handle polarized converter plug and non-polarized receptacle problems; and hook up or answer questions regarding ad hoc cable-ready TVs, VCRs, FMs, video games, etc. In short, today's cable installers need to be neat, clean, highly trained, motivated, self-starting and well-mannered professionals.

Even though the need is there, many companies do not fully use the potential of their installation department bacause, well, frankly, the installation workforce needs an image face lift.

Cable installer is an entry-level position, one of the beginning levels of employment. It expects initially the least in the way of experience or background and, accordingly, pays the least. Those who have a particular interest or aptitude for math or electronics eventually move up to technician. At any one time, a cable system's installers may range from right off the street to fully qualified for a technician opening. What is needed is a way for you and other fully qualified and experienced and professional skills from the rank-and-file mix.

'I would like to hear your views on what you. . . think about a separate, voluntary certification program'

This is where a voluntary installers' certification program would be valuable. Your experience and knowledge easily can get overlooked in an informal, everyday, "catch-as-catch-can" work environment, especially when you are out on the road most of every workday. What you, and thousands like you, need is a certificate with your name on it from a well-respected organization working for you on the chief's wall and in your personnel file, while you continue to do your very best.

Of course, obtaining a certificate would require extra effort. If the standards were so low that everyone could earn one without much effort, it would not be worth anything. Herein lies the greatest value of a voluntary program. While the certificate is the physical object, it is what you do to earn it that is the real advantage to you, your employer and the industry at large. It is a lot like a high school or college athletic program. Anyone who really wants to work hard can make the varsity team and earn a letter. But the real value is not just to those getting on the team. Such a program gives all interested existing and future classmates something to focus on and work toward that will encourage higher, steady self-improvement in the desired areas.

Installers certified to have the street sense and knowledge to determine the best way to speed installations, improve the workmanship and reduce any call backs, successfully sell upgrades or have a positive impact on reducing churn will prove to be much more cost-effective even at earned increased salaries or bonuses, and more likely will be successfully promoted faster.

So, tell me how you feel. Are you in favor of voluntary certification for installers or against it? Please send a postcard with your name, address, vote and any comments to: Bob Luff, United Artists Cablesystems Corp., 60 Craig Rd., Montvale, N.J. 07645.

INTRODUCING THE DECODER THAT'LL SEND THE COMPETITION SCRAMBLING

In fact, they may never be able to catch up to the PM™ system, Zenith's new affordable RF addressable converter.

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What's more, the PM system offers an impressive list of subscriber-friendly features. Including stereo and VCR compatibility, unified remote control, and expanded PPV capability. Which almost guarantees increased revenue for you.

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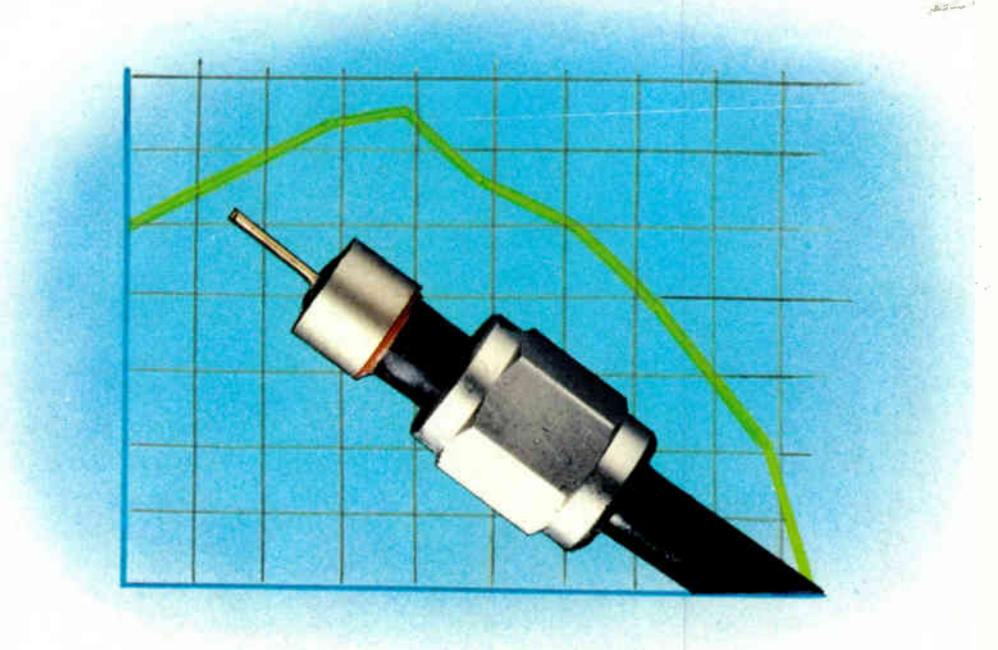
Reader Service Number 69.

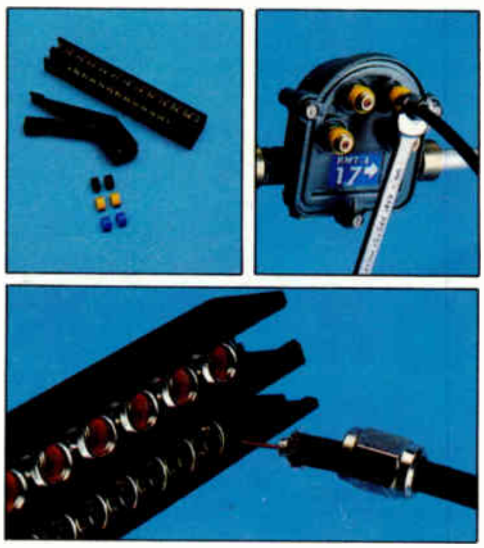
Reduce maintenance budgets with the EZF™ Connector System...



Raychem's new EZF Connector System addresses the problems of F-Connectors — RF leakage and moisture penetration — which are among the leading causes of maintenance problems for a cable-TV operator.

EZF is not just a connector, but a system that provides complete, long-lasting performance. Its new design assures superior mechanical strength, tight electrical connections and environmental sealing.

The EZF Connector System has gone thru extensive environmental testing. UV exposure, waterhead testing, thermocycling and salt spray exposure are some of the tests that the EZF System has been designed to pass and still provide exceptional RF shielding.



Features of Raychem's EZF Connector System.

1. One connector fits RG-59, cable and one connector fits RG-6 cable.
2. The only connector available today that provides RF shielding of 100 db at 300 MHz after thermal cycling and salt spray exposure.
3. The system provides an environmental seal at both the cable jacket and port thread interfaces.
4. Reduces finger tight connections and subsequent trouble calls.
5. Crimp tools are no longer needed. A common 7/16" wrench does the final tightening and installation.
6. Cable preps are accurate each time with the EZF Cable Preparations Tool. (For use on both RG-59 & RG-6)
7. Identify customer service with different colored EZF Sealing Boots.

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