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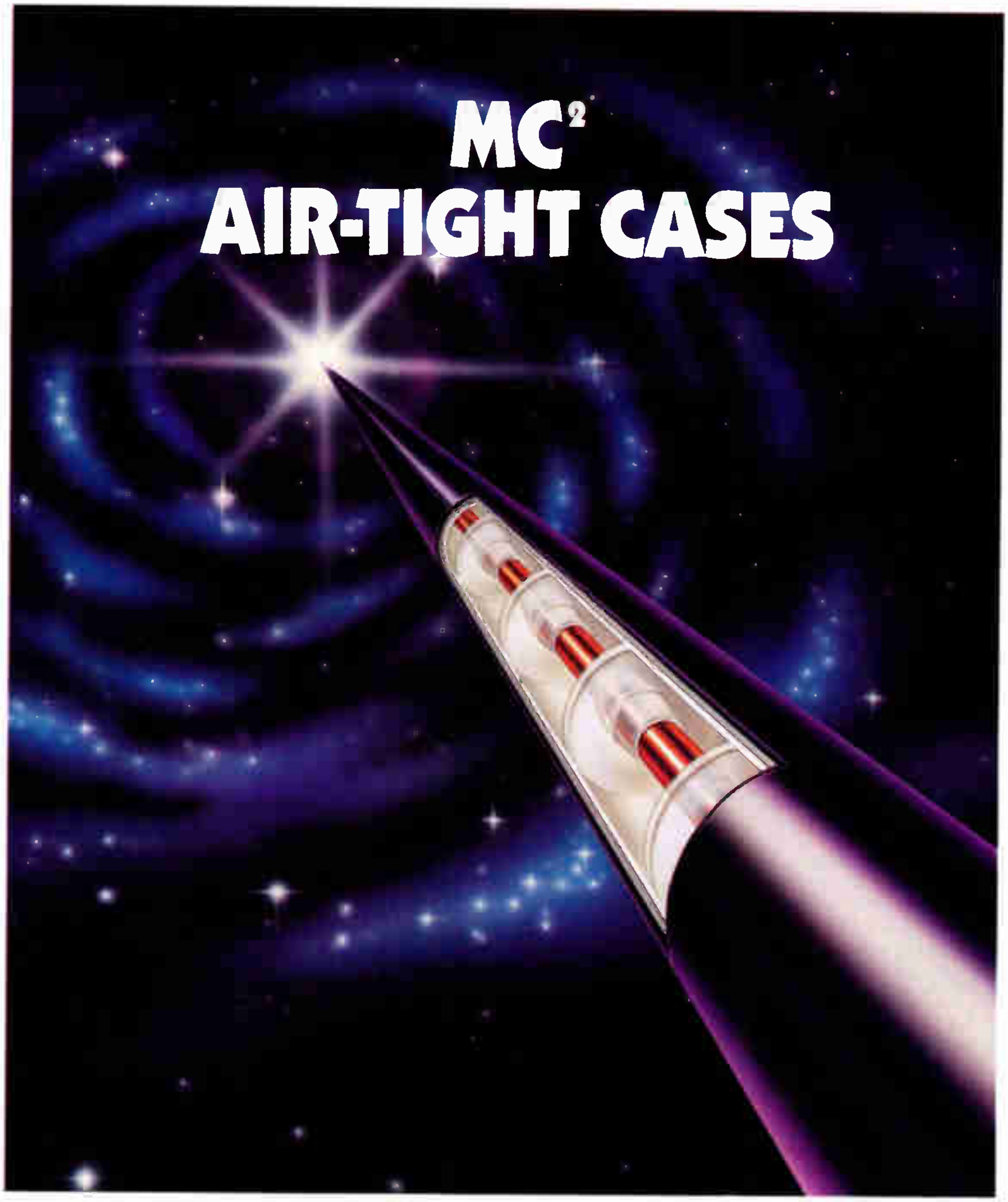

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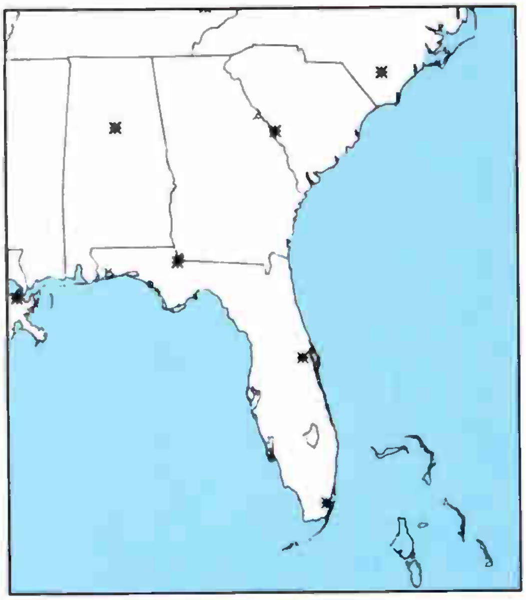

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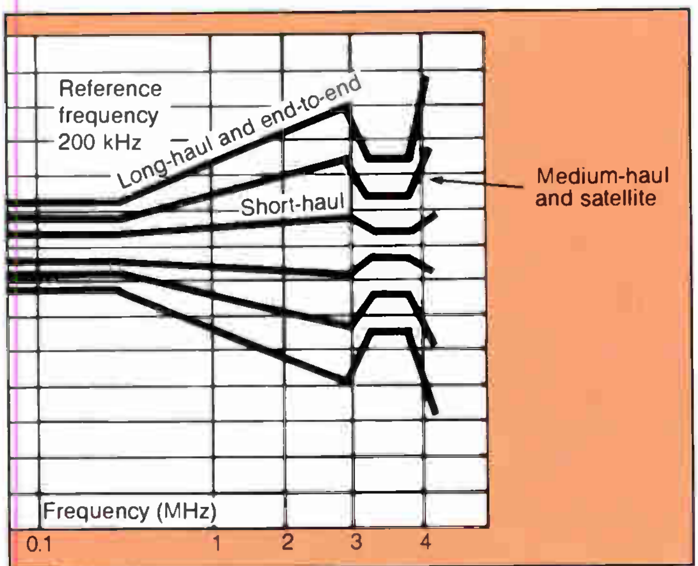

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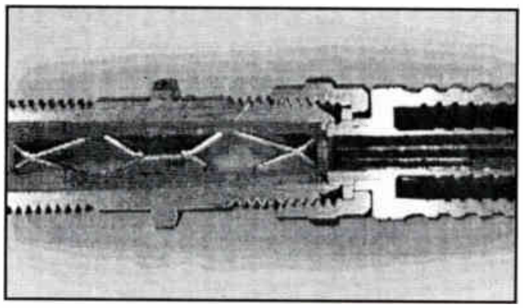
Features

THE F-CONNECTION
THE INSTALLER'S NEWSLETTER



PUBLISHER'S LETTER

The SCTE: "It was 20 years ago today..."

Welcome to Orlando, Fla.! If you're here this month, you'll likely visit Walt DisneyWorld, Epcot Center, the new Disney/MGM Studios Theme Park and Sea World. But, of course, the attraction that beats all of these "hands on" is the Cable-Tec Expo, presented by the Society of Cable Television Engineers. No doubt about it, the expo is at the top of the list of technical events available for engineers and technicians. And now, for the first time, installers can be part of the experience with the introduction of the SCTE's Installer Certification Program testing.

This month also marks the 20th anniversary of the SCTE; a celebration is planned for Friday's Expo Evening at Sea World. For any organization, 20 years represents a historical milestone in itself. For the SCTE, it's much more than that, taking into account its growth and influence in the CATV technical community. Many, many people have been responsible for the Society's accomplishments in its 20 years of service.

Back to the expo

Talk about growth: In 1987, the Society held the expo here at the Hyatt Hotel, this year, it's in the huge Orange County Convention Center, with the Annual Engineering Conference at the Stouffer Orlando Resort. While we don't know the actual number of people planning to attend, odds-makers in Vegas are betting a significantly higher count than last year's 1,300 attendees.

As usual, we'll be on the floor, in the classroom and everywhere else. Also, if you're exhibiting and have any show-related information for the *CT Daily*, just hail one of our staff (including Gary Kim, *CT's* special correspondent). But, alas, if you're not able to attend the show this year, watch for our August issue; we'll capture the expo action in words and pictures. (And plan to be in Nashville, Tenn., for Expo '90!)

For an up-to-date agenda of seminars, special events and other activities, read "News," beginning on page 12. And don't forget to drop by CT Publications' first presentation of our "Painless technical writing" seminar. It's planned for Saturday, June 17 at 2 p.m. in the Technical Training Center near the exhibit hall. Instructors are Rikki Lee (*CT* editor) and Ron Hranac (Jones Intercable's senior staff engineer).

More news you can use

Joining forces: Summit Media International Inc. of Golden, Colo., a publisher of trade magazines and newsletters for communications and media industries, has acquired our company, CT Publications Corp. Summit Media President Paul Maxwell is certainly no stranger to our industry. He was co-founder of *CableVision* magazine and founder of *Multichannel News*; he was president of X*Press Information Services before founding Summit Media in 1987. At last month's National Show he was inducted as a cable pioneer for 20 years of service in the industry.

This joining of forces is perhaps one of the most exciting events in cable TV publishing to occur in years. I look forward to working with Paul Maxwell and his staff of experienced professionals. And, after all is said and done, our goal is still the same—to be the best. I know you won't be disappointed.

A class act: Recently, Texscan Corp. in El Paso, Texas, hosted a successful fiesta dinner and half-day press conference; it included tours of the El Paso and the Juarez, Mexico, plants. Like a panther, the new management team at Texscan is streamlined and focused in the CATV arena. At the helm of the reorganized ship is Bill Lambert, backed up by George Fletcher, Bill Dawson (now vice president and general manager of Texscan MSI) and Burt Henscheid. The inertia propelled by these talented people can only bode well for the company. I know we'll be hearing a lot from Texscan in the very near future.

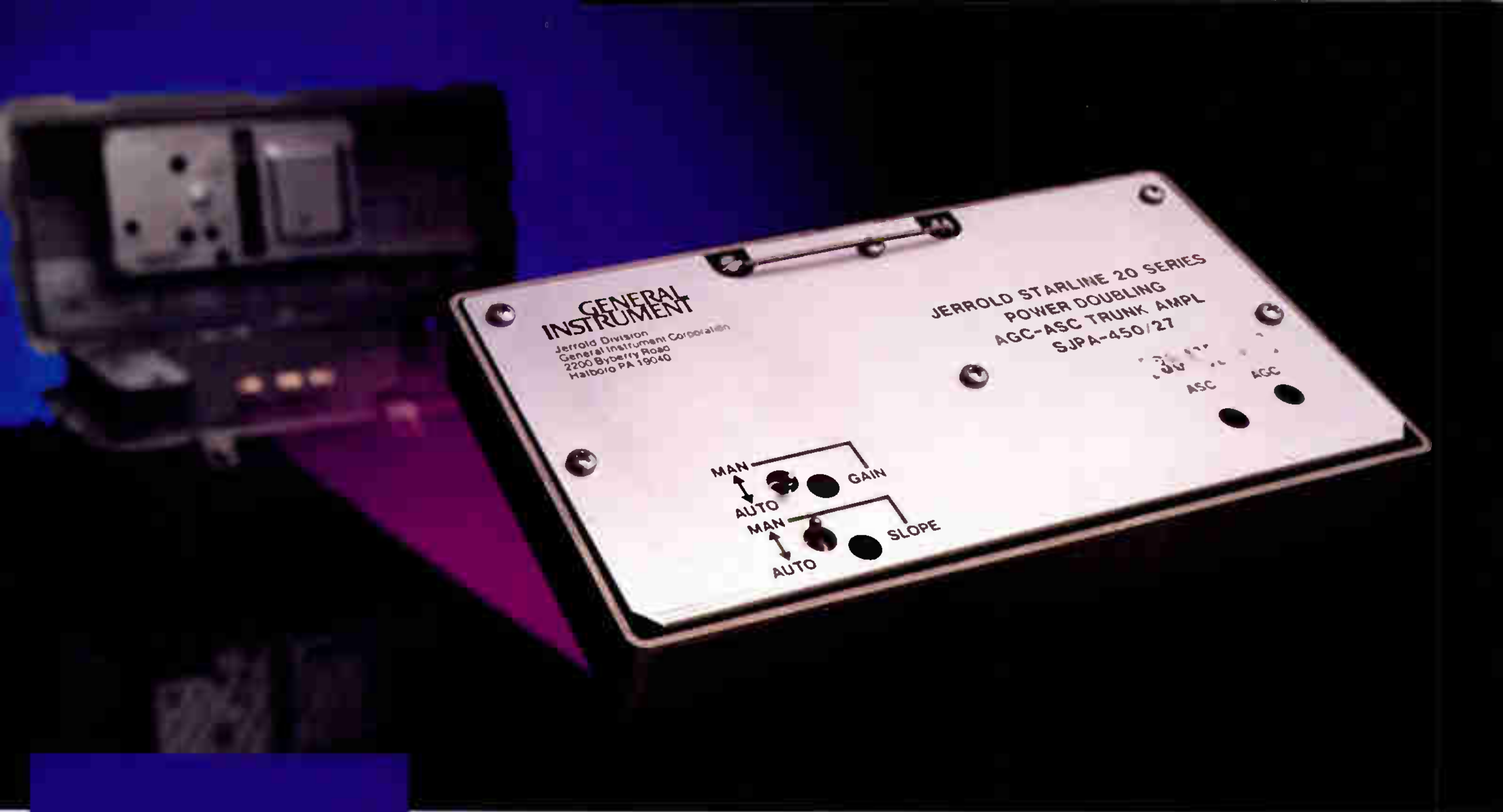
New faces, new places: At Pico Macom, Bill Fitzgerald was appointed president and CEO. His background includes extensive experience in management, manufacturing, and sales and distribution in the United States and the Far East. In his new position, he will assume responsibility for expanding Pico Macom's product line and increasing customer service. Congratulations, Bill.

Meanwhile, at Midwest CATV, Rex Porter was named vice president of the Western region; he has opened a 35,000 square foot warehouse in Phoenix. You can reach him at (800) 782-4566 or (602) 233-3555. Rex has been in cable over 20 years and is practically a household word in the technical side of the industry. An SCTE charter member, he received the Society's Member of the Year Award in 1987. He's also on the Society's Senior Engineering and Scholarship committees.

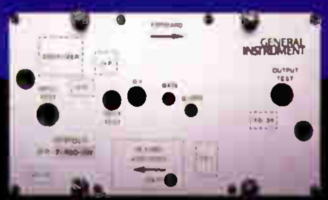
In addition, Midwest CATV recently opened a sales office in Denver and is currently seeking a major warehousing site.

Mortarboards off to the grad: Pam King, Jones Intercable's technical training coordinator at corporate headquarters in Englewood, Colo., graduated from Metropolitan State College with a bachelor of science degree in electrical engineering. What makes this accomplishment so special is that she completed her course work by going to night classes for six years. Take a bow, Pam.

Paul R. Levine



JLP Line Extender



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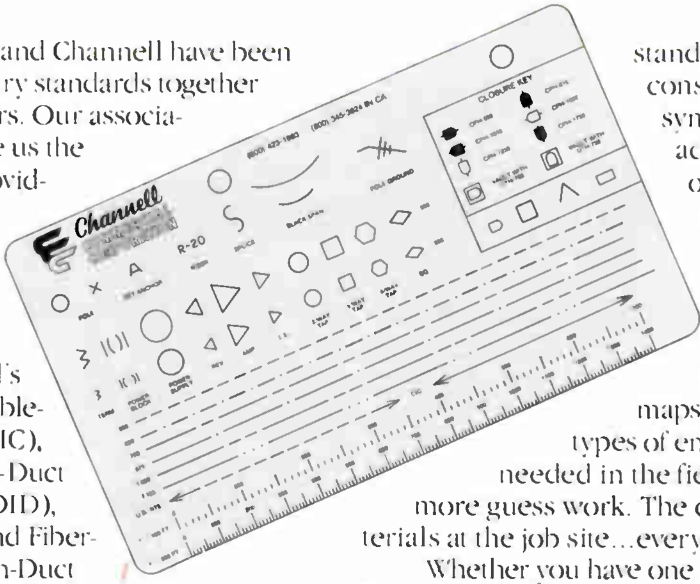

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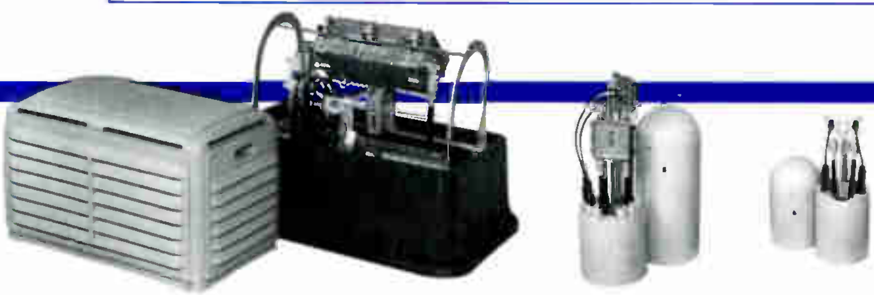

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SCTE announces Cable-Tec Expo '89 agenda

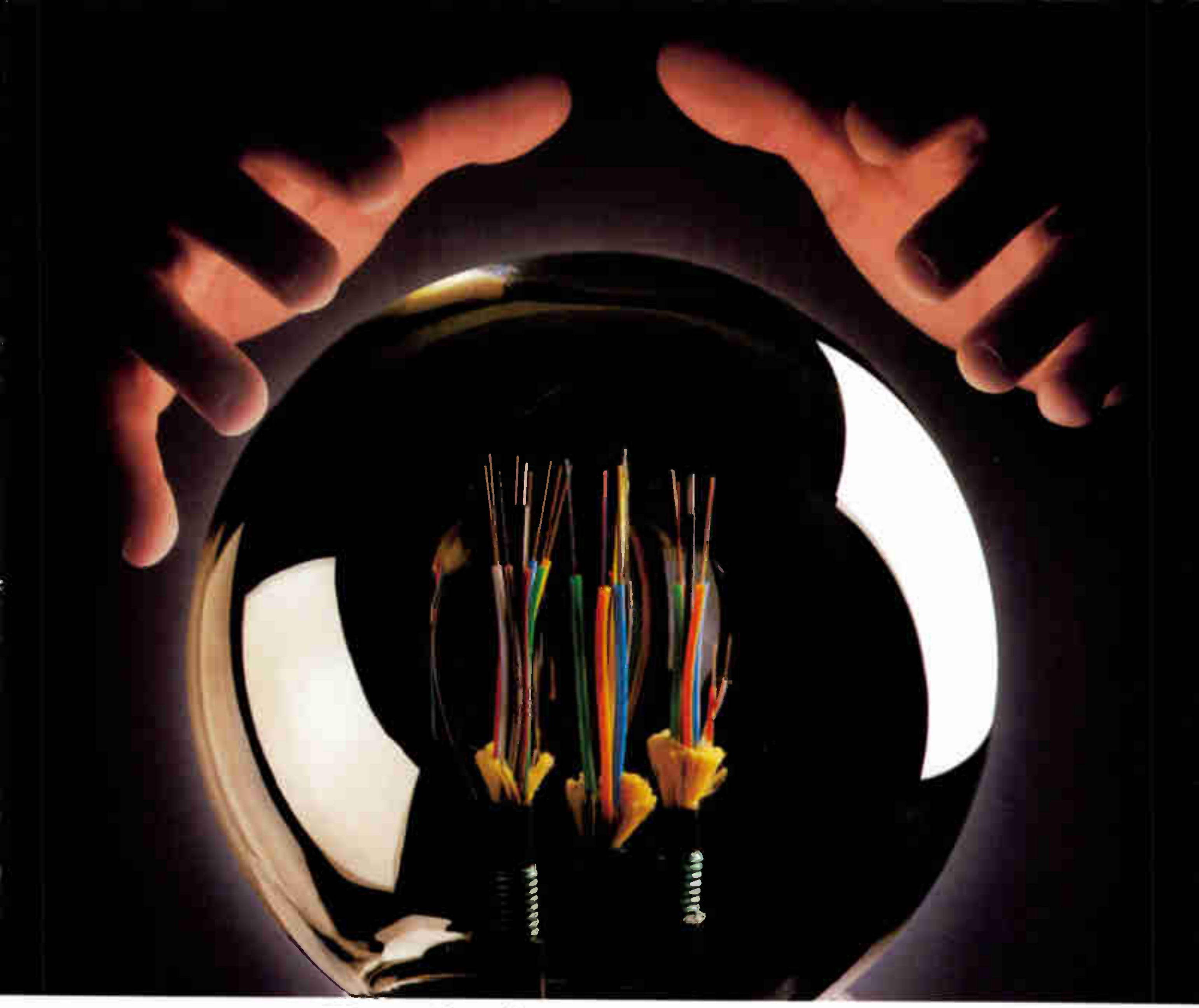
ORLANDO, Fla.—The Society of Cable Television Engineers will hold its 1989 Annual Engineering Conference at the Stouffer Orlando Resort and the Cable-Tec Expo at the Orange County Convention Center here June 15-18. The agenda for the conference and expo is as follows:

Wednesday, June 14 (Stouffer Orlando Resort)
5-8 p.m.—Interface Practices Committee meeting
5-8 p.m.—Conference registration (Crystal Ballroom Foyer)
6-8 p.m.—Hospitality by Wavetek (Wedgewood Room)

Thursday, June 15 (Annual Engineering Conference, Stouffer Orlando Resort)
7:30-8:30 a.m.—Registration
8:30-9 a.m.—Opening remarks by William Riker (SCTE)
9-10:30 a.m.—Session A: "High definition television," with Walt Ciciora, American Television and Communications Corp. (discussion leader); Wayne Luplow, Zenith Electronics; and Norman Hurst, David Sarnoff Research Center.
10:45 a.m.-noon—Session B: "Digital video: A future alternative," with Steffen Rasmussen, ABL Engineering.
Noon-2 p.m.—Membership luncheon with awards and keynote speaker Paul Weitz, Johnson Space Center (Atrium).
2-3:15 p.m.—Session C: "Cable vs. the Telcos," with Gary Kim, Focus Communications (discussion leader); Steve Wilkerson, Florida Cable Television Association; Gary Moore, Southern Energy Consultants Ltd.; and Mark Balmes, BellSouth.
3-5 p.m.—Expo registration →

Expo workshops

- "Fiber-optic test measurements," with Norm Elsasser (Photodyne) and Sandy Lyons (Siecor).
- "Signal level meter basics and alternative measurement techniques," with Ron Hranac (Jones Intercable), Tom Archer (Sencore) and Don Runzo (ComSonics).
- "Data transmission techniques," with Don Patton and Andy Paff (Anixter Cable TV).
- "Supervisory and management fundamentals," with Dr. Bill Brown (Rollins University).
- "Signal leakage, CLI and the FCC," with John Wong (FCC), Robert Dickinson (Dovetail Systems) and Brian James (National Cable Television Association).
- "Remote automated system testing," with Dwayne Lipp (Superior Electronics), Jay Staiger (Magnavox) and Jim Hayworth (ATC). Full morning session on Friday.
- "Basic spectrum analyzer theory and operation," with John Cecil (Hewlett-Packard). Full morning session on Saturday.
- "Local origination equipment and its use," with Jay Dorman (MPCS) and Lenny Melamedas (UA Columbia Cablevision).
- "AM fiber-optic transmission," with J.R. Anderson and Wes Schick (Anixter).
- "Installing fiber-optic cable," with Larry Nelson (Comm/Scope), Ken Carter (ATC) and Dan Pope (AT&T Bell Laboratories).
- "Installer certification: Assuring quality performance," with Richard Covell (Jerrold) and Ralph Haimowitz (SCTE).



3:30-5 p.m.—Session D: "Fiber-optic technology," with Scott Esty, Corning Glass; and Jim Chiddix, ATC.
5-7 p.m.—CLI Committee meeting
6-8:30 p.m.—Welcome reception sponsored by Anixter, AT&T, Raychem, SCTE Florida Chapter and the Florida Cable Television Association.
8-11:30 p.m.—Jerrold Night at Church Street Station

Friday, June 16 (Cable-Tec Expo, Orange County Convention Center)
8 a.m.-1 p.m.—Expo registration (Civic Center South Lobby)
8-9:15 a.m.—Workshop Period A
9:30-10:45 a.m.—Workshop Period B
11 a.m.-12:15 p.m.—Workshop Period C
Noon-5 p.m.—Exhibit hall open (Hall D)
Noon-2:30 p.m.—Lunch in exhibit hall
6-10 p.m.—Expo Evening at Sea World

Saturday, June 17
8 a.m.-1 p.m.—Expo registration (Civic Center South Lobby)
8-9:15 a.m.—Workshop Period D
9:30-10:45 a.m.—Workshop Period E
11 a.m.-12:15 p.m.—Workshop Period F
Noon-5 p.m.—Exhibit hall open
4-5 p.m—Exhibitor's reception
5:30-7 p.m.—Amateur radio operators reception (Yellowtail Room, Stouffer Orlando Resort)
7-10 p.m.—Scientific-Atlanta party (Crystal Ballroom, Stouffer Orlando Resort)

Sunday, June 18
8:30 a.m.-noon—BCT/E and Installer Certification Program exams (Crystal Ballroom). (You must register and pay for exams before 1 p.m. on June 17.)
9-10:30 a.m.—Chapter Development meeting (Japanero Room)
9 a.m.-noon—Cablevision of Central Florida Tour (Palani Room)

Committee probes engineering topics

WASHINGTON, D.C.—The Engineering Committee of the National Cable Television Association met here April 26-27. On the first day, some of the topics and discussions included:

IS-15 multiport: It was announced that multiport units are being produced in ample quantities. Field reports are in of tests from four locations, indicating good technical performance and subscriber and dealer acceptance. Steve Nussrallah of Scientific-Atlanta presented a report on the IS-15.

Pay-per-view copy prevention: There was an update from Eidak Corp. giving a description of the product's improvements. Studies seemed to indicate day/date equality of PPV with home video release. Only one complaint was received due to the customer's inability to record a program. Eidak expected a fourth quarter rollout to other stand-alone systems.

Syndex: The NCTA will not oppose the syndicated exclusivity rules; other companies or groups may appeal independently.

HDTV: There may be an occasional cooperative effort with the ATTC (Advanced Television Test Center). An ATTC co-op testing plan is under consideration as well as a CRC proposal to do objective testing. MUSE tests were recently conducted at Media General and Jones systems, demonstrating the viability of CATV carriage of these signals. Decisions on HDTV are expected in late 1991 by the FCC's Advisory Committee and perhaps 1992 by the commission itself.

Congress: Rates and customer service are the emotional items that have the attention of Congress. There were discussions on improved service commitments, digital dispatch techniques and other automatic hardware.

BTSC: Alex Best discussed how BTSC measurements might be performed with dbx switched out. Those changes are intended to be added to the test methodology that exists now.

ARRL: Two members of the American Radio Relay League came to the Hartford, Conn., NCTA leakage seminar and had positive things to say about the cable industry.

SCTE: There was a report by Executive Vice President Bill Riker and a reminder to register early for the Cable-Tec Expo.

NESC: The 1990 National Electric Safety Code changes will become effective Aug. 1. Some of the changes are thought to be favorable to cable

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systems in clearance requirements over streets.

Signal leakage: There is a strong interest in an SCTE (cumulative leakage index) handbook that would include forms and procedures to assist in the filing process.

On the second day, John Sie, senior vice president of Tele-Communications Inc., presented TCI's HDTV proposal. Some of the results from the Sunnyvale tests and the Faroudja Labs demonstrations in Japan were given; all seemed favorable and are contained in the TCI approach. TCI planned a Faroudja demonstration over a Dallas system during the NCTA show.

Jerrold establishes fiber business unit

HATBORO, Pa.—The Jerrold Division of General Instrument recently formed Cableoptics, a new business unit to serve as the focus for the company's fiber-optic CATV programs. Spawned from Jerrold's Applied Media Lab, Cableoptics will continue research and development of fiber system architectures. It also plans to develop, market and implement fiber products. According to its Director David Robinson, one of Cableoptics' objectives will be to extend fiber to the tap if not directly into the home.

Cableoptics is currently examining various component technologies and developing prototypes. The company's System K, a switched-star fiber-to-the-tap design, is one such prototype under development. Also, its dual-fiber 80 channel AM system was showcased at the NCTA show last month.

Pangrac receives '89 Vanguard Award

DALLAS—David Pangrac, director of engineering and technology for American Television and Communications Corp., received the Vanguard Award for Science and Technology at last month's National Show. It was presented to Pangrac by the National Cable Television Association for his development of ATC's fiber backbone concept.

Texscan, Anixter announce agreement

EL PASO, Texas—At a recent press conference, Texscan Corp. and Anixter Cable TV announced a joint development and marketing agreement to expand the capabilities of the Anixter/AT&T Laser Link system. Under the agreement, Texscan will manufacture Laser Link receiver housings and RF components for Anixter. Texscan also is authorized to market plug-compatible Laser Link receivers in its Pathmaker Plus product line of 1 GHz platforms.

The agreement completes a full system of CATV fiber products entirely researched, developed and manufactured in the United States.

Ham operator to fly on shuttle

NEWINGTON, Conn.—Ham operators here on Earth will soon be able to communicate with an amateur radio station in space when the Space Shuttle Amateur Radio Experiment commences in March 1990. Approval for inclusion of the experiment, called SAREX, on the secondary payload list of Flight STS-35 was received from National Aeronautics and Space Administration headquarters.

Ron Parise, a payload specialist for the ASTRO-1 payload and a licensed amateur radio operator, will operate the station in the orbiting space shuttle. Ham operators located between approximately 46°N and 46°S latitudes will be able to communicate directly with the shuttle from homes and schools. The SAREX transmissions may be received by standard "scanner" radios.

Jones approves specs for Catel's TransHub

ENGLEWOOD, Colo.—Jones Intercable gave final approval to the system and product design specifications for its 800-mile CAN (cable area network) fiber-optic rebuild in Broward County, Fla. Catel Telecommunications provided the specs on its TransHub III (TH III) AM-on-fiber system. More than 50 TH III units will be used in the rebuild, as well as 1,700 miles of fiber and 82 AM laser transmitters. The equipment contract for Catel is over $1.2 million.

The design and engineering document was signed recently by Bob Luff, Jones Intercable's vice president of technology.

GTE gets FCC's OK on Cerritos project

STAMFORD, Conn.—GTE Telephone Operations-California, a subsidiary of GTE Corp., recently received approval from the Federal Communications Commission to construct and operate both fiber and coaxial cable systems for advanced service testing in Cerritos, Calif. The company will soon begin providing dial tone over a fiber network to the first residents of the approximately 700 homes initially slated for fiber connection. Later this year, up to 100 of those homes will receive phone and TV service over a second fiber network. By year-end, a third fiber network will allow five homes to participate in a test of services to include video-on-demand TV and switched video (allowing customer transmission of signals).

The FCC approval also upheld an earlier decision by its Common Carrier Bureau to permit construction of a coaxial cable TV system for all 16,000 homes and 2,000 businesses in Cerritos. With 77 of its 170 miles complete, the system currently serves 2,150 subscribers.

Holland resigns, forms new company

LOS ANGELES—Michael Holland, president of Pico Macom, recently announced his resignation from the company after eight years. He will be starting a new company called Holland Electronics Corp. that will focus on providing SMATV and CATV headend equipment and accessories.

- Alpha Technologies completed development and field testing of its PSM-1 power supply and RF modem for one-way CATV systems. The new device is designed to transmit power supply data in the 50 to 150 kHz band back to the headend via the trunk line and active device power path. Two active beta test sites are currently in operation: the Tele-Communications Inc. system in Bellingham, Wash., and Cox Cable in Macon, Ga.
- The National Cable Television Institute signed agreements with three MSOs (C-TEC Cable Systems, Cardinal Communications and Karnack Corp.). According to the agreements, the NCTI will offer its full range of self-study technical courses to personnel of each MSO.
- Grounding and/or dissipation array systems developed by Lightning Eliminators & Consultants were installed in 11 radio/TV broadcast facilities and cable systems last year. Cable systems outfitted with LEC products included Community Broadcasting, Los Alamos, N.M.; Valley Broadcast, Las Vegas; and T&K Communications, Owego, N.Y.
- U.S. Electronics Corp. reported that it received an outstanding response to its new repair facility during the first quarter of 1989. The facility, which opened Feb. 1 and is located in Montgomeryville, Pa., repairs distribution and headend equipment.
- CableBus Systems of Portland, Ore., recently purchased the rights to TOCOM Products' alarm products from TOCOM's parent, General Instrument Corp. The deal includes all TOCOM alarm products, both CATV and dialup.
- Microwave Filter Co. increased its net sales 6.5 percent for the second quarter ended March 31 compared to second quarter 1988. Net income increased 21.9 percent compared to last year's second quarter.

Reader Service Number 16.

Reader Service Number 17.

Broadband LAN market still growing

By Gary Kim
Special Correspondent

Although it often escapes the attention of many in the CATV community, as many as 4,000 facilities scattered across the United States may have broadband local area networks (LANs) installed today. Given an early push by federal government and military users, broadband got a big boost when international standards organizations blessed 75 ohm RF technology as the physical medium of choice for IEEE 802.4 manufacturing automation protocol (MAP) networks.

On the heels of that endorsement, many suppliers and manufacturers of CATV distribution equipment and services have taken a keen interest in the LAN market, especially the broadband segment of that market. According to one estimate, 127,000 nodes have been added at existing broadband sites since 1983, while 259,000 additional nodes will be added at those and new sites in 1989 and 1990.

And assuming broadband meets current analyst projections and continues to grow as a facilitywide networking technology, the period from 1991 to 1993 should see 1,046,000 additional broadband nodes added to the nation's total. That's good news for broadband vendors but is a drop in the bucket compared to the total number of installed LAN nodes in the United States, currently estimated to be at 4,565,000 in 1988 and expected to climb to 6,275,000 in 1989. Although end-users have been through several "year of the LAN" pitches in the mid-1980s, few observers now doubt that LANs will be the dominant architecture for PC connectivity in the years to come. In fact, by 1993 some observers expect to see nearly 15 million nodes installed in the United States alone. And at least 1,432,000 of those nodes should be broadband by the same date.

Make no mistake: LANs have gotten to be a pretty big business. The annual market value of LAN interface products alone (not including servers, cabling, power supplies, software, installation, testing and maintenance) should fluctuate between $800 million and $1.1 billion for each of the years 1988 through 1993. Total LAN equipment sales last year may have hit $2.4 billion.

Typical users

Typical broadband users include universities, large financial institutions, manufacturing plants, hospitals, military bases and research parks. Broadband's appeal in manufacturing plants probably has gotten most attention recently and factory networks may grow from 1,060 to 8,140 between now and 1991. Node counts on those networks may jump from 31,905 to 370,200 by the same date, according to an International Data Corp. forecast. Not all those installations will be broadband, but a large share will be, especially as per-node costs for the MAP drop to $1,000 or less by 1990. That's important because broadband does have competition.

The bus architecture contention standard known as Ethernet, widely used in Digital Equipment Corp. computing environments, became the first widely accepted de facto standard for LANs, although important market shares continue to be held by ARCnet, a token passing star-bus architecture. Today, Ethernet probably represents 50 percent of the installed LAN base. IBM, which supplies the other leading computer environment among large corporate, government and military users, has thrown its weight behind a token ring technology codified as IEEE Standard 802.5. Although token ring networks account for less than 12 percent of the LAN-installed base, it is growing much faster than Ethernet and should steadily grow as a LAN standard.

Token ring network interfaces supporting IEEE 802.5 protocols are about $1,000 today, while IEEE 802.3/Ethernet interfaces are $725 or less. By 1990, 802.5 interfaces may cost only $700 each, while 802.3 interfaces may cost about $400 per connection. As MAP interface prices drop and general purpose broadband modems follow suit, there won't be a tremendously large cost differential between broadband and baseband technologies. That will lay largely to rest a price-per-connection problem for broadband that vendors once faced. Because baseband network interfaces don't require RF modulation and demodulation circuits they have been less expensive historically.

Despite the facts that twisted-pair networks now can support 10 Mbps (megabit per second) transmission speeds formerly attainable only on coaxial cable, that contention networks using Ethernet or 802.3 protocols still have a large following and that interest in optical fiber use also is growing (the 100 Mbps fiber distributed data interface or FDDI token ring standard is particularly important), broadband still has its place. The reason: Some applications require capabilities that baseband networks can't support. Broadband commonly is used to:

- connect hundreds to thousands of users at a single facility
- serve a campus-sized area
- move video as well as data
- move data at high speed
- support real-time process control
- transport large files such as CAD/CAM (computer-aided design and manufacturing) data

Why broadband instead of fiber-optic ring networks such as FDDI? Cost, mostly. Optical signals still are difficult to combine and split while

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transmitters and receivers are relatively costly. And it's hard to beat the multiple-channel and flexibility advantages of a 400 or 450 MHz broadband network. I suppose waiting for fiber optics to totally replace RF technology and broadband coaxial cable is a bit like waiting for addressable terminals to destroy the trap business.

Backbone networks

In the early 1980s networking professionals debated the merits of broadband vs. baseband transmission techniques, generally pitting broadband against Ethernet and related contention access schemes. The debates have ended. Broadband now is widely seen as a backbone technology—sort of a transportation utility—that allows interconnection of many smaller workgroup networks. The issue isn't baseband or broadband anymore. The issue is whether there are needs for high speed, high capacity backbones to link subnetworks.

Factory networks have been a particularly promising arena for broadband. Recent research by the Boston-based Yankee Group sheds light on broadband's use in industrial settings. Based on a national survey of 1,800 large industrial sites with more than 100 employees, Yankee Group found who had plantwide networks:

- 20 percent of sites
- One in three large sites (500 or more employees)
- One in six small sites (249 employees or less)

These numbers suggest that the market for facilitywide networks has significant room to continue growing. Interestingly enough, broadband and twisted-pair are the most popular cabling schemes at these plants, with broadband media installed in 38 percent of sites and twisted-pair media installed in 29 percent of sites.

Also, although typically billed as an ideal technology for connecting hundreds to thousands of nodes the typical industrial network of today connects only a small number of devices:

- 30 percent of sites had 1-5 nodes
- 20 percent had 6-10 nodes
- 16 percent had 11-25 nodes
- 16 percent had 26 to 50 nodes
- 18 percent had more than 50 nodes

But the total number of networks to be installed at industrial sites is growing. By 1990, 40 percent of surveyed sites may have plantwide networks in place, Yankee Group found.

And twisted-pair, broadband and optical fiber are the top media choices for the installations planned:

- broadband, in 27 percent of plants
- optical fiber, in 18 percent
- twisted-pair, in 41 percent

And those networks likely will grow in size over the next several years. About 19 percent of installations report they will have more than 50 nodes when their facility networks are put into place.

So expect an ever growing number of 75 ohm RF technologists to find themselves working the data communications side of the fence in the next few years. For in the world of data, as in the world of telephony and CATV, there's a growing consensus that broadband pipes are a key strategic asset and business weapon. ■

Thresholds and generations

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

"We need to re-evaluate our pronouncements of gloom and doom in the carcinogenic world."

In the April column on pollution and probability, I condemned in the strongest terms I could muster the unscientific treatment afforded most of the hazards to health as presented to the public by the partisan spokesmen who are too often accorded the respect one reserves for the gods of antiquity. In my days as a physics student it was taught that a scientific truth was only acceptable if at least three independent laboratories had conducted unique experiments, predicted by the theory, that thereby confirmed the theory.

Time and again some medical superman will announce, based on a poorly conceived and managed hospital study, conclusions that even the most parlous pseudoscientist would be ashamed to release. One of the most infamous incidents of this kind was the recent triumphant announcement to all physicians that caffeine consumption was positively related to cancer-induced deaths. As detailed in the *New England Journal of Medicine*, a small number of terminally ill men afflicted with cancer were divided into two groups, where one group was asked to abstain from drinking coffee. In due course they all died but the coffee drinkers sooner than the non-coffee consumers.

This study made headlines throughout the country including the front page of such respected (?) newspapers as the *New York Times*. I read the original paper and recoiled in sorrow at the sloppy science and pompous phraseology of the medical authors. Fortunately, more capable medical analysts rejected the conclusions reached by this lone study; caffeine has survived an almost fatal underhanded attack. (Personally, I enjoy the drug called caffeine. It is almost as stimulating as was the pure spring water from our Oswegatchie, Conn., well in the 1920s).

Procedural defect

One of the most serious procedural defects in the study of carcinogenic chemicals is the supposition that humans will be subject to similar diseases as were induced in various animals by massive doses of the compound under investigation. There have been recorded many lamentable periods in history when doctors inflicted death upon humans in order to gain knowledge of the effect of environment, drugs and disease. Mercifully today, we are dependent upon animal experiments to guide us in the use of drugs to alleviate human ailments.

Unfortunately, there is not a simple transfer of the statistics obtained from fatal doses of the drug ingested by animals into suitable quantities for treating the humans exposed to the same drugs. It seems more than likely that many of the dosages we are mandated by the physician, aided and abetted by the Food and Drug Administration, are highly speculative and—judging from the fine-print side effects—all too often deleterious to our health.

I believe that a statistical reduction of the fatal dose to animals as, for example, one-millionth of said dose, will cause a cancer to appear in a certain percentage of the animals—and by extension to humans the same trauma—is difficult to prove in practice. The lack of proof that minute quantities of a chemical causes cancer leads us to a significant factor that is rarely ever mentioned in the medical dissertations: threshold. I interpret "threshold" to represent a level of dosage of the carcinogen below which it has no harmful effect. In future columns I will try to use this definition to critique many of the hazards mentioned in April.

Here is how I visualize the concept of threshold: Let us use common salt as our carcinogen. It is painfully obvious that any creature on Earth can be exterminated by a large enough dosage of salt. But there is most obviously a threshold level in which salt ceased to be life-threatening and is even essential to life! Another example of threshold: Take your common household microwave oven. Place a living creature inside the chamber and even the hardiest animal will perish.

Is there a threshold? Of course. Is it mentioned in the literature? No! We need to re-evaluate our pronouncements of gloom and doom in the carcinogenic world. Perhaps we will come to understand why trace chemicals are not so harmful after all.

Finally to "generations." If one of our medical doomsayers can find no evidence of cancer in the first generation, he will opine solemnly—wagging his distinguished beard as if to emphasize his undeniable wisdom—that the following generations will be afflicted with the plagues inflicted by the Furies: multiple or missing limbs, multiple heads and multiple miseries. Unfortunately as it happens, these misbegotten creatures have spontaneously sprung from unexposed humans. So how dare these doomsayers predict that the afflictions resulting from a possible carcinogen will skip some generations and land on others? Perhaps the inclination to promise generational disasters is the environmentalists' smokescreen for failing to discover adverse effects from minute quantities of animal carcinogens.

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One year later: Qualified Installer Program

It has been one year from the initial glimpse into Jones Intercable's plan of attack on service calls, since the NCTA technical paper "Managing service call reduction" appeared in the June 1988 issue of "CT." This is a continuation of that article and a summary of the results seen to date.

By Pam King
Technical Training Coordinator, Jones Intercable Inc.

The installer is responsible for the technical integrity of each installation performed. But more than that, the installer is an important cornerstone in our industry, frequently being the only company representative seen by the majority of the customers. The Qualified Installer Program (QIP) was developed to present installation guidelines for Jones International (Jones Intercable Inc. and Jones Spacelink Ltd.) installers, contract installers and technicians who work with drops. The elements of the program include:

1) An installer kit, which includes the QIP manual and handouts
2) A statement of commitment to quality workmanship
3) A series of meetings to review the program with the installers
4) Written skill evaluations (pre- and post-tests)
5) Five field skill evaluations (quality checks of actual installations)
6) Performance reviews and follow-up discussions between the installer and technician
7) Waiver options for variations to the program
8) Leader's guide for support in the presentation
9) Plans for requalification every 18 months

QIP, a company-specific version of the Performance Plus installer training program, sets performance standards that every installer is expected to meet. The QIP manual assumes installers already know the basics of an installation or are currently in training.

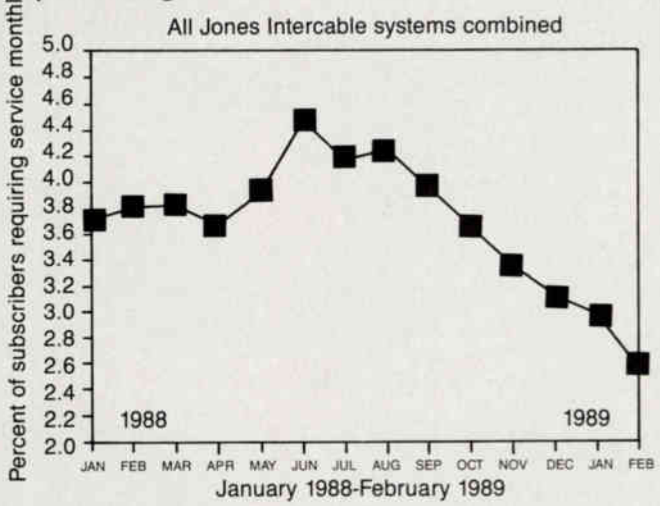
The purpose of QIP is to establish one drop practice for the Jones companies. This way, procedures can be standardized, professionalism is promoted within the installers, standards for good workmanship are advocated, performance standards are defined, and the importance of safety, elimination of signal leakage and good customer service are communicated. We knew from the beginning that the success of this program would rely primarily on careful performance monitoring, as well as closing the feedback loop between system managers, chief engineers and installers. Standardized installation procedures allow this to happen. We also recognized that since approximately half of all cable system employees are installers, by defining guidelines in the installation area, a sizable group is addressed. This achieves a high impact on system operations, specifically drop-related service calls.

When we initially developed the program, we attempted to give the systems everything necessary to present the concept to installers. However, there was a very important ingredient missing from our carefully prepared plans: How do you take a two-dimensional program on paper and turn it into a three-dimensional, living, working, successful program? We supplied each system with a manual and a leader's guide, but we still needed a "personal touch" from someone at the system. This person must understand installations, be enthusiastic about the program, be able to manage all of its elements, and be able to "read between the lines" and translate the material for the installers. The burden of this responsibility is placed on the system's QIP facilitator.

Bill George, installation manager in Independence, Mo., is responsible for managing QIP in his system. When he launched the program, he used the leader's guide, as well as the other elements of the program supplied to him by the corporate office. (QIP was a new program and this was the only way to decipher the guidelines set up by the corporate office.) From the start, he began customizing the program to meet his system's needs. This included initiating short training meetings, setting up individual installer files and tracking the percent of compliance of the quality checks (QCs) performed on all the installers, both in-house and contractor.

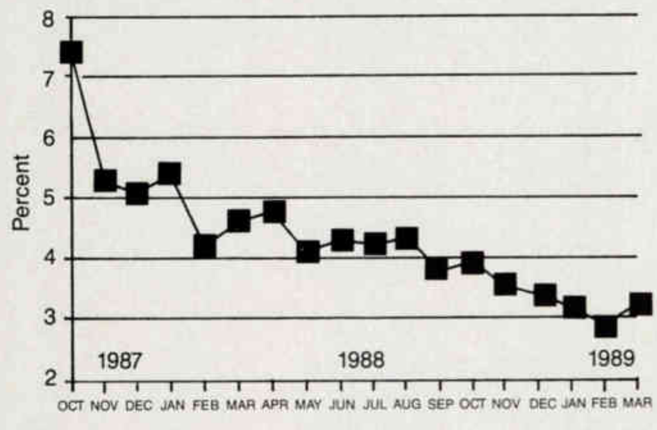
Still, the most important test was yet to come: Do the installations presently being performed reflect the material learned in the classroom? Will we see tangible results?

Figure 1: Jones Intercable service call percentage



Graph by Todd Acker and Kelly Shadel

Figure 2: Albuquerque system service call percentage



Graph by Brian Throop and Del Guynes

Tracking service calls

Todd Acker, Jones fund engineer, tracked the company's service call percentage since 1985. His research indicated a significant reduction in percentages over the last year, as noted in Figure 1. Additional research revealed that a large part of these service calls are in the installation area.

We realize that not all of this reduction is a result of QIP. However, we have been able to identify that it is an essential part of a good preventive maintenance (PM) program. This has been documented in our system in Broomfield, Colo. In April 1985 the system had a service call rate of 4.2 percent, with a year-to-date of 3.6 percent. Three years later it was 1.7 percent. At the end of March 1989 it was 1.4 percent.

There were several factors contributing to the reduction, according to Dewey Wagner, the system's technical manager: "Before the system was able to come up with a solution to reduce service calls, we needed to know the source of the majority of them. Analyzing past call reports, we noted that 42 percent of the calls were drop-related, 25 percent were converter/decoder calls and the rest were set problems, fine-tuning calls and feeder and trunk problems, in that order.

"To give some history of the Broomfield system: In early 1985 we had one trunk technician. Maintenance techs were non-existent and no one knew what CLI was. So we felt our first step should be to implement a PM

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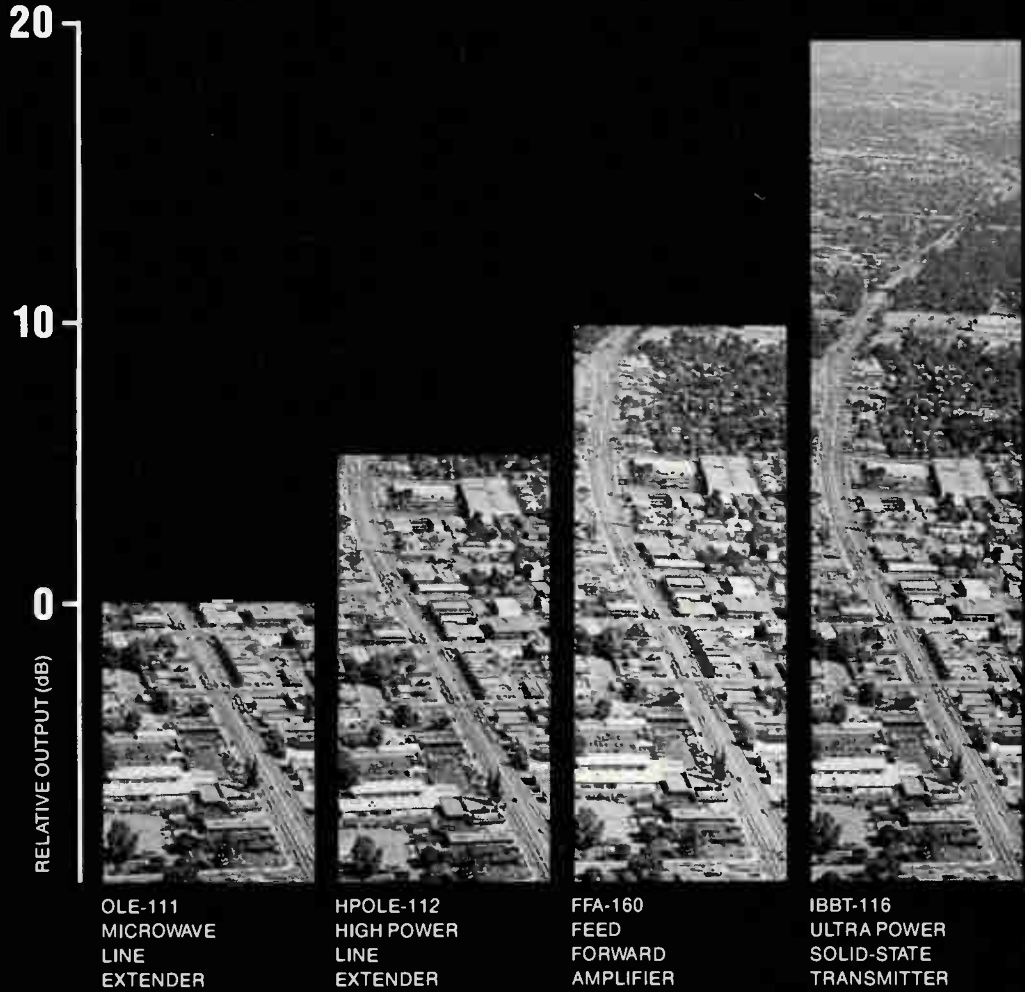

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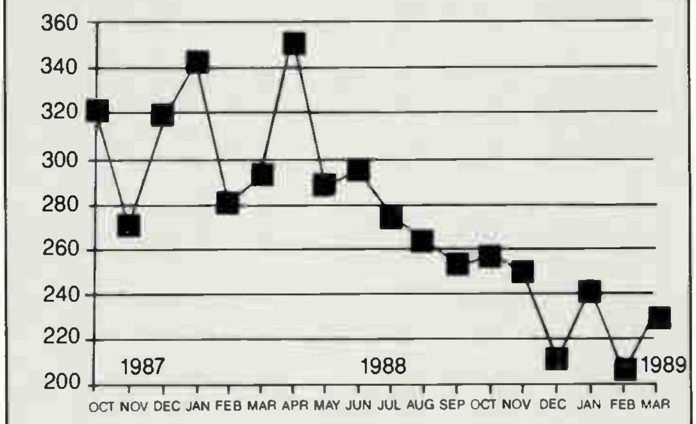
Figure 3: Albuquerque drop-related service calls



Graph by Brian Throop and Del Guynes

program. This would include normal sweeping, balancing, headend checks, power supply maintenance and general plant maintenance. Upon implementing the program, we saw an immediate reduction in outages but the service call percentage stayed relatively the same.

"The next step was to start monitoring leakage utilizing the service and maintenance techs. Right away we saw a reduction in drop ingress calls. This was a good start, but our service call percentage was still in the 2.5 to 3 percent range.

"The next project concentrated on replacing the wired remote converters in the system with infrared remotes. Because of franchise requirements, we still had to offer a wired remote upon request, so we have been unable to completely eliminate these converters. However, by reducing the number of wired remotes, converter calls were reduced by about 40 percent."

With the implementation of these programs, the system started to see an acceptable percentage but it leveled off to a range of 2.2 to 2.4 percent. Again service calls were analyzed; the system pinpointed drops as the major problem. Every time new contract or in-house installers were hired, the system ended up running service calls behind them or needed to send them back to correct an install. Most of the calls were generated from the drop—specifically, poorly cut or loose fittings.

"The F-Connection" newsletter

Then came QIP. The program dealt with the proper method for cutting fittings, proper drip loops, avoiding cable trespass, drilling holes, weatherproofing connectors, grounding, safety, professionalism, when not to do installs, how to protect oneself when accused by a customer of damaging the TV set and other information to ensure all installs are done correctly and safely. Installers received a manual explaining the ways and whys of doing installs for Jones and a written test to assure that they understood the guidelines. Finally, they were given a field test based on doing quality checks on five installs per installer. They were graded, along with the written test, at Jones' corporate office.

If the installers pass both tests, they are presented a patch, card and certificate showing they are a Jones Intercable qualified installer. If they fail one or both tests, they are given additional training and retested within 30 days. If they are not able to pass either one of the tests after three tries, they will not be allowed to do installs for Jones.

All contractors, including contract supervisors, are required to complete the QIP program before working in the Jones systems. This can be a problem because contractors "float" their associates from company to company. So it is advisable to qualify as many contractors as possible to ensure that when they bring new people into a Jones system they have at least successfully completed the written test. All that is left is to do a quality check of five installs and grade them accordingly.

Even with all of the Broomfield installers certified through the program, an active quality assurance program had to be in place. A minimum of 10 percent of all installs are checked weekly for quality to ensure that they

(Story continued on page 32)

Testing QIP in Albuquerque

By Brian Throop
Engineering Manager
And Joe Roney
Quality Assurance Supervisor, Jones Intercable

The Albuquerque system in 1987 was a perfect place to test the effectiveness of Jones Intercable's new installation guidelines program. At that time, the drops in the system were in very poor condition. Because of the way most houses are built here—stucco siding, flat roof, slab floor—installs are difficult and expensive. The majority of the drops had been laid across roofs and attached poorly (or not at all) to the sides of the houses. In addition, aerial drops were non-messengered, bonding and grounding was not being done and weatherproofing was rarely done. Due to these factors, service calls were disproportionately high for drop-related problems. Because staffing was needed to run service calls, little or no preventive maintenance was being done. The net effect was a service call percentage of about 7 percent of the subscriber base on a monthly basis (Figure 2) and a CLI figure in excess of 75. Throw all of these problems at an 1,800-mile system with 68,000 subscribers and you have a large problem.

Being one of the initial test systems for the QIP rollout allowed us to start corrective measures in early 1987. We first began training our in-house associates, which included 26 service techs, 14 maintenance techs and 15 installers. Because this group did very few, if any, new installs (in-house installers handle primarily disconnects and changes of service) we began creating guidelines for jobs other than new installs. The original version of QIP dealt only with new installs, and we felt that every visit needed to have minimum standards set for what the tech/installer should correct to eliminate return visits. Some of these items included bonding, tightening and weatherproofing all fittings and other items that could eventually result in a return call.

After rolling the program out in-house, we began the larger task of including all contract installers (approximately 75) in the training process. It was a drawn-out process to qualify 75 installers, mostly because contract companies generally have a fairly high turnover rate. Couple this with additional turnover caused by installers failing field checks and the process looked like it would take forever. However, once it was completed it became very manageable to just handle the normal new-hires.

All new installers begin QIP training immediately and are not assigned workloads until they are fully qualified in both written and field skills. To date, of the 405 installers this system has started to qualify, approximately 200 have completed both field and written evaluations. Of these, 85 are currently active in this system and 14 are pending completion. As you can see, about 200 (or 50 percent) of the installers who started never finished qualifying. QIP qualifying is a very effective process for assessing the projected performance of new installers.

Local installation specifications

Soon after beginning QIP, it became evident that many system-specific procedures needed clarifying. Waivers can be submitted to the corporate office if any specific guidelines in the program must be modified. Because of the large number of stucco houses in Albuquerque and our goal to make a drop last 20 years, we found it necessary to add a number of specific specifications for this system. We created what we call our local installation specs (LIS). This is a 40-page addendum to QIP that describes items in more detail

Qualified Installer Program manual

than standard QIP requirements. This text includes system-specific items such as tagging and trapping procedures, radio codes, prices and pictures of specific installation items. One of the major additions we found necessary was the method for attaching to stucco walls. We found that the standard nail clip-type fastener generally will not hold well enough to give 20 years of service; the result is the drop wire coming loose and hanging on the side of the house. The method we decided to use is a screw and plastic anchor, along with a metal clip. This requires drilling a hole for the anchor that takes a bit more time, but the drop attachment will last for years. Many of the methods we chose to use require more time, but the overall goal is to create an affordable drop that will not require reworking in a short amount of time. Two important items that must be considered before implementation of this type of program are tools for installers (such as cordless drills) to save time and the prices paid for contract labor. Don't be surprised if contractors request rate increases; a 20 year drop usually takes a little longer to do than the current method.

Probably the most critical part of the program is verifying that the work is being completed correctly and measuring its quality. This is accomplished by the in-house quality assurance (QA) staff. We started with one person, have expanded to five, and are currently checking about 25 percent of completed installation work. This group also handles QIP training, testing, field evaluations and other corporate-related inspections that require reporting on overall system progress.

To get a true picture of the quality of each job, these QA techs check each item very closely. A quick visual check is not enough; all connectors are checked for tightness, proper crimping and weatherproofing. All aspects of the install are checked very thoroughly, from terminators to customer satisfaction; discrepancies are documented. All jobs must pass with a minimum of 84 percent of the items correct. Any items found not correct are reported on a "go-back" and require the installer to return within 72 hours to rectify all identified problems. If the problems are not corrected, a charge is imposed and our in-house crew completes the repair. Any contract company whose percentage falls below 85 percent for the week or has more than 20 percent go-backs for the week is charged $35 per go-back. Because of the serious effect these QA checks can have, the QA techs must be very accurate and consistent. The tracking and documenting of the work is enormous and very time-consuming. Because of this, we have added a data base program and optical scanner to help facilitate the process. Our corporate office has been able to use some of the research from our program in the development of the companywide program.

Results so far

In a little over one year during which the system has been operating under QIP guidelines, we have reduced drop-related service calls by 25 percent (Figure 3). In Albuquerque, this translates to around 300 calls per month and, at $35 per truck roll, $10,500 per month or $126,000 per year. This has allowed us to shift service technicians to maintenance functions and allowed the system to reduce its overall service call percentage from 7 to about 3 percent and obtain an acceptable CLI figure. Even with these improvements, we still have a long way to go. It will take a few more years to have reached all drops and bring them up to our new standards. But the hardest part is complete: getting the initial training done and creating our system-specific standards. We are now anxiously awaiting the most recent revision of the QIP manual.

(Continued from page 28)

meet system standards. If an installer is not doing the job to specification, additional training and testing is required. Because of this program, the system started to run fewer service calls on new installs. All reconnects were brought up to QIP specification. There were fewer customer complaints about the install and the installer's professionalism.

An added benefit of QIP is that service techs are able to concentrate on leakage monitoring and the mechanical integrity of the plant while spending less time on service calls. The less a customer sees of a service tech, the better customer relations will be.

Aside from the benefits of reduced service calls, introducing the program also has helped identify areas that require additional training. For example, most Jones systems have tackled the problem of loose F fittings. However, there is a complex web of interlocking emergent problems not unique to any one system:

1) Quality assurance training—When Jones started QIP, it was incorrectly assumed that installations were consistently being checked and continuing the QC process under the name of QIP would not cause additional work. However, it was discovered that the QCs were not being done. Many systems quickly saw the need to fill this void, so they hired a quality assurance (QA) technician or, in the case of larger systems, established a full-time QA department. In many cases, these associates are in need of job descriptions as well as additional training and support.

2) Salary—In order to attract and keep qualified installers, salaries need adjusting. For example, in one of our systems, the typical installer has been with the company for less than half a year. This is due primarily to installers finding a similar job in other disciplines and acquiring a higher salary there.

3) Communication—Lack of communication is a common comment quoted by installers. Memos can be lost, miscommunicated or misinterpreted. Installers are not always able to attend meetings and thus hear the news third- or fourth-hand.

4) Upgrade guidelines—Completing a QIP install is generally not a problem. However, bringing an existing install up to spec while performing a change of service or reconnect requires specific guidelines, especially when the grounding does not comply to the National Electric Code.

These and other issues, now that they are identified, can be remedied. For example, since this is the age of video, Jones is exploring more communication through informal and inexpensive videos. The introduction of *The F-Connection*, the Jones newsletter for installers, has been developed to bridge the gap between the installer and the corporate office. It includes program updates, practical training tips and material submitted by our systems describing various training- and installer-related topics.

Installer data base

We soon discovered that keeping track of 1,000+ in-house and contract installers was not an easy task. For all systems (except Albuquerque, N.M.), the corporate office grades all written and field skill evaluations with an optical scanner, determines who is qualified, returns to the installer the qualification patch, qualification/ID card, certificates, congratulations letters and system tracking updates. It was decided to implement a data base program to facilitate this tedious and time-consuming task.

The data base program tracks the progress of all installers enrolled in QIP. It also is being extended to include all technical associates, since we are developing a total technical curriculum, with the installer training being just one segment. Although the data base program is not complete, it has already been a boon in keeping our notes straight.

This year we plan to further develop QIP by creating a series of technical interactive laser disc programs. Two programs, "Basic Installer Training" and "Safety in an Aerial Environment," are being produced by the Business Learning Group for early 1990 completion. At that time, these programs will be made available to the industry.

It is especially fascinating to note how each system has tackled QIP. The accompanying sidebar gives additional insight into a system that customized the program, as well as some cost advantages associated with a well-run plan.

Acknowledgments: The author would like to thank the Jones Intercable associates in Independence, Mo.; Broward County, Fla.; Broomfield, Colo.; and Albuquerque, N.M.; for their candid feedback of the Qualified Installer Program and for their assistance with this article.

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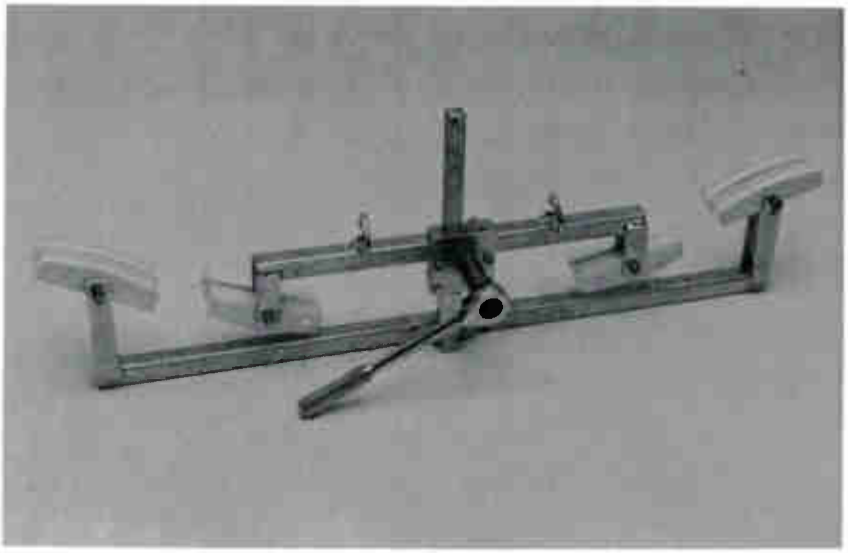

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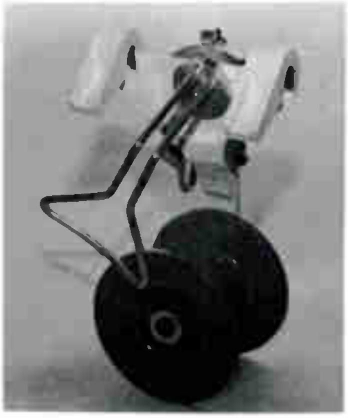

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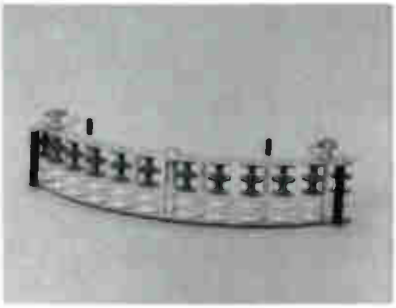

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Reader Service Number 26.

SCTE: 1969-1989

20 YEARS OF SERVICE

Technical training and the SCTE

By Howard Whitman
Manager of Editorial and Promotion
Society of Cable Television Engineers

One of the greater testaments to the increasing importance of training in the cable industry is the growth experienced by the Society of Cable Television Engineers in recent years. The SCTE is dedicated first and foremost to the training of all of the industry's technical personnel. Society membership figures (from 2,500 members at the end of 1984 to 5,000 four years later) prove there is a growing number of personnel who also feel that technical training is a priority commodity that cannot be ignored or undervalued.

As the industry faces growing competition from new technologies, it must reach and maintain a level of excellence that will keep subscribers satisfied while attracting new ones to its services. The best route to fulfilling these goals is to educate personnel at all levels: from installers to engineers. The only way for one's skills to evolve is to continue developing and improving them through further learning. Our industry must realize this if it is to be a contender in the ongoing competition for the consumer dollar.

Ron Hicks

More at stake

There is more at stake here than just business considerations. We must take pride in what we do and persevere confident in the knowledge that we provide the best possible service to our subscribers. Additionally, don't we all gain a degree of satisfaction from helping others, even if helping others is our source of livelihood?

It is for these reasons that educational organizations such as the SCTE were formed. The SCTE hopes to improve performance in all aspects of operations, resulting in an improved level of service, a flourishing industry and, ultimately, a satisfied public.

We offer a number of training opportunities, including our annual Cable-Tec Expo, the training and hardware conference that allows industry manufacturers and suppliers to meet with system technicians and engineers. The expo offers hands-on instruction as well as technical seminars and demonstrations on proper equipment operation.

For those who are unable to attend the expo, training also may be derived at one of the many technical seminars conducted by 49 local chapters and meeting groups. These can be found in accessible locations throughout the United States and the Caribbean. Seminars feature presentations by respected industry professionals and are valuable forums for technical discussion at the local level, expanding the knowledge of our members while aiding in their individual development.

Training seminars may be prohibitive to some due to inaccessibility or time constraints. Fortunately, we have developed a method of bringing seminars to industry personnel everywhere. Our Satellite Tele-Seminar Program provides videotaped programs each month, making them available for systems across the country to downlink and record; these programs may be used for immediate and future employee training purposes. We recently premiered a new series of product-specific tele-seminar programs, developed to aid and assist in training technical personnel in the use of specific companies' product lines.

BCT/E certification

Seminars are not the only available means of technical education, however. The Society's Broadband Communications Technician/Engineer (BCT/E) Certification Program is also a valuable method of enhancing an individual's personal development within the industry. Through a challenging program of study and testing, candidates for BCT/E certification receive much more than a certificate. They gain valuable knowledge and experience as well as a means of evaluating their professional abilities in the process.

In hopes of furthering its goals of a well-educated technical community the Society developed the new Installer Certification Program (see article on page 52). Candidates for certification will not be evaluated purely on their performances on examinations. Other means of evaluation will be utilized, such as field exercises testing a candidate's skill, experience and practical knowledge. Examinations in the program will be administered for the first time at the expo in Orlando, Fla., this month.

The Society's emphasis on training will only grow stronger in years to come. With the addition in 1988 of Director of Chapter Development and Training Ralph Haimowitz to the Society's national headquarters staff, SCTE has concentrated its efforts to provide training opportunities to the industry. In addition to acting as a liaison between the national headquarters and the local groups, Haimowitz is working to upgrade and increase the Society's training materials and information. He also is developing new technical training programs for systems throughout the country. Last year he conducted seminars for installer/technicians, service technicians and field supervisors in Charleston, N.C., and Dallas.

Of course, we are not the only organization currently offering technical training opportunities. There are a number of excellent options available and these should be sought out. The bottom line is this: Through improving our skills and knowledge, we improve our industry, our service and ourselves.

Training options and advantages

By Tom Brooksher
Marketing Director, National Cable Television Institute

If you are like most people in the technical side of the industry you have mixed feelings about training. On the one hand, your installers and technicians need all the training they can get to do their jobs efficiently and reliably. On the other hand, your people are so busy trying to keep up with the work that finding time for training is difficult. And training is an expense item in your already pressured budget. So what do you do?

Unfortunately, all too often the solution is to put training off. So, one crisis after another drives home the point that you need system-level training. Now you're faced with those mixed feelings and confusing options again.

Is there any hope? Yes. It starts with understanding what training can and can't do for you, sorting out the options and implementing the solution that best fits your situation.

Most often, when you reach the point when you say to yourself, "We've got to get more training for our people," you've just discovered an installer who has completed 137 installations and successfully grounded only 13 of them. What you're really saying to yourself is, "The quality of our work is below acceptable standards because our people are insufficiently trained." And you're right: The first thing proper training can accomplish is to raise the quality of work performed by your technical staff. But that's far from training's only benefit.

Consultant Bill Ross proved beyond a shadow of a doubt that training CATV technical personnel dramatically increases their efficiency. In case you missed it, he set up a test in two similar systems and carefully measured the results. He left one system to rely on on-the-job training. In the other system he implemented a training program using a self-study curriculum. After 12 months the system with the training program needed only 10.4 installers to complete the same number of installations per month that the system without the program completed with 13.3 installers. So properly trained employees are more productive.

While quality of workmanship and efficiency are probably the two most directly measurable benefits, there are several other important advantages. Customer satisfaction is one; better trained workers doing better work deliver better quality signals to subscribers and project a more professional image, which reflects both on the worker and the company.

Training also instills confidence in employees. People who feel they know their jobs project that confidence—to customers, supervisors and other employees. This translates to better work performed more efficiently. It also makes for more loyal employees. Workers who feel good about their ability to do their jobs feel better about their jobs and their employers. They recognize that their employers have made an investment in them and see a value in them. Knowing that they are viewed as valuable employees produces loyalty.

Finally, training creates promotable employees. If your field force is inadequately trained you probably find yourself reaching outside of the organization more often to find someone qualified to fill a supervisory position. Promoting, rather than hiring, is less expensive, less time-consuming and creates employee loyalty in itself. Supervisors hired from outside the organization may have the experience and training you need, but they must be trained in the policies and procedures of your company. An employee who is promoted typically can step in and get up-to-speed more quickly. Hiring from the outside is necessary and even advantageous at times; but if you are doing it because your people aren't trained adequately, something is wrong.

Ron Hicks

Training alternatives

Once you are convinced that training can fulfill the needs of your organization, the next step is to review the many alternatives. Each has its advantages and drawbacks, so the real purpose of this exercise isn't to determine which alternative is best but which is best in your specific situation.

The first choice is between in-house and out-of-house training. In-house can take many forms, including training by supervisors, system-level specialists, regional specialists and regional and national centers. But regardless of the level, in-house training occurs within your company at the local, regional or national level.

The advantage of this is that it is personal and specific to the policies and procedures of your company. The disadvantage is that to do a comprehensive job it is extremely expensive: Curriculum has to be developed, trainers have to be hired and trained and you can only spread the cost over the employees of your organization. Unless your organization is extremely large and centralized, it is usually cost-prohibitive to implement a comprehensive program. An in-house program that is meant to be less than comprehensive can meet some of your needs, but you need to recognize its shortcomings.

The typical program of this type should attempt to meet a well-defined, more limited need such as initial training of newly hired installers. In this situation, the objective might be to train inexperienced installers so they can begin making routine installations without on-site supervision. Such a program could include a week's intensive training by the installation supervisor, chief tech or an in-house specialist. The curriculum could consist of a predefined checklist of tasks the new installer is required to master by the end of the week. The instruction will probably rely heavily on the expertise of the instructor demonstrating the techniques involved and reinforcing the in-person instruction with a few handouts from corporate, a few magazine articles or some materials obtained from the Society of Cable Television Engineers.

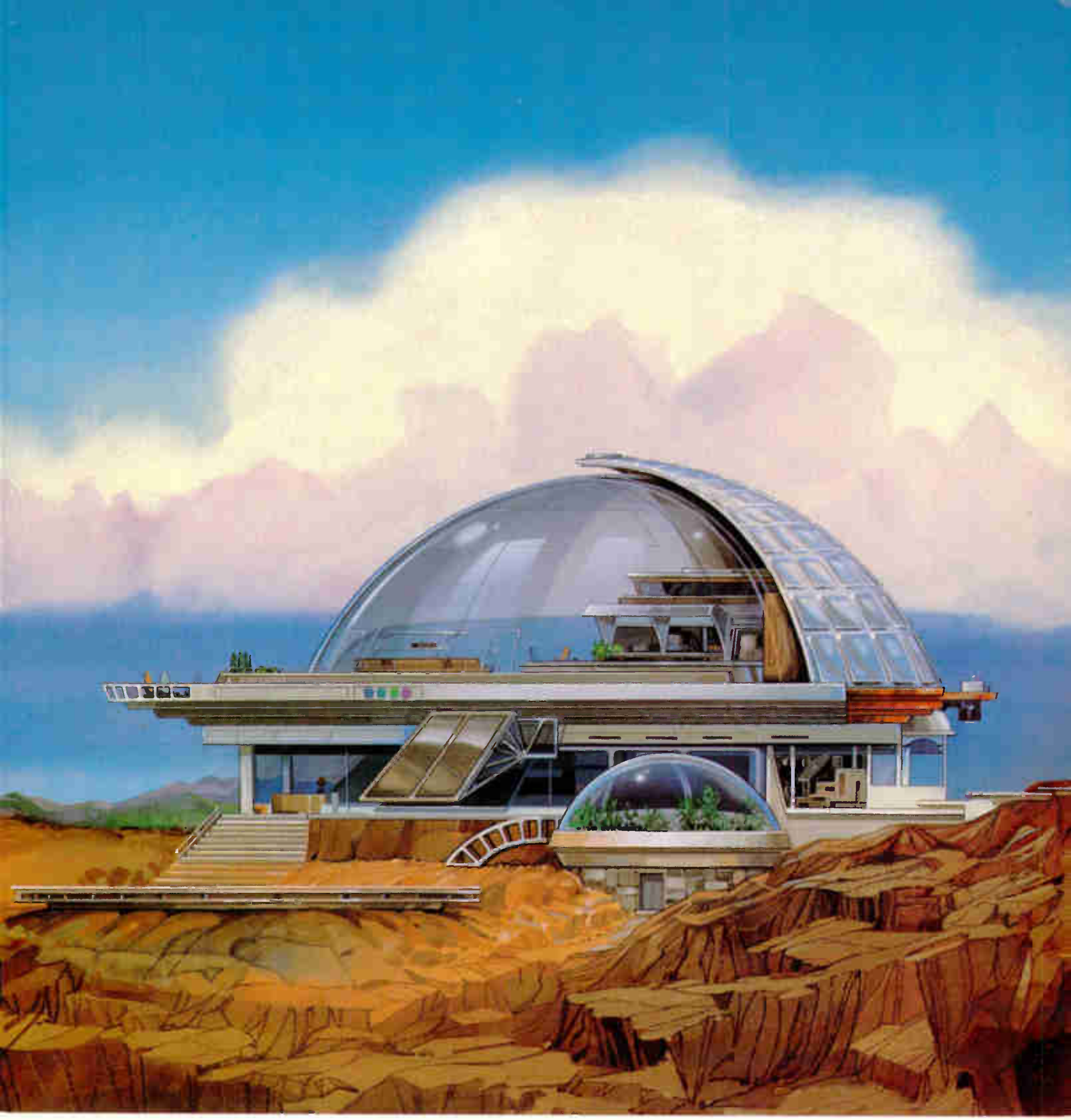
Such a program is routine in the industry, particularly for new-hires. Its advantages are that it gets employees to the point where they can be sent into the field to start producing. Once there, the next plateau is usually reached through on-the-job experience—seeing the problem, asking for help and implementing the solution. The disadvantage is that it only equips new employees for the most routine situations and unleashes them on customers in a trial-and-error mode. It can subject them to the biases, limited exposure and bad habits of the supervisor (if the training is being administered by one) and more often than not doesn't teach the employees the reasons behind the tasks.

Some of the largest MSOs have developed sophisticated regional and national training centers to serve their systems. Generally, these are very good programs that can fulfill most if not all of the potential benefits of training. They offer personal training using comprehensive, specially developed curriculum. If done well, their only drawbacks are cost-oriented. It is extremely expensive for an MSO to create and maintain such a facility and program. The costs to systems of sending employees to the center include the direct costs of the student's tuition, travel, lodging and meals, as well as the indirect cost of not having that employee in the field for a week or more. Many companies find these programs affordable for some employees but not all. Systems located closer to training centers are more apt to find the programs affordable than systems that have to bear heavy travel expenses.

Out-of-house options

This leads us into the second major alternative: out-of-house training. To spread the costs, some MSOs have opened their training facilities to employees of other operators. Probably the best known centralized MSO training facility is the ATC National Training Center in Denver. It has an excellent curriculum and facility and has increasingly taken its training programs on the road for week-long seminars in cities where ATC has systems. By all accounts, where available this has proven to be a good training resource.

The other two major external training options are the SCTE (and related programs) and independent training companies. The SCTE, through



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Reader Service Number 29.

local chapter seminars and publications disseminated through its national headquarters, is an important and valuable resource. Local chapter seminars can be an excellent, low-cost source of training. They are not meant to provide a substitute for a comprehensive program but are invaluable as a means to supplement such a program with in-depth seminars on special topics and technical areas.

The SCTE also produces and distributes hundreds of publications and videotapes on topics ranging from *CATV Signal Level Meter Basics* to *Fiber Optics—Here and Now.* The SCTE offerings are an excellent resource to draw from and can assist in attaining the competence levels necessary to successfully complete the SCTE BCT/E testing and certification process.

There are a few independent companies offering technical training within the cable industry. These primarily offer self-study or correspondence training. The advantages they offer include low cost per employee trained, availability regardless of where the employee is located, no loss in productivity (employees typically complete their studies during non-working hours), self-pacing (students can work at the program as quickly or as slowly as they comprehend the material) and comprehensiveness (the courses can be developed to cover all level of expertise). The disadvantages are that the courses lack personal instruction and have to be developed on industrywide standards. Thus they can't take into account the policies and procedures of your company.

In evaluating self-study there are a couple of questions to ask that will ensure that the course you select will provide practical, quality training. First, if your need is for CATV technical training, does the course provide CATV-specific information or general electronics? Electronics training is great, but it is no substitute for detailed instruction on drop, feeder, trunk and headend construction and maintenance. A curriculum providing CATV technology and techniques, along with electronics theory when it is necessary, is often the best solution for system-level training. Ask for a detailed outline of the course to determine this.

Second, how practical is the information? Was the course written by cable veterans or industry outsiders? Ask to see sample lessons or excerpts from the course and determine this for yourself.

Third, what checks are provided to maintain the integrity of the course? Are students required to pass exams to verify their comprehension? Does the course require completion of a final exam and, if so, what checks are in place to ensure that students don't cheat to pass the final?

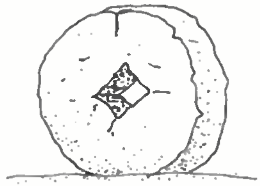
Fourth, what kind of a track record does the training company have in the cable industry? How many students has it successfully trained and for how many different MSOs and systems?

Finally, what kind of support does the training company provide you in administering the courses? Do you get regular notification of the progress of students in your organization?

The best solution

So which of these alternatives is best for your organization? If you are like most cable operations, the best solution for you will involve several alternatives used for different systems with different employees in different situations. The optimal program includes a budget for sending a few employees to regional or national centers, either operated by your company or other companies, to take advantage of personal training in key, often advanced, areas. It includes financial means to obtain support materials and training expertise for a local program, often directed primarily at getting new employees up-to-speed quickly. And it includes funds to provide quality self-study opportunities to allow employees to progress beyond introductory training when unable to obtain additional personalized instruction locally or at a center. It also will provide for employees fortunate enough to attend classes to obtain advanced training.

But in order for any of these areas of the solution to be most effective, there must be a real commitment on the part of the company and system management to support any and all training programs in use. Employees must have management and supervisory personnel available to explain unique policies and procedures relative to the techniques they are learning. Managers and supervisors must answer increasingly challenging questions as the employees push back their own technical horizons and are stimulated to reach for even greater understanding. The rewards will be higher quality workmanship, more efficient technical personnel, greater customer satisfaction and more confident, loyal employees who are available for promotion to positions of greater responsibility.



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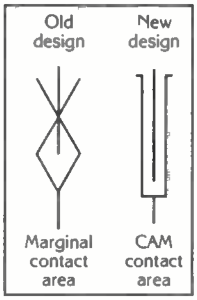

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Reader Service Number 31.

Training programs in fiber optics

By Wes Schick
Manager, Fiber-Optic Products, Anixter Cable TV

And Virgil Hollingsworth
Marketing Specialist-Fiber Optics, AT&T National Product Training Center

So you're committed to fiber optics. Your system is planning a fiber supertrunk or perhaps launching into an upgrade program utilizing a fiber backbone architecture. Plant design is under way, equipment is on order, deliveries are scheduled and construction contractors are all lined up. Everything is in place to assure that your fiber project goes as smoothly as possible.

But before you get too comfortable, be sure you've considered who will maintain your fiber plant once it's in. Are these people trained in optical technology? If not, do you know where to go for training? What specific areas should be covered by a comprehensive program?

In the past year, numerous companies have emerged with products and services relating to fiber. Companies dedicated to providing educational services have expanded course offerings; new companies have been formed with the expressed purpose of providing fiber training. Most of these entities rely heavily on product manufacturers for instruction, either working directly with the manufacturers' product support service department or hiring full-time instructors with manufacturer experience in R&D or field applications.

There's a very good reason for this reliance on manufacturers: They have the most expertise in new technologies. Because several years of research and development are invested in optical technology before it is successfully deployed in a new application (e.g., CATV), manufacturers become experts in the field. They can allocate significant resources to the study and development of fiber technology; they have the potential for return on that investment through commercial introduction of a final prod-


Courtesy Anixter Cable TV/AT&T

uct. While independent training companies can access much of this information, they cannot fund original research at a comparable level.

Most manufacturers make formal training programs available to customers using their products and many are open to non-users. These programs can generally be relied upon for the technical depth required by participants to maintain the manufacturer's equipment. But not all of these programs cover more than product-specific information.

Using a hybrid approach

To offer your people a comprehensive training program, it may be necessary to use more than one manufacturer or a combination of manufacturer and independent trainers. If you buy lasers and optical receivers from one company and fiber cable and connectors from another, this hybrid approach may be appropriate.

For example, some training programs in the telecommunications industries are provided by AT&T. It offers more than 14 different programs in various levels of technical depth. Some of these are available as "suitcase courses" at your location. Others are conducted at one of four training centers. Courses vary in technical depth, duration and lecture vs. hands-on format. For illustrative purposes, we will use AT&T's curriculum as a suggested guideline for designing a training program.

A series of seminars for the manager and non-technician presents fiber technology and its applications in the communications business with a focus on the CATV industry. The non-technical seminars range in length from one to three days, with most subject matter presented in a combination of lectures and discussions. Topics include types of fiber, cable designs and applications, terminating equipment, closures, splicing and connectorizing techniques, and testing procedures.

A special eight-day course also is offered for managers on the principles of information networks and distribution systems. It provides a general overview of terminology, concepts, protocols, standard components and systems used in the design and implementation of local, metropolitan and wide area networks (LANs, MANs and WANs) for the exchange of voice, data, image and video information.

Courses for technicians are a combination of lectures and demonstrations reinforced with hands-on field exercises that comprise 75 percent of class time. Most technical courses range in length from two to five days. Course topics include:

- *Cable placing*—aerial (two days) and underground (three days).
- *Distribution and outside plant fundamentals*—installation and splicing (five days), testing (two days), assembling connectors onto fiber (two days), loop distribution (three days), route restoration planning (one day) and rotary mechanical splicing techniques (two days).

All courses emphasize safety and work area protection practices.

Each facility is equipped with at least two labs dedicated to hands-on training. Our 12 full-time trainers are required to undergo regular instruction to bring them up-to-date on the latest developments. They also must attend special workshops on training technology, with emphasis on presentation technique.

Another group of training specialists work in the optical research labs and are responsible for identifying developments appropriate for trainer education. These specialists become directly involved in developing (and updating) courses to ensure that the trainers are equipped with the most current information to pass along to the students.

Course participants leave the center equipped to work in hostile environments, as well as in the lab or classroom. Instructors encourage students to contact them with any questions or problems that arise after the course has been completed. This is a valuable resource for the students when they've returned to the field.

A good place to start

The ideal training program for your technical staff may encompass a number of sources to be certain your people are properly trained for the equipment and systems they will need to maintain. Your equipment supplier is always a good place to start and may well refer you to other available courses. If you are dealing with several different vendors for your fiber system, be sure you contact all of them for their recommendations on what your people need to know.

In any event, do not underestimate the importance of training. Your fiber system's performance and economy will be greatly enhanced when you can rely on your own technical staff for its care and maintenance.

Federal job training program

By Frederick P. Sutliff
Manager, Training Services, Henkels & McCoy Inc.

A shortage of skilled workers in the telecommunications industry prompted us to get into the training business. Pirating employees or hoping that new-hires would learn on the job was not satisfying the cable industry's needs. Many employers are facing a labor shortage that shows no sign of letting up. Serious in some areas of the country and critical in others, the shortage is creating competition for an ever declining pool of workers.

Our solution has provided some answers for many cable operators and contractors. The constantly evolving technology dictated that we form a training department to keep employees qualified in their fields. So we initiated our own training programs, written and taught by technicians with a practical knowledge of the industry.

Also, we brought (or "suitcased") the training to our field operations to maintain productivity. The closer the training environment is physically and perceptually to the actual job, the greater the skills acquisition and retention. The concept of learning by doing was applied in every one of the programs, minimizing lecture and maximizing hands-on. The emphasis is to train for *jobs*, not for the sake of training.

In 1981 Henkels & McCoy Training Services began providing instruction under the federal government's Job Training Partnership Act (JTPA). Little did we realize that we would become one of the government's largest job-training contractors nationwide. Publicly funded programs have led to our graduating more than 8,000 students nationally after putting in more than 2.8 million hours of classroom training. Under the JTPA, the government pays us for placing graduates in employment related to the training; the new-hires must remain on the job for a minimum of 30 days.

The U.S. government has funds available for upgrade training of existing personnel and for customized job training. Specifically, if your company has the need for a number of individuals with certain skills, the government can provide the funds. You set the minimum entrance requirements, participate in screening/selection, approve the delivery system of instruction and offer employment to the successful graduates.

The majority of the students in this program are workers who have lost their jobs or individuals who have been underemployed. Many are used to making a decent living. However, they need retraining because their work skills are obsolete. And it needs to be hands-on, vocational skills training that leads to employment in a growth industry in as short a time as possible.

Course curriculum

Our basic cable television course consists of 350 hours of training; class size ranges from 10 to 20. The first block of training includes pole climbing, line construction, proper tool usage, CATV symbols and reading strand maps, bonding and grounding, and lashing cable. The next area consists of splicing, cable preparation, connectors, taps, splitters, extenders and amplifiers, all aspects of aerial and underground construction as well as meter usage and troubleshooting. We then move on to the installation, addressing such areas as MDUs and customer/public relations. Finally, in discussing the work of the service technician, students cover the concepts of distribution, amplifier application, powering, system layout and design, maintenance testing, and troubleshooting.

Students are equipped with a tool kit during training; it becomes their property once they obtain employment. Additionally, the installation/technical manual used in the course is structured so the participants will be simultaneously reading about the tasks they are doing.

Safety and customer relations are emphasized throughout the course. Additionally, we provide interviewing skills, resume preparation and job survival skills. It is not only important that the students find a job after training, we hope this is the entry into a career.

We continually update our courses and equipment. By doing these, our graduates are well-received by the industry, since they have been exposed not only to today's technologies but tomorrow's as well. Currently we are updating to include pay-per-view, loss and leakage detection, two-way systems and fiber optics.

Training for tomorrow

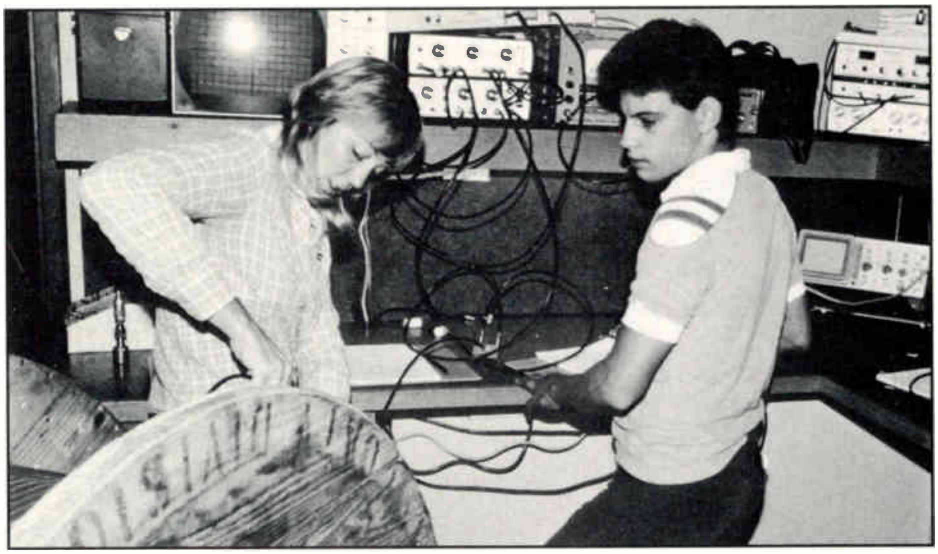
By Ronald W. Wolfe
Manager, ATC Training Center

On Thursday, June 4, 1981, American Television and Communications Corp. dedicated its new National Training Center (NTC) in Denver. The move to open a training facility created a great deal of favorable publicity for ATC. At that time, there was no other facility in the industry dedicated solely to the advancement of its technical personnel. Eight years later, the center is still seen as a symbol of the MSO's commitment to the industry.

Training programs began at the installer level with new courses developed up to and including chief technician/engineer. Today, the NTC curriculum includes many courses ranging from two-day seminars to an associate degree available through the center in conjunction with the Cleveland Institute of Electronics.

The center has had to react, often quite quickly, to meet the changing training needs of our operations. ATC's corporate engineering and technology department has become more involved with the activities at the NTC. It has assisted in developing and delivering several of our newer courses.

When the industry started to react to the problem of signal leakage a couple of years ago, the NTC offered a two-day seminar on CLI (cumulative leakage index) and leakage. It taught students the history of the problem and gave them the knowledge necessary to implement leakage control programs. Well over 200 employees of ATC and Paragon Cable as well as students from other MSOs have benefitted from CLI training.


ATC National Training Center

At the ATC National Training Center students use sweep test equipment to perform a return loss test of coaxial cable.

The level of sophistication of test equipment used in the field has grown rapidly, in some cases beyond the ability of the operator to keep up. Last year we began offering a seminar on equipment ranging from DC voltmeters to optical time domain reflectometers. Recently, fiber backbone technology developed by ATC started to look attractive for system implementation. So we developed two levels of seminars on fiber optics that offered both theoretical knowledge and practical applications experience. And the NTC is currently revisiting its course content and curriculum to determine if there are new areas of concern to address.

Centralize or decentralize?

In addition to our curriculum, the NTC is changing physically as well. Many of our longer courses and all of our short courses and seminars can now be taught in the field. This enables a system to increase the number of technicians who can attend a given session while minimizing travel expenses. Through this program of decentralized training, we have been able to more than double the number of students we train in a year without increasing our staff.

A dedicated facility for training is still important and decentralization can only be carried so far. Many systems have only one or two people who are (or need to be) familiar with the operation of a microwave link or headend alignment, for example. It is simply not practical to teach these types of courses in the field. In addition, the location must have access to the equipment that the students are attempting to master. This is not possible in a system environment due to the fact that the headend serves subscribers. Any adjustments made during the training process would generate service calls.

"Through...decentralized training, we have been able to more than double the number of students we train in a year."

At the NTC we have a complete headend with many different types of equipment operating; it can be adjusted to any extreme without generating service calls. There is also a microwave link that might just be the shortest licensed path, about 200 feet. (The only thing we have a little trouble demonstrating is rain fade.) There are two satellite dishes in the backyard as well as a pole farm and some sample plant. All of these items, when combined, enable us to provide a well-rounded educational experience for technical employees of all levels.

As we all know, this industry will not cease changing. It is our mission to ensure that our technical staffs are able to keep pace with these changes. It is fairly certain that new technologies will require us to evolve our training programs to take advantage of them. For example, in the near future, it will be necessary for more than just a handful of leading engineers to have a working knowledge of high definition TV systems. If the multiport provides to be a viable product for our industry, it will be necessary to train our technicians so they can install it and answer subscribers' questions.

The one certain thing in the future of the industry is that it will continue to grow and change. This requires that we focus on training our employees to grow and develop with it. The ATC National Training Center, like any successful business, must continue to evolve to meet these changing training needs.

SCTE: 1969-1989

20 YEARS OF SERVICE

Installer Certification Program

By Ralph Haimowitz
Director of Chapter Development and Training
Society of Cable Television Engineers

One of the major functions of the Society of Cable Television Engineers is to meet the technical training needs of the cable industry, and the Society has responded with numerous programs to fulfill this goal. The one area that needed more effort was developing a method to train installers and installer/technicians. We also needed to certify that they had the knowledge and ability to perform the basic requirements of their job.

Installers are of vital importance to our industry. Without them we would not be able to deliver our product to the customer. The entire image of the local cable company lies in the hands of the installers because they often are the first employee that the customer meets face to face. If they lack a neat and clean appearance, talk rudely to a customer, ignore questions or simply fail to do the job to the satisfaction of the customer, the company will be viewed in a most unfavorable way.

From a technical point of view, installers should use the best approved methods of performing the tasks of their job, which can range from climbing poles and ladders properly to interconnecting house drops with VCRs, computers, converters and TV sets. From a regulatory point of view, signal leakage is the greatest single problem facing most cable systems. The majority of leaks occur in the house drop, with improperly installed fittings the most common culprit. Finally, think of the benefits of not having to send a service tech to the customer's home because of a reception problem caused by improper workmanship during the initial installation.

One way to resolve all of the problems is to provide our installers and installer/technicians with training in all areas of their responsibility, from safety to customer relations to proper installation practices. And a way to accomplish this is through the new SCTE Installer Certification Program.

Ron Hicks

"The entire image of the local cable company lies in the hands of the installers."

Minimum generic requirements

The goals of the Installer Certification Program are to establish minimum generic requirements that should be observed by every installer and installer/technician in the industry. Once they have mastered the elements of the program and successfully completed the required examinations given by the SCTE, the Society awards them a certificate indicating their competence in this area.

Local chapters and meeting groups, under the guidance and direction of SCTE national headquarters, will conduct the training and examination of all candidates. Installer training workshops and certification examinations also may be given by any national SCTE director, members of the national staff or other individuals designated by the Installer Certification Program Committee.

Installers and installer/techs applying for certification will be charged a $20 registration fee. This fee will entitle the applicant to one full year's installer membership in the SCTE, as well as covering the cost of the installer manual and the initial certification examination fees. Annual dues for the installer level of SCTE membership will continue to be $20.

Installer membership in the Society entitles the individual to all of the discounts afforded SCTE members at conferences, meetings and seminars, as well as discounted prices on all SCTE products, publications, materials and videotapes sold by the Society. Installer membership does not include voting privileges, holding an office at national or local levels, insurance coverage or any other active membership benefits that require an expenditure of Society funds. A special membership card will be issued for installer members of the Society.

The certification program will consist of training conducted by local chapters and meeting groups using the installer manual as the basis for classroom training as well as hands-on training in proper drop cable preparation and fitting installation, signal level meter reading, safe and proper ladder use and proper pole climbing. Trainers for ladder and pole climbing must have prior certification by the Society in order to provide this instruction.

Upon completion of the training program, a 50 question written examination provided by national headquarters will be administered to the candidates. Chapter and meeting group presidents will be authorized to proctor this examination. Other local group members also may receive approval to act as proctor following application to the Certification Committee. Prerequisite requirements for proctors include national membership for at least three years and a statement of ability from the chapter or meeting group.

In addition to the written examination, four practical examinations will be conducted:

1) Proper drop cable fitting preparation and installation
2) Signal level meter reading
3) Proper and safe ladder use
4) Proper pole climbing techniques (optional)

Each of the practical exams when successfully completed will be recognized with special seals that are to be attached to the certificate. The pole climbing certification is considered to be optional in areas where pole climbing is not required. Proctors for the practical exams also must be approved by the Certification Committee.

Installer certification by the Society is valid for a period of three years. The triannual recertification process will be announced at a later date.

The SCTE and its local chapters and meeting groups are expected to seek support for the program from state associations and system management. It is our hope to convince industry management that every installer and installer/technician working in their system should be certified—both in-house installers and contractor personnel. For more information on the Installer Certification Program, contact your local chapter or meeting group or call SCTE headquarters at (215) 363-6888.

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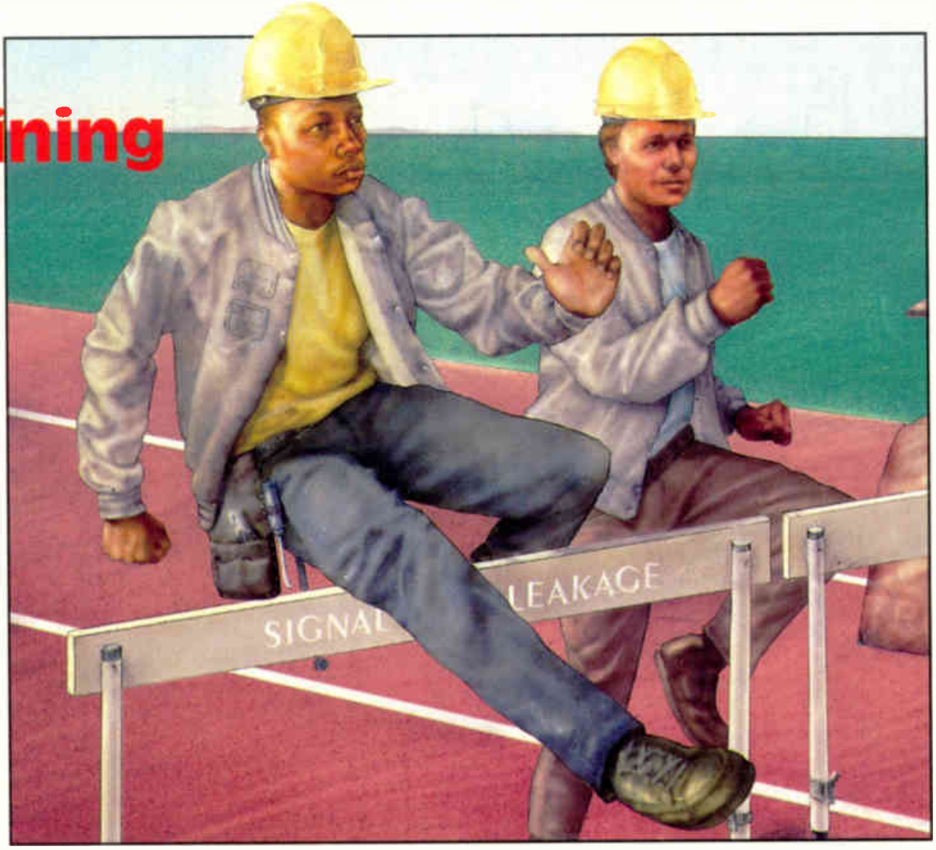
Reader Service Number 40.

See us at the Cable-Tec Expo, Booths 441, 449.

Certifiable technical training

By Alan Babcock
Technical Training Manager, Warner Cable Communications Inc.



Ron Hicks

The goal of every professional trainer is to positively impact and enhance the performance of employees in completing job tasks. The improvement can be measured by more pieces produced, less waste of materials or time, fewer accidents, more or happier customers and by a long list of other quantifiable measurements. Improvement also can be less quantifiable but evident in employees who feel better about themselves or their competence, increases in morale and other more subjective measures.

The major goals of Warner Cable training programs are to achieve job proficiency and improve performance. This is true for all department areas: customer service, sales, management and technical. To achieve training goals, the first step is to identify job tasks that need improvement. Targeting specific tasks to be addressed is only effective when they are defined by a "larger picture" and compared to a model of total competence for any job.

Job tasks are analyzed routinely to target job training needs. Supervisors have been asked to play a very important role in this part of the process: They inform the training department of the primary skill requirements of the jobs. Task forces are assembled to review requirements and come to a consensus on major functions of the jobs.

The technical training function provides perhaps the best example of linking training to job performance. We have developed some very specific guidelines for installation and preventive maintenance. These engineering standards define the technical specifications that must be maintained and play a key role in determining

the level of proficiency desired. The task force list of job requirements and major functions as well as the engineering guidelines are combined; these form the criteria for certification, the process by which we determine an employee's proficiency in the job.

Although it may be easy for employees to argue about whether or not they need training, it is impossible for them to argue against needing to be proficient in the job they perform.

Certifying installers

Installer certification has existed for nearly two years. The key components of the certification process are the installation manual, a checklist, a written exam and an installation class. The class is intentionally mentioned last because in many ways it is the least important part of the certification process. Every technical employee working in the field is expected to become installer certified; this includes contract installers. To become certified there are two methods:

1) Employees who are new installers are sent to a training class for a one-week intensive program. The program teaches the intricacies of performing an installation according to our specifications. The class stresses safety, customer relations and the technical requirements of an install. A passing grade of 85 percent is required as satisfactory completion of the class. Upon successful completion employees are observed by a supervisor performing installations on the job; the supervisor completes a checklist demonstrating satisfactory performance.

"Training exists as a way to achieve the proficiencies necessary for certification."

2) Employees who have been installers for a period of time and feel they are already competent in the job are allowed to be certified without attending the installation class. Employees and the supervisor must agree this is appropriate. Many supervisors believe even the experienced installers can benefit from the classroom experience and recommend sending them to a class. Most experienced installers, however, are able to complete the in-system certification. This includes a series of checklists used to verify proper tool issuance, adherence to safety procedures, appropriate customer service practices and installations completed to our specifications. The supervisor then submits the completed checklist to the corporate training department and a written exam is issued. The exam tests understanding of the installation manual, with a passing grade of 85 percent or greater.

In both of these methods, certification is only complete after a supervisor has verified the employees' ability to perform the job. Training is provided to assist employees in becoming competent enough to achieve certification. This type of certification process will eventually exist for each level of technical employee, i.e., demand maintenance, preventive maintenance, etc.

Certification accomplishes two very important things not associated with many training programs. First and most important, performance on the job is *the* measure of successful training. Unless employees can perform the tasks required on the job, certification is unattainable. Training is available to assist employees to become competent in the job. But if job performance at established levels isn't attained, certification cannot be awarded. A change in employment status may be recommended. Because the supervisor is the one who must verify the employees' performance, a positive relationship is created between the employees and supervisor, which reinforces a commitment to the established standards.

Second, the training program is designed to target the areas of deficiency and provide the training necessary to improve performance on the job. Persons already qualified to perform the jobs aren't forced into training they don't need and are recognized for the knowledge, skills and abilities they already possess.

Ensuring competence

Certification is not a training program; it is a process of ensuring that employees are competent in the job they are performing. Training exists as a way to achieve the proficiencies necessary for certification. Certification of the entire universe of our technicians is a long-term goal that when realized will assure us of a competent work force.

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Reader Service Number 44.

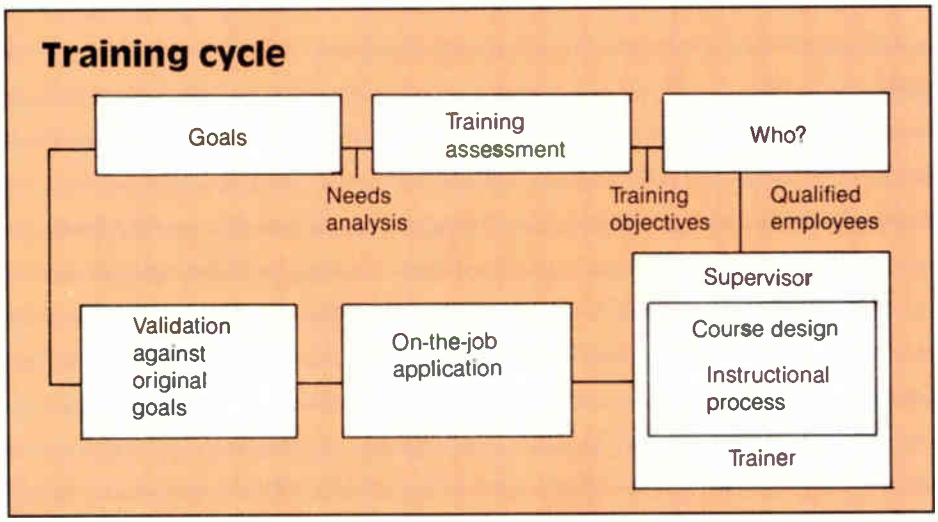
The supervisor's role in the training process

By Dan Rumrill
Technical Trainer, Viacom Cablevision

When does the training process begin and how is training supported? What role does the supervisor play in the process? An employee's first step toward looking for a new job may depend on the supervisor's approach to training. New employees are given the standard "welcome aboard" package, complete with the necessary forms and the nickel tour of the facility. The supervisor's approach to the development of new employees greatly affects their ability to become productive members of the company.

In today's workplace, trust and commitment on the part of the supervisor are essential to retaining qualified personnel. Career development has become an important issue to employees. The supervisor plays a major role in training, whether or not there is an in-house trainer.

Training begins the minute new employees are hired and continues throughout their employment with the company. The supervisor plays a key role in establishing the tone of work behavior. By embracing the new-hire as a valued part of the workforce, the supervisor sets up a working relationship that can prosper. Developing training guidelines and a follow-up program communicates to the employees that the supervisor is committed to success on the job. The supervisor also sets the pace for accomplishing departmental and system goals.



Ron Hicks

For all of us, system goals have to be met. We establish objectives, make our long-range plans and develop our budgets to meet these goals. With a well-trained staff these goals are more easily achieved. In the course of a day, a supervisor may be required to meet department objectives for production, evaluate personnel performance and meet with other managers and supervisors to discuss operational concerns. This ongoing process seems to leave no room for development of our personnel. How do we train our employees to meet the increasing demands of an ever growing cable system? How does the supervisor maintain the edge needed?

Taking an active role

To meet these challenges, the supervisor must take an active role in training. No longer can the supervisor depend on the system trainer to provide all of the training necessary to keep personnel up-to-date on the latest technology. The supervisor must provide training on an ongoing basis to maximize its effectiveness.

As a supervisor, you can approach the training process as if you were developing operating objectives. Decide what the end result should

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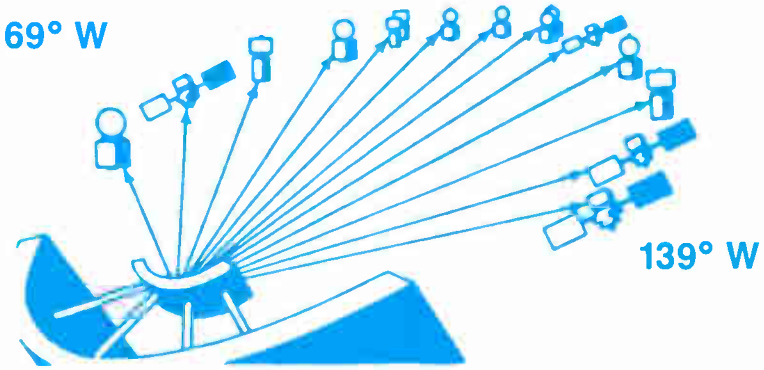

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be and make a plan. Planning and implementing goals are probably familiar to you so use this skill to develop a training plan for your group. The accompanying figure shows a goal-oriented training cycle. This is how it works:

1) Set the goal or objective you are trying to accomplish; e.g., reduce installer callbacks by 5 percent.
2) Perform a needs analysis to determine whether training is going to improve performance.
3) Assess the best type of training to achieve the intended results; e.g., in-house training, on-the-job training (OJT), outside seminars, etc.
4) Establish concrete, measurable objectives for the training.
5) Determine who would best benefit from the training.
6) Provide the training utilizing yourself, other installers or technicians or, if available, the system trainer.
7) Verify that the employees are using the skills that were taught during training.
8) Measure their performance against original objectives. Are they using the new skills? Has their performance improved?

The first step in the training process is setting an achievable departmental goal or objective. For example: If the goal is to reduce installer callbacks, start with an achievable goal of an overall reduction of 3 percent annualized. By establishing a goal that can be accomplished without undue hardship, the success rate will be higher. By establishing objectives, the evaluation of training becomes valid.

Then assess whether there is a legitimate need to spend capital to accomplish the objective. It may be that the costs of training outweigh the benefits of what you want to do. But if training has been determined to be the most efficient way to meet the objective, decide which type is needed to achieve it. Explore what is available to the department. Will two hours of in-house classroom training meet your needs or is an outside consultant (such as a vendor's application engineer) necessary? Many vendors are willing to come to a system and give a seminar on their products. This venue may be appropriate when the system is upgrading to a new technology. Having an outside source provide new product training may save hours of a technician's time learning about the new equipment.

Last but not least is on-the-job training. This method, when properly applied, can benefit the trainee with actual hands-on application.

Once the method is determined, the supervisor must establish concrete, measurable objectives for the training plan. The objectives should be clear to all who read them and should reflect the expectation of the trainee by the end of the class.

The supervisors have direct responsibility for the performance of their department. They are the key players in deciding who, what and how their personnel should be trained. If this decision is placed upon someone else, little will be done to maximize the success of the training objectives. Taking an active role in developing the objectives, material or the training itself will bring you into the training loop. This will ensure the chances of greater success.

Decide who will most benefit from the training and evaluate what personnel to send to the class. Consider if the new-hire installer will benefit from a class on distribution design or basic drop troubleshooting. Send only the personnel who will benefit most from learning the new skills.

The training itself can be provided by the supervisor, the in-house trainer, a qualified technician/installer or an outside source. Whatever method is used, the supervisor should participate in it. By attending the training class, the supervisor shows support for the learning process.

Following up

The key to a successful training program is the supervisor's following up on the newly acquired skills. Verifying that the new skill is being used and supporting that usage will validate the training for both the plant personnel and the supervisor. The supervisor also benefits from this process by developing skills in personnel evaluation.

The training cycle does not have to be a formal process. Sometimes it may be a case of demonstrating the proper way to perform a task for the employee. Other times it may require a needs analysis and developing a formal training program to meet and exceed the objective. In either case the supervisor is directly involved in the training process and plays an important role in the effectiveness of a training program. By maintaining regular skill-enhancing programs, the supervisor and the company will retain the experienced personnel needed to fulfill their goals.

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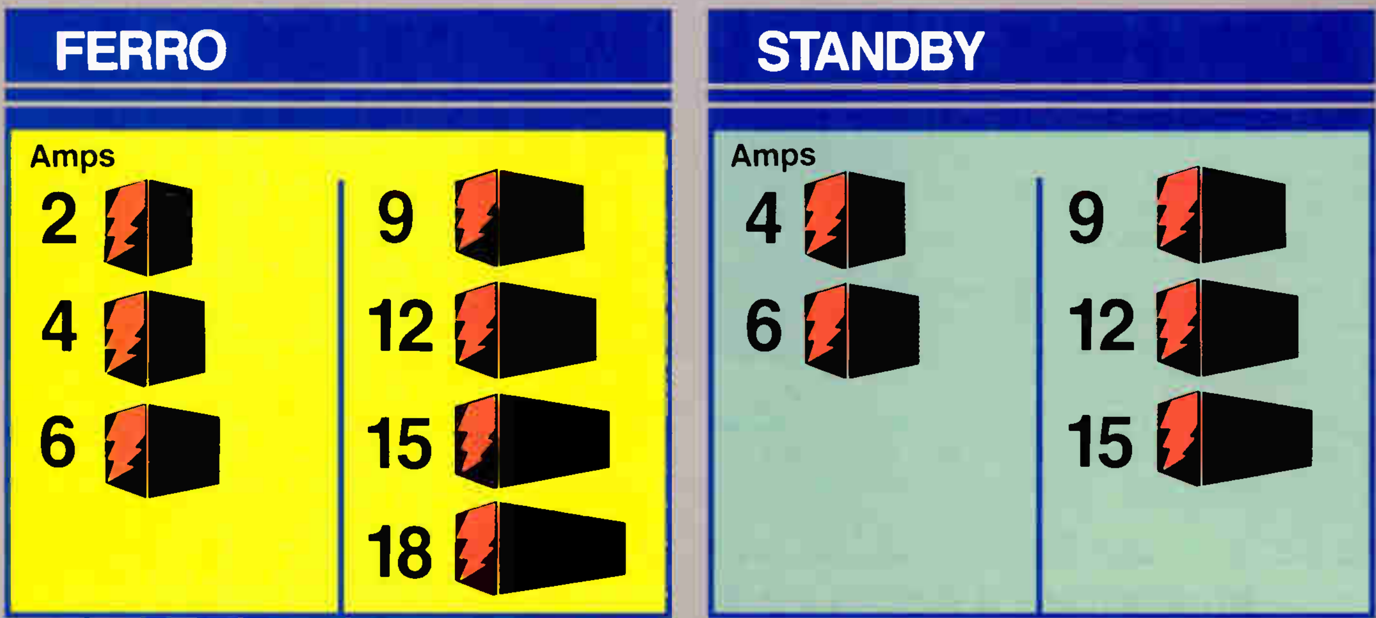

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In the good ol' summertime

This is the second of a two-part series on preventing lightning-related outages in CATV plant.

By Roy Ehman
Director of Engineering, Jones Intercable Inc.

In Part I, we discussed some lightning causes and effects in the outside plant that no matter how spikes or other dirty power got onto our coax center conductor it could be dealt with efficiently and cheaply using the new AmpClamp technology. In this part we need to look at what we can do about lightning strikes and near-strikes to our towers, headends or other buildings.

Using Figure 1 (the isokeraunic map), it is quite easy to read off the number of lightning days per year in your own area. Notice how it peaks up to 100 days per year in an east/west line through central Florida. It can also be seen that even in parts of the country where lightning is less prevalent there are still as many as 30 lightning days per year, any one of which could be the day that blows away a couple of modems or a PC board in your headend. Note that the map has nothing to do with the *intensity* of the lightning. That could be anything from 10,000 to 400,000 amperes and contain from two to 26 individual strokes or pulses of the same polarity (see accompanying table).

On page 76 is the dramatic shot of lightning striking a tree that was mentioned in Part I. Tree sap is a good conductor and is instantly vaporized to a large volume of steam, frequently causing the tree to explode. If you were standing too near you would be filled with "bark shot." The main point to note, however, is on the opposite side of the picture from the tree. If you look carefully, you will see a "streamer" (or "leader," as it is more properly called) going upward from the power line. This leader is the precursor of the actual strike; it is busy forming an ionized path for the lightning to come down.

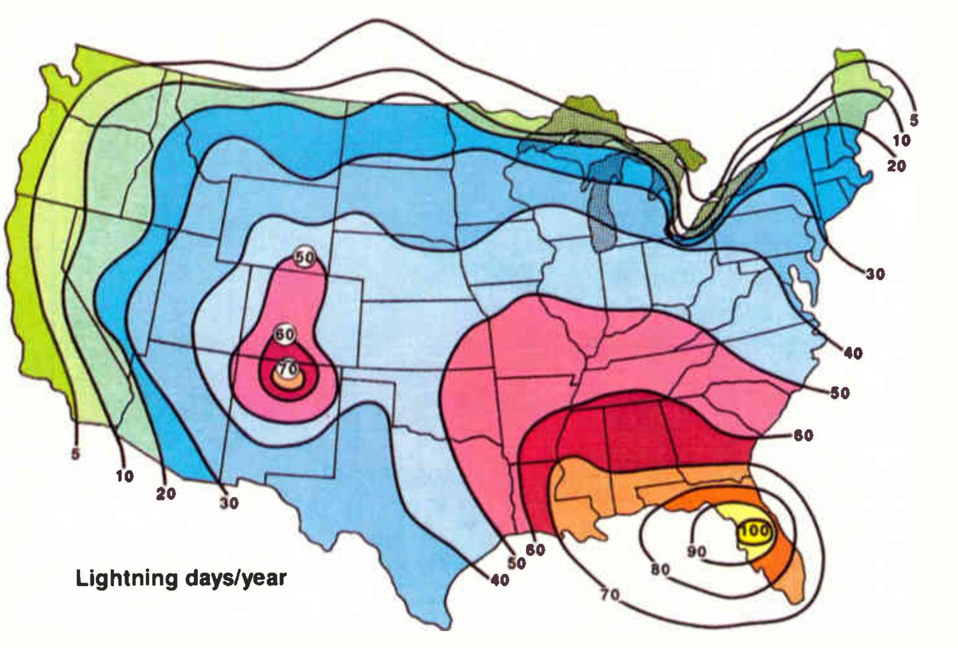
The structural aspects such as height, shape and size of a building will influence the lightning hazard. For example, as illustrated in Figure 2, the higher the structure or tower is above average terrain the more strokes it will tend to collect from the surrounding area. Less evident is the fact that high structures will trigger strokes that might not have occurred at all. Further, since storm clouds tend to travel at specific heights, with their bases from 5,000 to 10,000 feet, structures on hilltops or in mountainous areas tend to trigger lightning even more readily.

Lightning strike statistics

Total charge transferred	2 to 200 coulombs
Peak currents	200 to 400,000 amperes
Half value time duration	10 to 250 μs/stroke
Current rise time to 90 percent	4 or 5 ns to 30 μs
Time between strokes in one flash	3 to 100 ms
Number of strokes per flash/strike	1 to 26 (average < 4)

Note: A *flash/strike* is defined as the ionized channel resulting from the lightning discharge. It may conduct from one to 26 or more strokes before it clears.

Figure 1: U.S. isokeraunic map



Designed by Chris O'Neil, Jones Intercable

Protection approaches

There are two basic approaches to lightning strike protection to towers and buildings:

- Remedial: Design to divert the stroke channel and cope with all the secondary effects or
- Preventive: Design to prevent the buildup of charge in the area of concern and so prevent the lightning from striking at all.

The remedial system must deal with all the parameters listed in the accompanying table. The preventive system need only leak off a small amount of the charge continuously. For example, a typical stroke of 20,000 amperes for 20 μs is equivalent to 166 mA for two minutes. A continuously "leaking" system could drain off much more than that during the passage of a storm front.

There are four system concepts that qualify as remedial protective systems. These include the well-known air terminal (lightning rod), the Faraday cage, the ionizing approach and the laser lightning rod. The latter is still largely unproven and not in widespread use.

An ordinary lightning rod with a suitable conductor running straight down to a ground of 10 ohms or less will have an inverted cone of protection around it that subtends an angle of 45° with respect to the mast at the top (shown in Figure 3). It also indicates how inadequate a single air terminal would be for a building. As well, this is only strictly true for masts up to about 50 feet; at heights beyond this the protection droops down from the tower and flares out closer to the ground. Graphs are available to define this area quite precisely.

Having mentioned grounds (and since all lightning protection for towers and buildings depend to a greater or lesser degree on grounding) we need to look a little closer into that subject.

As stated in Part I, a ground is a very relative term specified by its resistance in ohms. In the cable industry we drive an 8-foot rod into the ground and the job's done. In good, moist dirt of relatively high conductivity (low resistance of 100 ohm-cm) that ground would be on the order of 35 ohms. An associate aptly described this as "a copper bridge to nowhere." This value would be adequate for grounding out small leakage currents and other uncritical applications. It would certainly not be low enough for grounding an office building, headend or tower. How can we improve this number, especially in medium to poor soil where that same rod may yield values from 350 to 3,500 ohms?

One way is to drive the rod deeper; this is done by using sectional type rods illustrated in Figure 4 that allow the operator to couple rods together and keep driving them down depending on what lies beneath. Typically the resistance goes down and sometimes moister or more conductive soil is reached. The gains much beyond 10 feet are not generally very rewarding. Use of a hammer drill is fast and prevents the top of the rod from mushrooming. (Remember to contact local util-

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Figure 2: Lightning incidents to tall structures

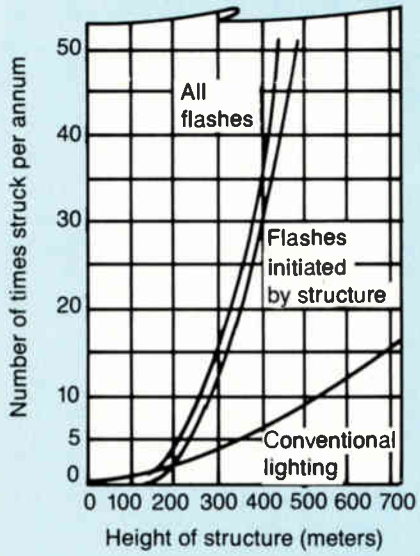
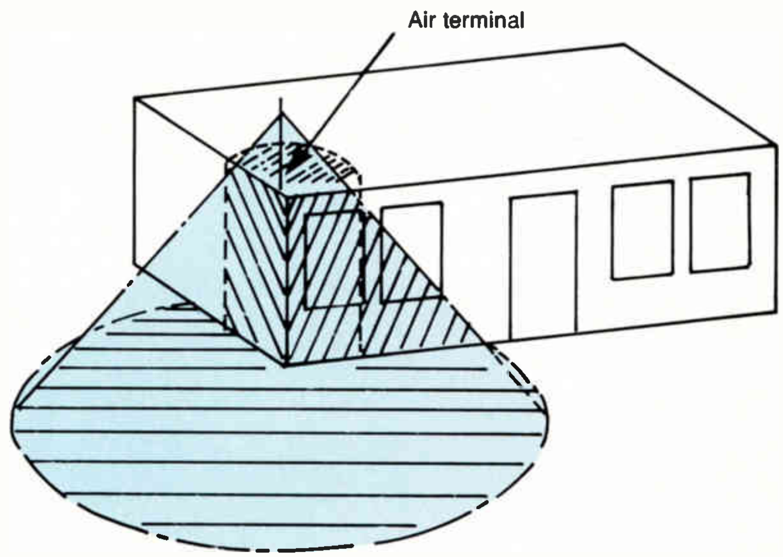


Figure 3: Air terminal effectiveness



ities, as always, before trenching in ground wires or driving rods.) Here are the results from three grounds driven around Tylertown, Miss. (36° 06′ 57″ N, 90° 08′ 31″ W):

Ground #1—8-foot = 40 ohms, 32-foot = 2.5 ohms.
Ground #2—8-foot = 400 ohms, 56-foot = 1 ohm.
Ground #3—8-foot = 270 ohms, 200-foot = 49 ohms.
As can clearly be seen, Ground #3 was particularly disappointing!

The following are the results of four grounds driven in a new subdivision near Bay St. Louis, Miss. (30° 18′ 31″ N, 89° 19′ 48″ W):

1) 8-foot = 100 ohms, 64-foot = 5 ohms
2) 10-foot = 118 ohms, 60-foot = 5 ohms
3) 10-foot = 74 ohms, 50-foot = 15 ohms
4) 10-foot = 42 ohms, 60-foot = 7 ohms →

Saga for a Society

This is the saga of that well-known Society.
It's told in verse purely for emphasis,
But if you require further clarification
Please read whatever's in parenthesis.

Once upon a time—no one knows the date
(Actually, it was June 22, 1969)—
At a small hostel in an unknown land
(Of course, it was the San Francisco Hilton),
A small gathering of noble descent
(Would you believe 79 CATV engineers)
Met to establish a secret band
(No secret—it was the SCTE).

The plan was perfect, the strategy sound:
To share knowledge with all those deserving.
It would sharpen minds, strengthen skills
And please the people they were serving.

These pioneers traveled the known universe
(That is, the 48 contiguous states)
And taught each who would listen a mystery
(How to apply for membership).
Riches and power they promised to all
(Not to mention improving one's abilities);
Their deeds were recorded in history
(Or in back issues of *The Interval*).

Once each year thousands converged
From cities, towns and woods.
They increased the Society's expo-sure
And put hands on the vendors' goods.

Soon, many an eon and millenium passed
(Well, 20 years is a long time).
The Society grew to incalculable size
(Over 5,200 members so far)
With countless clans at every corner
(About 50 chapters and meeting groups)
That made all who belonged very wise
(Or at least, CATV-wise).

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As has the Society with its worthy task.
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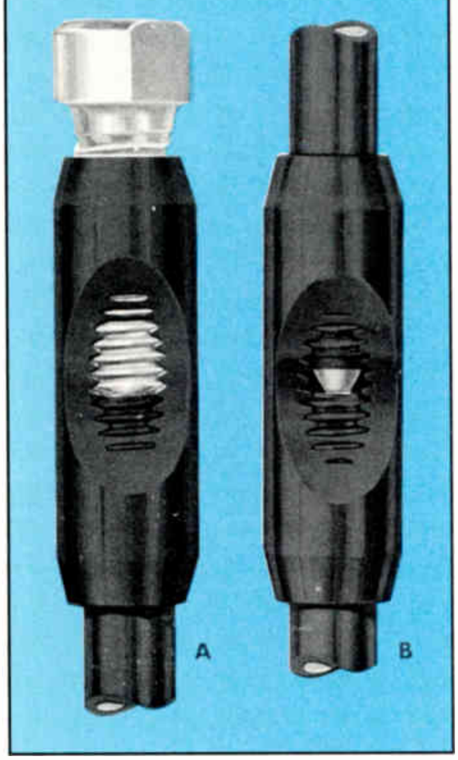
Figure 4: Cutaway sections of couplings showing ends of rods and driving bolt



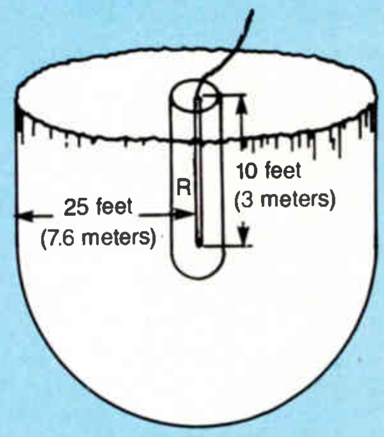
A better alternative is to drive multiple rods and connect them in parallel. To do this we need to understand that any given ground rod has an "effective earth interface hemisphere" (depicted in Figure 5). Placing additional rods too close together causes these hemispheres to overlap as in Figure 6 and the hoped-for improvement is not fully realized. The answer to how far apart parallel ground rods must be driven to achieve optimum reduction of resistance to ground is that they should be spaced approximately one to two rod depths apart. Chemical rods should be spaced 2.2 rod depths apart.

It is immediately apparent that if we are going to use parallel rods *and* drive them deeper, then they need to be spaced further apart. Extending this principle finally leads to a situation where you either run out of real estate or the lines joining the grounds become so long that they develop significant surge impedance and so nullify the desired lightning grounding ability.

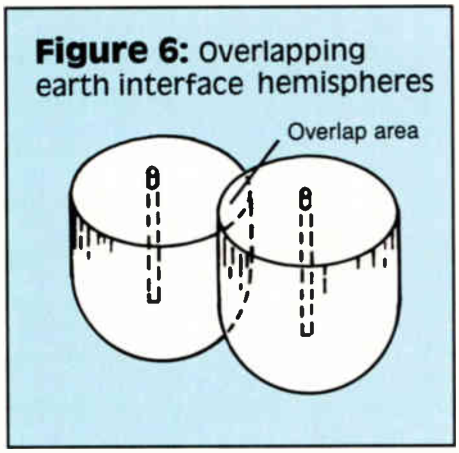
One way to reduce the surge impedance is to connect the ground rods with hollow, soft copper tubing 1 to 2 inches in diameter, as shown in one manufacturer's suggested first-cut layout for grounding a tower (Figure 7). The tubing connections provide reduced surge impedance and lower the ground resistance. Do not drive grounds within one ground rod length of the tower base, to reduce the possibility of a flashover to the supporting pier.

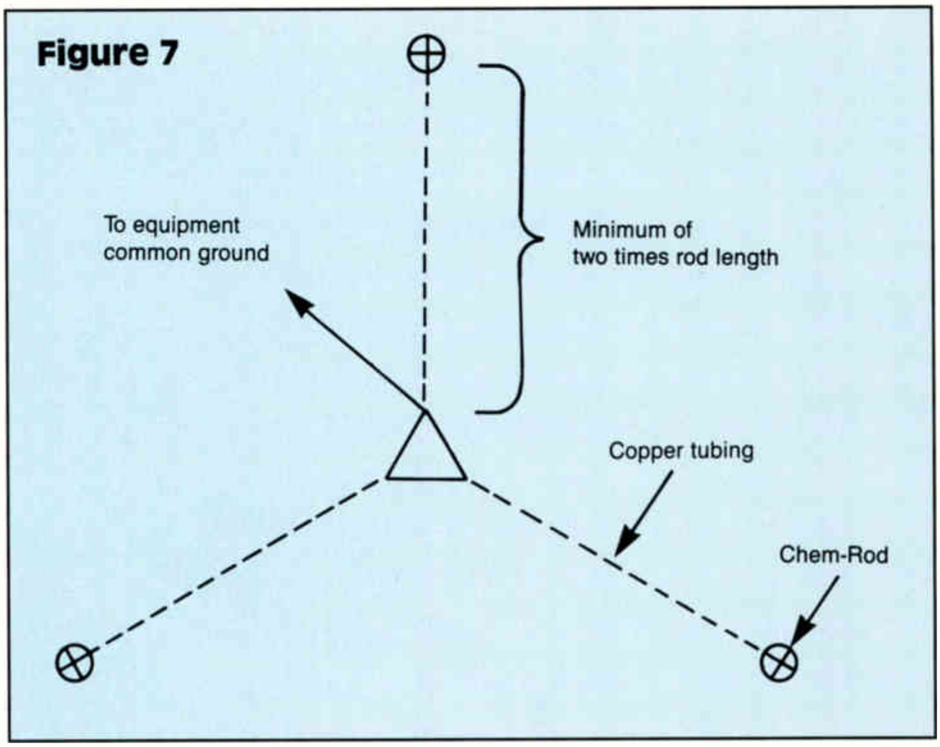
If a ground less than 10 ohms is not obtained by this simple approach, more radials with more ground rods can be installed while continuing to observe the spacing requirements. Another approach to the problem is to treat the soil around the rods with conducting salts; common salt ($NaCl_2$) works well.

Figure 5: Earth interface hemisphere



A shallow circular trench of radius equal to the rod depth is dug around the rod and filled with a saturated solution of common salt. The results are almost immediate and significant. Problem is, it does not last long before it must be done again and you now have a maintenance and supervisory problem. Also, the salt eventually corrodes the ground rod, raising its resistance





and aggravating the problem.

Enter the Chem-Rod: This is a ground rod that is actually a tube about 2 inches in diameter and 8 or 10 feet long (Figure 8). It has "weep holes" throughout its length through which a conductive salt (chosen to be suitable for the particular earth environment) can ooze out, creating a large "earth interface hemisphere." The resistance drops over the first few months and tends to stay there even through dry seasons when the soil resistance increases. When properly chosen, such a rod is virtually maintenance-free and only needs to be topped up every few years.

The rods are typically installed vertically using an auger of some kind or, if the ground is too difficult, there are models that install horizontally in a (shallow) trench. An inspection hatch is provided through which to inspect the level and top it up if required. In difficult situations the rods can be ganged together in effective configurations as shown in Figure 9. They also can be installed in parallel as with ordinary rods. Chem-Rods are quite expensive, ranging from about $250 to $550 each but are sometimes the only solution to a serious grounding problem. This would include bentonite soil enhancement, connector and the inspection well. Freight is additional.

An extension of Figure 7 tower grounding layout is to add more similar radials and ground rods, the idea being to give the lightning many parallel paths that reduce the amount of current carried per radial and, more importantly, reduce the surge impedance. Extending this principle even further we wind up with another approach, the ground plane.

The ground plane consists of a grid of copper wires, sometimes chemically bonded to a core of steel for strength. The intersections are silver soldered and the whole forms a "plane" beneath the tower that can and should be extended to any nearby building, particularly if there are leads running from the tower to the building. The theory behind this approach is that the surge impedance of such a broad area is so low that no potential gradient can be sustained even under high currents with steep rise times. The whole area can be considered at the same potential during a lightning strike while several thousand amperes are being spread out into the ground all around.

This means that there is now a common ground that can be used by attaching to the ground plane at any point. This is a particularly suitable approach if the opportunity exists to install the ground plane over the whole area of interest *before* a building is put up over it. Figure 10 illustrates a portion of a ground plane as typically deployed in a power switching substation for the equalization of potential, the protection of personnel and the dissipation of a lightning strike.

If the building is already in place, a substitute for a total ground plane would be to bury a 2/0 wire below the frost line and no less than 18 inches below grade around the periphery of the

Figure 8

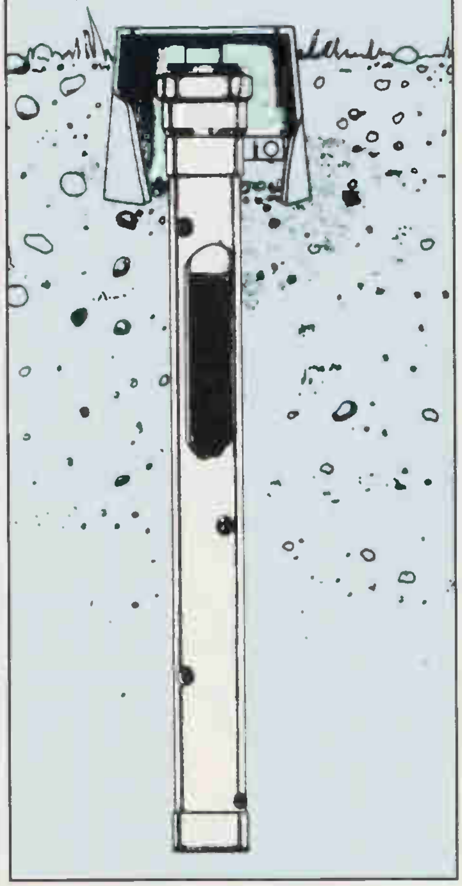
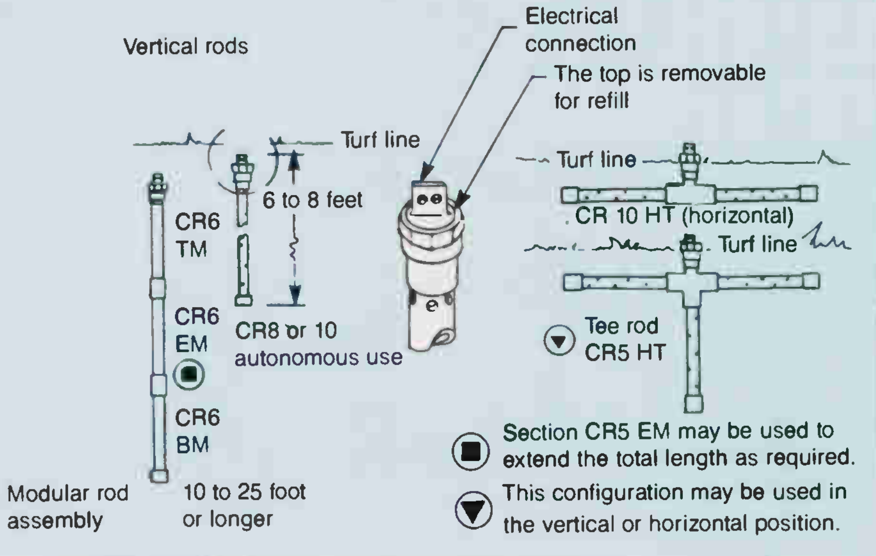


Figure 9: Chem-Rod combinations



building connected to grounds every 20 to 100 feet apart. Connect it to the rest of the ground plane if a tower is present. This ring of grounds is meaningless if there is nothing protecting the top side of the building, such as the close presence of a tall enough tower or other protective device(s).

Either approach works well when the ground or the ground plane is adequate and properly installed. An extra safe approach is to use the ground plane and attach it to good ground rods at various points as well.

When making connections that may carry lightning a conductor equivalent to 2/0 gauge should be used. Special stranded copper material is available that equates to this gauge and has less surge impedance because of the well-known propensity of currents to travel on the skin of conductors. It typically consists of 32 strands of 14-gauge wire with a weight of 44

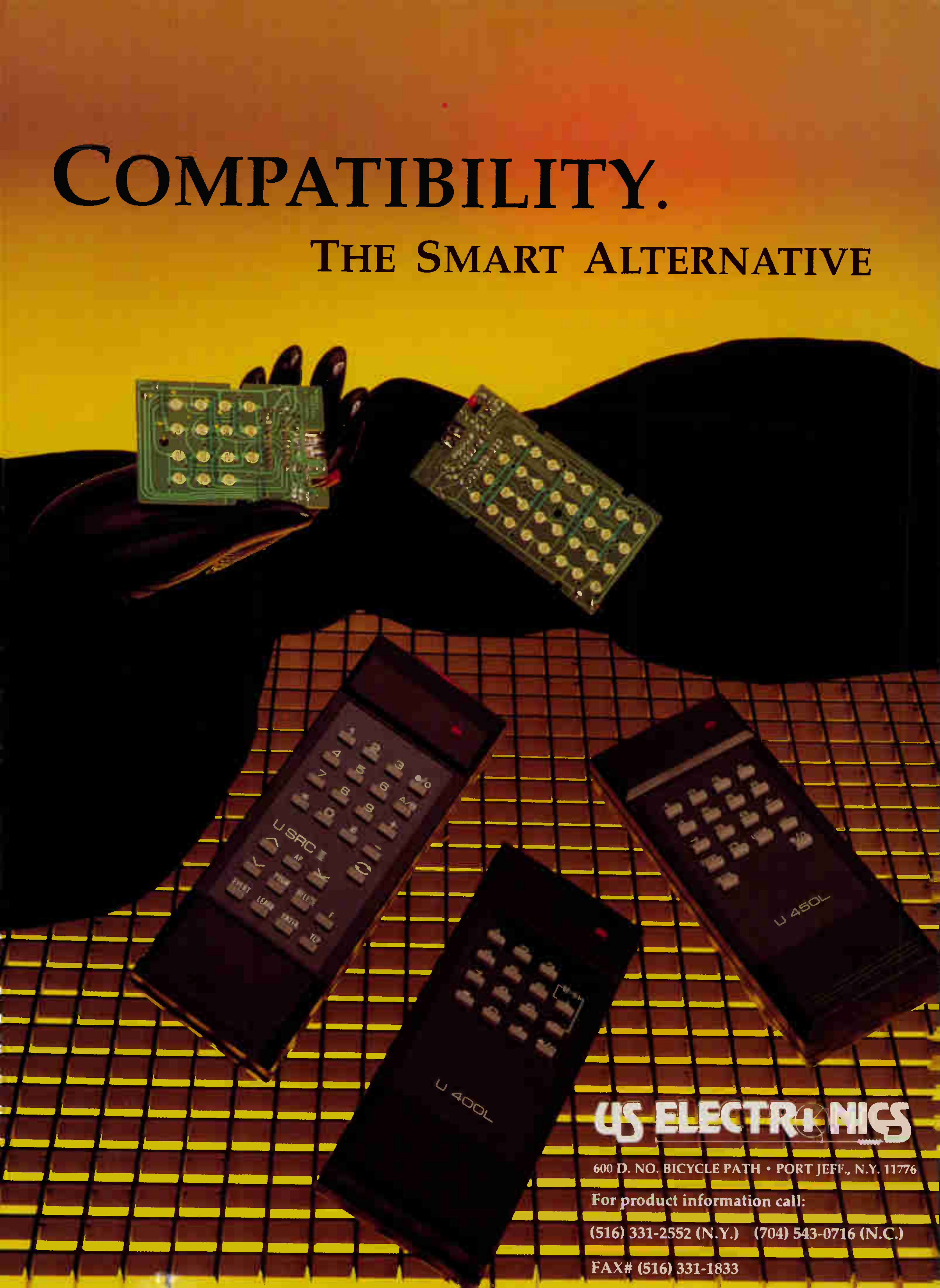

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Figure 10: Ground plane

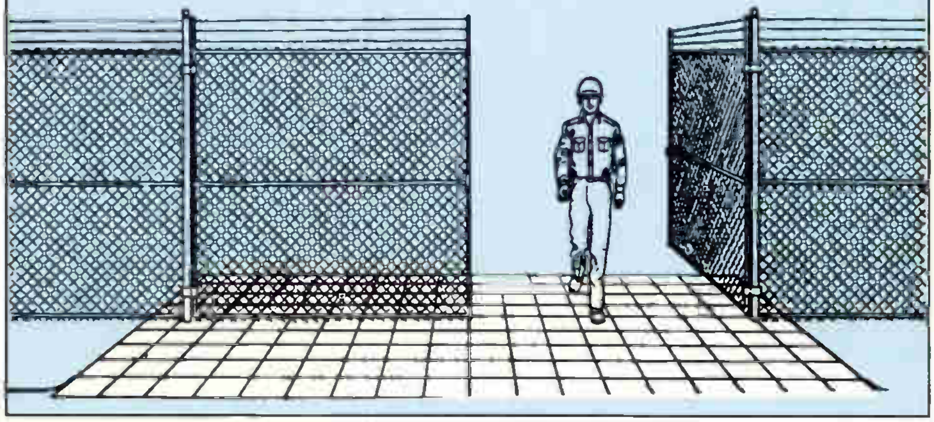
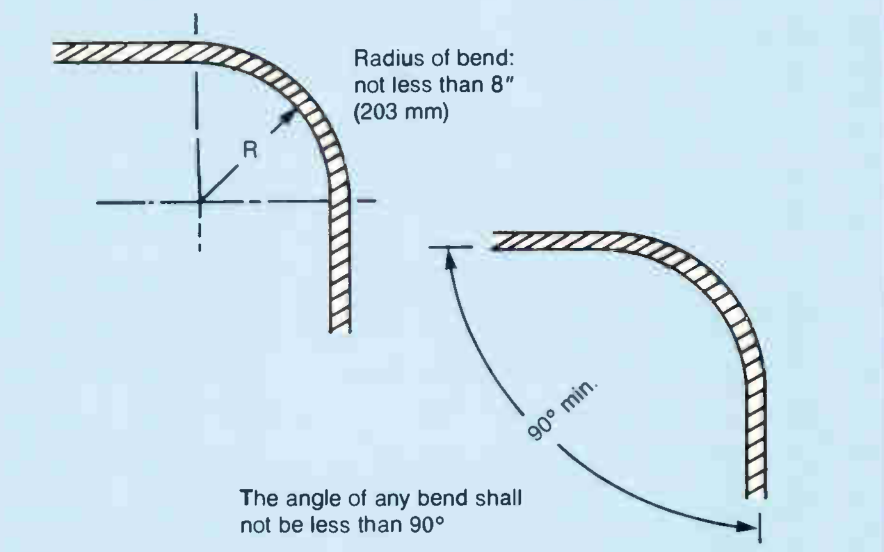


Figure 11: Conductor bends



pounds per 100 feet and can be supplied tin plated.

Lightning hates to go around corners; so the National Fire Protection Association (NFPA) specifies that all necessary bends must have a radius of at least 8 inches and not turn more than 90° on a single bend (Figure 11). Connections to grounds must be made below grade in order to get the maximum depth from a given rod, for safety and in order to provide a suitably radiused bend in a vertical plane.

In Canada and the northern parts of the United States it is necessary to bear in mind that only the part below the frost line does any good. This year, for instance, the frost line in Buffalo, Minn., and parts of Wisconsin went down to four feet, due apparently to the effect of late snow. An 8-foot ground rod with 48 inches of frost is a 4-foot ground rod! Frozen ground does not conduct.

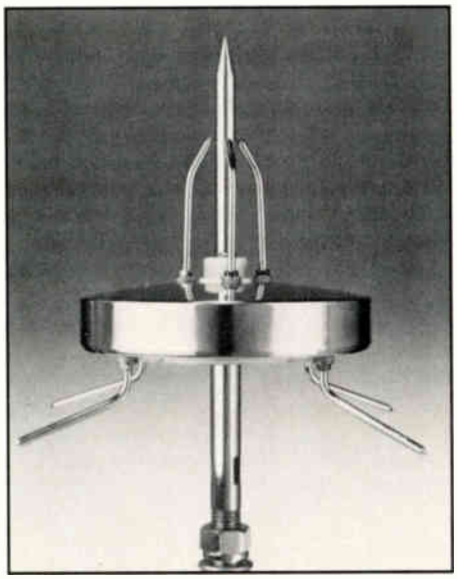
Tower guy treatment

The guys of supported towers must be strapped to good grounds at top and bottom. Where they attach to the tower they should be bonded to the tower so as not to rely on a simple, possibly oxidized, pressure connection. The bottom bond to ground obviates the possibility of lightning traveling down a guy wire—with nowhere to go—to crack or blow up the guy base. This also prevents arcing at contact points and possible welding of the turnbuckles as well as providing a highly conductive path.

Properly bonded and grounded guys provide additional paths for lightning, spreading the current over greater areas of ground. Studies have shown that this technique also significantly reduces the surge impedance of the whole installation and damaging voltage gradients in the tower itself by as much as 50 percent compared to a free-standing tower. When using clamps, attention must, of course, be paid to using the appropriate metallic junctions; *never* join copper to galvanized metal. Cast bronze is the proper material and the NFPA specifies that the clamp must have a minimum of 1.5 inches of contact area. Figure 12 illustrates such a clamp. At other less critical points and where metal is thick enough, cadwelding is recommended for permanent, reliable high conductivity. Bimetallic connectors are available for making good connections betweeen dissimilar metals.

Most tall towers are erected in sections. Where they are joined together by flanges or otherwise, there is a discontinuity in the metal of the tower. This could cause lightning traveling down the tower to sideflash at one of these points to coax or other wiring. This is obviated by clamping an 8-foot ground rod, point up, to the top of the tower so that it is a few feet higher than anything else. A 2/0 stranded ground cable is cadwelded or clamped to the ground rod using an approved clamp and taken down the tower in one continuous length and properly attached to the grounding system. This procedure does not apply to towers protected by dissipation arrays since the rod is intended to accept a strike while the dissipation arrays would be trying to prevent a strike.

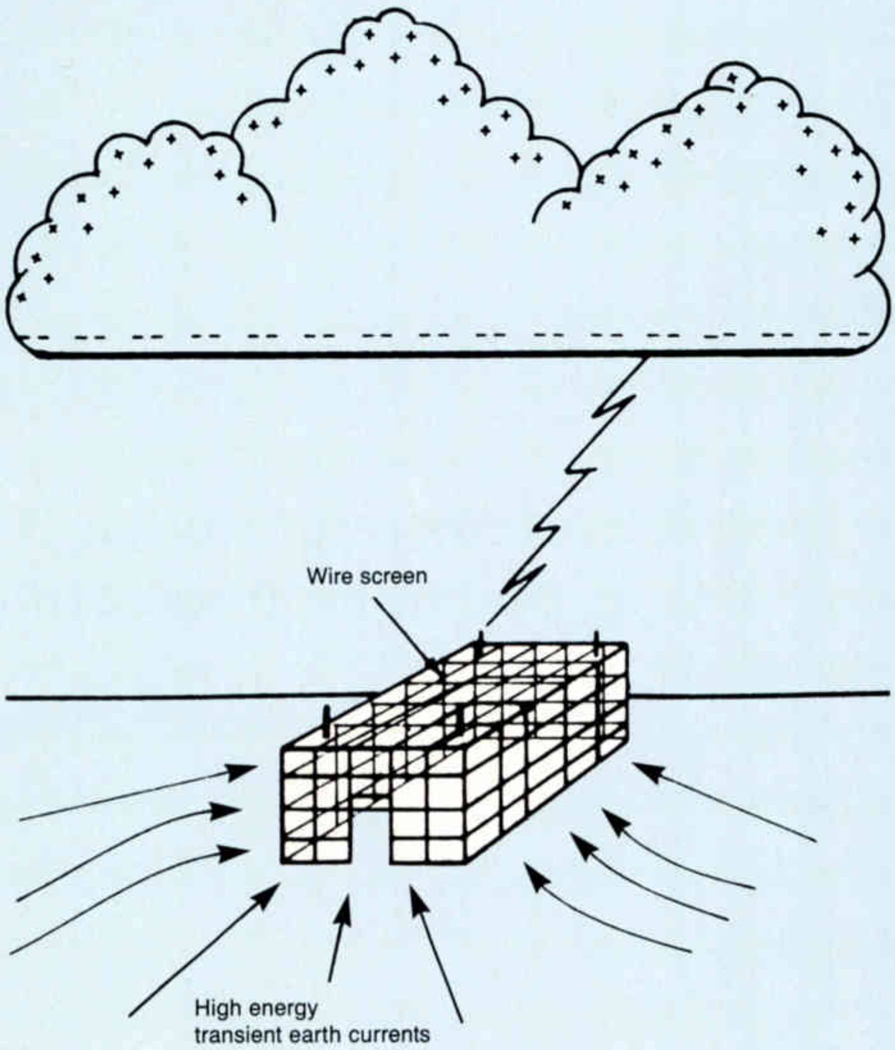
The tower/headend I/O interface is a subject in itself. Typically the coax leads exit the tower some 12 to 15 feet above ground and go over to an adjacent equipment building by means of a cable tray or ice bridge. Roger Block of PolyPhaser Corp., writing in *Mobile Radio Technology International*, shows that a self-support tower of 150 feet with a median lightning surge of 18,000 amperes and rise time of two seconds will produce an L × di/dt voltage of 243 kV between top and bottom. By "tapping" the tower with the coax at 15 feet above ground the headend entry point will be approximately 7.3 kV above system ground. It is therefore better to exit the tower at or near ground level. All coax sheaths must be bonded to the tower at this point to prevent induced current buildup. →



Prevectron ionization system

Figure 12

Figure 13: Faraday cage



Additionally at the point of entry to the equipment building there should be a bulkhead panel where the tower I/O lines are terminated on appropriate connectors. A suitable panel would be constructed from 1/8-inch copper plate, continue on down and be welded to the ring ground around the building. Inside the building a subpanel should be attached to the bulkhead panel where protectors may be mounted for every line that enters or leaves the building. These protectors shunt the voltage between the coax center conductors to the common system ground. Jim Stilwell of TeleServices R&D has set up many installations using the grounded bulkhead approach and has found it to be very effective in shunting away the unwanted sheath currents.

Protecting buildings from lightning

As was shown in Figure 3, a single lightning rod will probably not be effective unless the building is very small and the the rod is high enough so that the building is under its "cone of protection."

The first and most popular approach in the United States is the Faraday cage (Figure 13); the procedure is described in the NFPA 78 Lightning Protection Code. In simplistic terms, air terminals are placed every 20 feet around the periphery of the building and a 2/0 stranded wire is run every 100 feet (every fifth terminal) to excellent grounds. The consultation and work is carried out by specialists in this field who finally hand the owner a UL certification.

Even many-storied buildings can be protected in this way. A parallel ground resistance of as little as 0.1 ohm has been achieved with a concentrated and calculated effort. A major problem with the Faraday cage is to conceal or camouflage down leads so as not to destroy the aesthetics of a beautiful old or modern building. If sufficient foresight is exercised before a buildina is finished, the downleads can be run inside the skin of the building and be completely invisible. Doing it afterwards is difficult and more costly.

Another approach (the most popular in Europe) is the ionization method (see accompanying photo). Again, in the most simplistic terms, the charge buildup that occurs just before a strike is taken from the air and used to charge a group of capacitors. The rate of voltage buildup (dV/dt) in the upper voltage range is monitored. A few tens of microseconds before there is a real threat of the lightning striking a given place and when the potential gradient dV/dt rises beyond a predetermined threshold, the capacitor is caused to discharge onto the ionization air terminal.

This device, developed in France with worldwide patent protection, is the Prevectron. It produces an ionizing leader or "electronic feeler" that rises upward, effectively quadrupling the height of the mast and vastly increasing its cone of protection.

If a strike needs to occur, the ionization air terminal takes the hit and transfers it to ground. Apparently no maintenance is required and the system is fully effective. The national PTT building in Paris and the new Scanticon Convention Centre in Denver are examples of buildings protected in this way. The big advantage is that even a large irregularly shaped building can be protected with only one or two heads on 20-foot masts. These are almost unnoticeable from a distance. Also obviated are the multiplicity of down leads and lateral tie-ins required with the Faraday cage.

Dissipation arrays

We now move into the hotly debated area of dissipation arrays. The arguments have been raging back and forth since 1947 and even earlier. Opinion is highly polarized between believers and non-believers. Both views will be presented.

Figure 14 depicts the charge during storm buildup and a simple electrical model of the situation. The dissipation array comes in various configurations and all are based on the premise that

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Figure 14: Dissipation array system

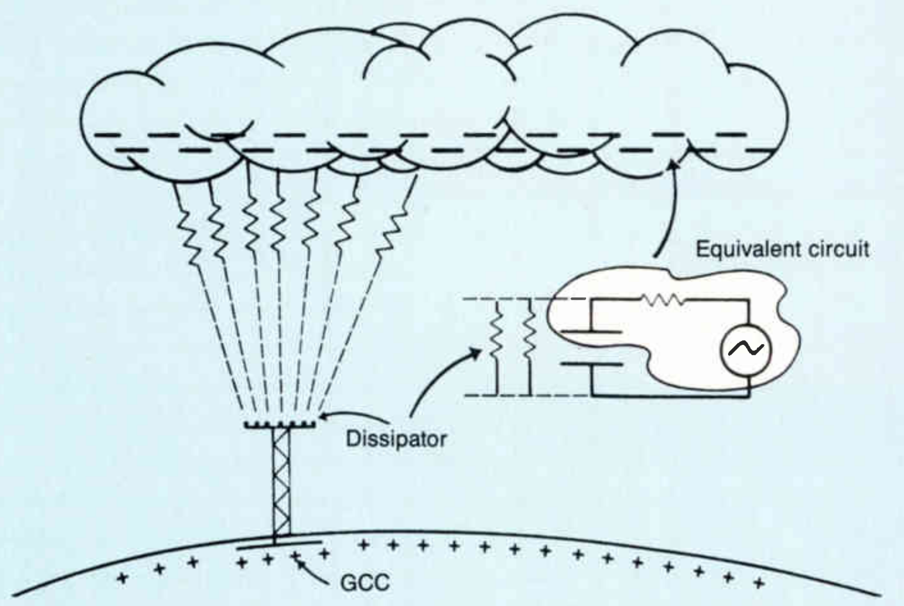
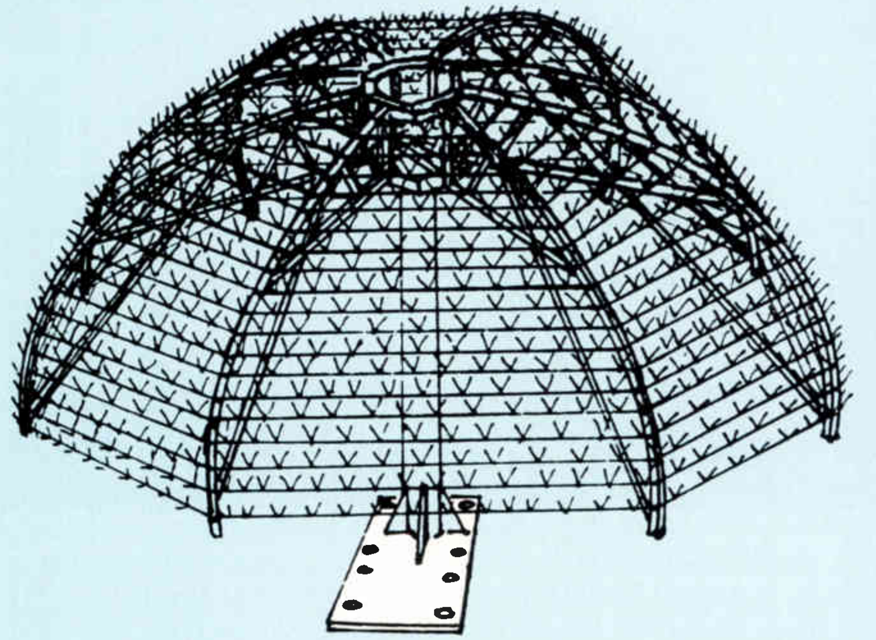


Figure 15: Hemisphere array



a single point immersed in a strong field will conduct about a microampere of current. That being the case, then, paralleling 1,000 points should produce 1 mA. Several thousand points could conduct 2 or more mA and that is all it takes to "bleed" the bound charge away so that the earth-to-ground potential cannot build up sufficiently to strike. Actual readings of these currents confirm these numbers.

There are several implementations of the multipoint dissipation array and one of these that might be seen mounted on the top of a tower is shown in Figure 15.

The unbelievers: In an article in the April 1988 issue of *Mobile Radio Technology*, author Roger Block, president of Polyphaser Corp., related that in 1975 the Office of Naval Research, NASA, the Federal Aviation Administration and the U.S. Air Force held a conference to "Review Lightning Protection Technology for Tall Structures," which produced 287 pages of conference notes. He also cited several array-protected installations that "subsequently suffered many lightning strikes." One of the conference participants, Dr. Rodney Bent (president of Atlantic Scientific and Atmospheric Research Systems), was hired by the Office of Naval Research to study dissipation arrays.

In his report, Bent presented calculations showing that dissipation arrays do not really

"When using clamps, attention must...be paid to using the appropriate metallic junctions; never join copper to galvanized metal."

work. NASA appeared to have dismissed the dissipation array technology in favor of triggering harmless electrical discharges from clouds by firing into them rockets that trail a ground wire.

In concluding, Block wrote, "If lightning arrays do not prevent lightning strikes, then why are so many dissipation array users satisified with their results? They purchase the dissipation brushes and, when they are installed, a better ground system is installed, too. Subsequent damage is prevented or reduced...but they offer no proof, such as recording current surges on a lightning counter, to show that lightning does not continue to strike the tower...I hope that someone will prove to me that dissipation arrays work."

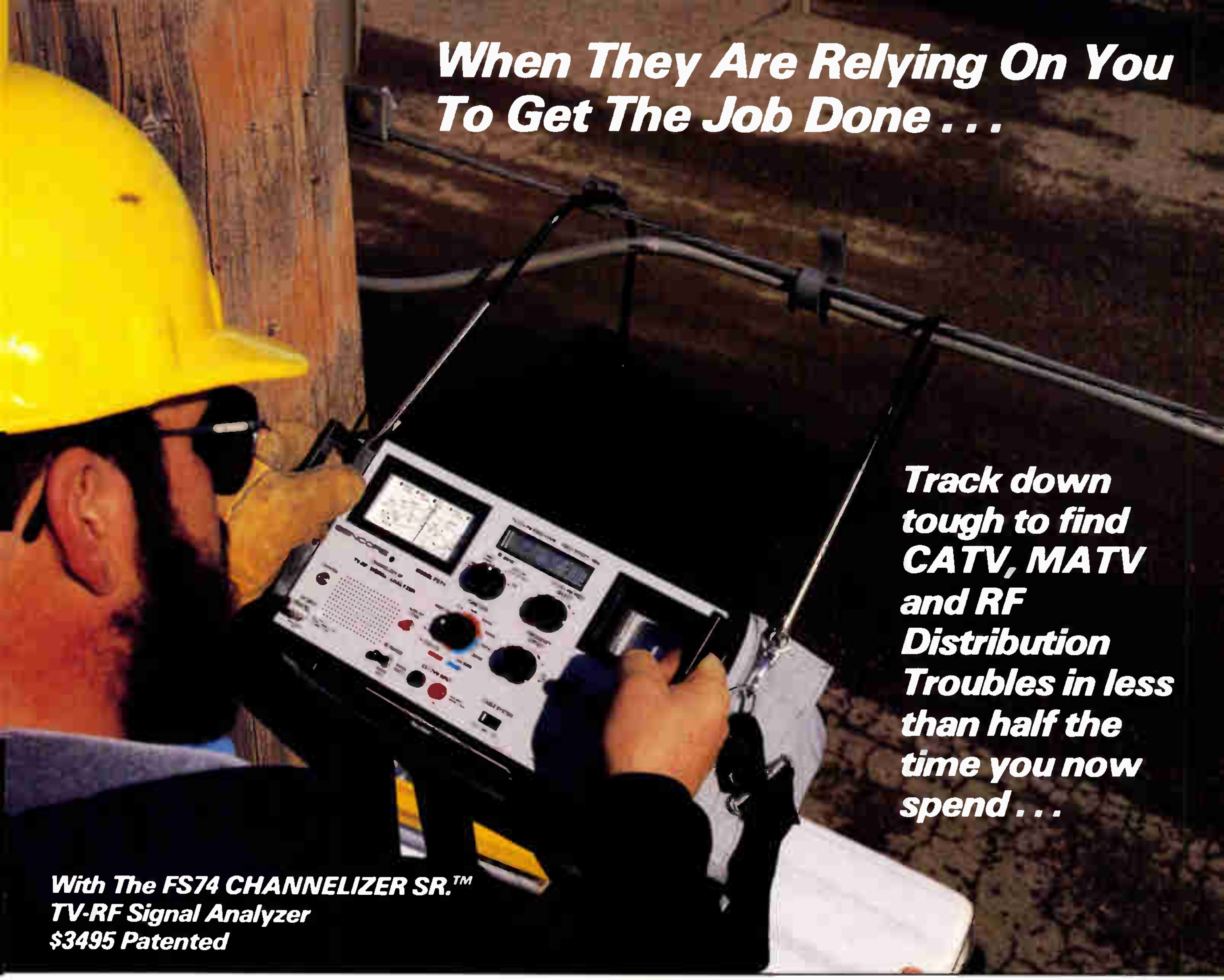
The believers: John Wright, director of radio engineering for Cox Cable Communications, says, "We installed a dissipation array device in Pensacola, Fla., in 1987. We have had no hits since." He has had several other successful lightning prevention installations on towers of various heights.

My own experience with two dissipation arrays on a 6,000-foot mountaintop television receiving site near Salmo, British Columbia, has been positive. Not only were we being struck from time to time with damage to microwave and TV equipment, but almost every summer afternoon a cloud-to-ground charge would build up and fill our screens with hundreds of little lines, making the pictures unwatchable. When the clampers saw the spikes they tore the picture to shreds, so the clampers had to go.

The array stopped the strikes but even more importantly it completely eliminated the picture impairment and thereby saved the site. The mountain was almost pure rock and pebbles so there was only a lightly buried ground plane of thick wires. This ground plane existed both before and after the array installation. What is most "striking" of all is the report of Joe Huser who maintained the site and the six-mile access road. He was at the top on several occasions and was able to observe an approaching front complete with lightning. When it passed over our site the lightning ceased. After passing the site the strikes were seen to resume!

In a report in an April issue of *Electronic Media*, Russell Shaw tells how Turner Teleport Chief Engineer Jack Barr tried all the usual remedies of grounding and bonding and still suffered lightning damage. His old TBS tower protection system consisted of "bonding everything together (from the same power source) so that when there is a lightning strike, everything goes up with the same potential and comes down

(Continued on page 184)



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Mechanical performance of the F-fitting interface

By Barry A. Smith
Technician, Department of Research and Development, Tele-Communications Inc.

And David L. Franklin
Project Engineer, American Television and Communications Corp.

The simple F-fitting interface (cable-to-fitting and fitting-to-equipment) is often taken for granted or unappreciated. Though small, this interface represents a great number of potential problem points and historically has been blamed for a significant portion of service calls within the cable system. This connection point is actually a complicated junction with some unique electrical, environmental and mechanical requirements and characteristics. If we as an industry wish to improve service to our customers and to decrease the detrimental impact from this common complaint source, we must increase our efforts in examining this interface and increase our understanding of its requirements.

Electrically, the interface must maintain a 75 ohm impedance to provide proper match to the CATV plant. Low contact resistance must be maintained between the center conductor and the F-port terminal contact to assure proper signal flow. To provide adequate shielding, low contact resistance must be maintained between the fitting and the cable's outer conductor (foil and braid) and between the F-nut and the terminal port.

Environmentally, the junction must remain sealed to prevent condensation, moisture ingress and corrosion buildup. This seal must be maintained over great extremes in temperature and humidity (typically between −40 to +140° F, from 0 to 100 percent humidity) at various altitudes and in every imaginable circumstance.

Mechanically, this system link must provide reliable, long-term retention of the cable-to-fitting attachment over a large variety of cables (differences in manufacturers, braids, jackets, etc.). It also must be able to stand up in all types of climatic conditions, such as wind and ice loading. The fitting-to-port connection must be strong enough to allow secure attachment under all of the conditions previously mentioned.

Economically, the large number of these junctures requires that the F-fitting be reasonably priced. Experience has taught us, however, the reasonableness of the price must be determined by more than just the initial cost. We may be able to buy a connector for 10 to 15 cents initially, but the cost of servicing and maintaining this device may well justify paying a significantly higher price at first so as to reduce operational costs

Table 1: Typical fitting retention vs. crimp ring inside diameter

	53 percent braid	67 percent braid
.010 inch too small	65.1 lbs.	78.9 lbs.
.005 inch too small	57.1 lbs.	76.6 lbs.
Manufacturer's recommended	45.0 lbs.	59.8 lbs.
.005 inch too large	31.5 lbs.	52.6 lbs.
.010 inch too large	25.1 lbs.	41.0 lbs.

Table 2: Typical fitting retention vs. cable braid coverage

	Average of four fitting designs
40 percent braid	38.9 lbs.
53 percent braid	48.4 lbs.
67 percent braid	66.4 lbs.
95 percent braid	86.3 lbs.
Quad braid	78.0 lbs.

Figure 1

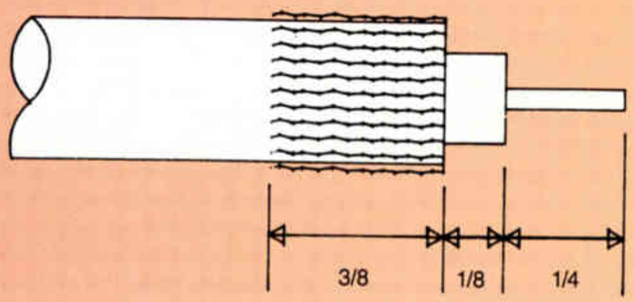
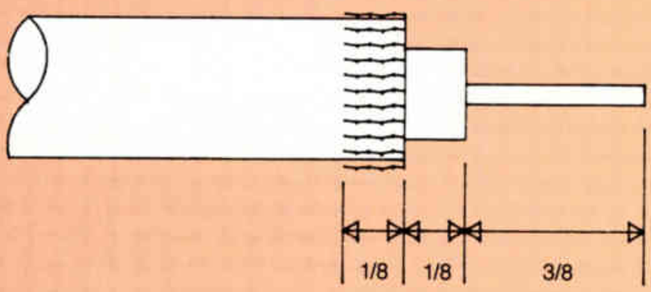


Figure 2



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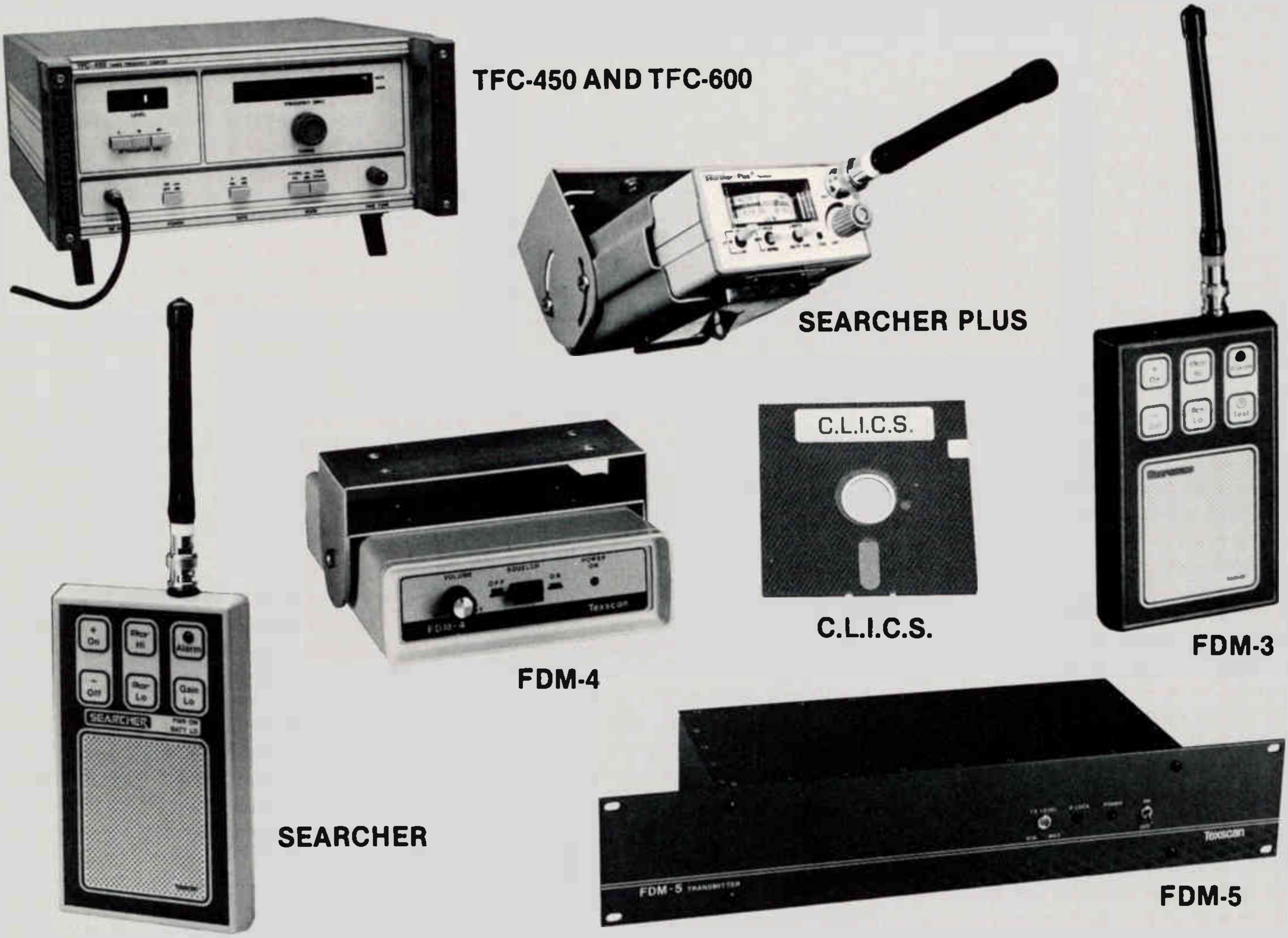

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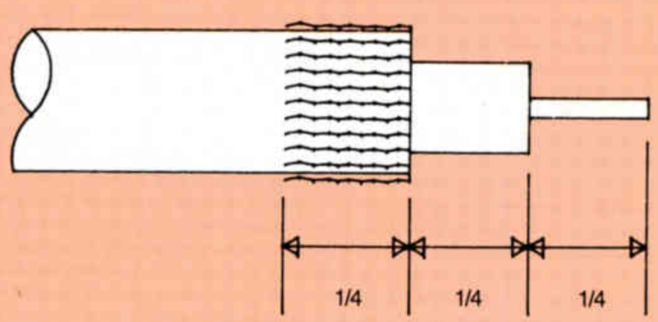
Figure 3



and customer dissatisfaction. Another consideration might be the ability of the connector to be reused. If such practice is allowed, we may well be able to pay more the first time to save more later.

This article is intended to describe the complex nature of the fitting interface and the effects of various factors upon the mechanical integrity of the connection. Issues specifically addressed include the effects from mismatched components and the problems that arise from improper cable preparation. (Subsequent articles will address other issues of the F-fitting link.)

Selection of compatible components

Selecting compatible components is imperative. Study of the commonly available interface components reveals over 11,000 possible combinations for matching a one-piece F-59 crimp-type fitting onto a 59 cable. This potential is caused by at least 14 different braid configurations, 15 different F-fitting crimp ring inside diameters, five different cable preparation dimensions and 11 different hex crimp sizes.

The fitting-to-cable interface is typically designed for easy assembly and maximum retention force when the installation is complete. Most of the F-fittings are designed to withstand a pullout force of at least 40 pounds. This can be affected by many factors: the jacket outer diameter, the jacket thickness and material, the braid coverage and construction, the fitting's crimp ring inner diameter and post outer diameter and, of course, the hex crimp size. Optimum performance of the F-fitting connection requires selection of the right fitting, correct cable preparation and the use of proper tools. An error in any of these aspects can make the connector attachment difficult, decrease the shielding effectiveness, create paths for moisture ingress, reduce the retention strength and/or result in premature failure of the interface.

In most drop cable-to-connector interface designs, the mechanical strength and contact pressure are established by a "sandwich" composed of the cable's braid, jacket and folded braid between the fitting post and crimp ring (some manufacturers use different compression mechanisms). It is believed (though not yet proven) that the compression force of this "sandwich" begins to relax as the jacket material migrates away from the areas of compression with prolonged exposure to time and temperature. The rate at which the jacket relaxation occurs depends on the cable's construction—i.e., foil coverage, braid coverage (single-braid, tri-shield, quad-shield, etc.) and the jacket's physical composition. Variations in jacket composition occur between the different National Electrical Code (NEC) ratings (D, X and V) and between different manufacturers. The accompanying tables illustrate some of the effects that arise due to some selected significant causes.

Table 1 demonstrates the requirement for proper crimp dimensions. The inner diameter of the connector crimp was varied to determine its impact upon cable/connector retention strength. Although the table appears to support a call for a smaller crimp diameter, it should be remembered that another criteria for this interface is ease of installation. The smaller crimp rings caused extreme difficulty in fitting installation, especially with the greater braid coverage. An increase in difficulty will result in an increase in the number of poor interfaces in the system. The two requirements must be balanced: The 40 pound retention requirement can be met with the standard fitting without adversely affecting the installation task.

Table 2 provides more detail regarding the impact of braid coverage

Table 3: Typical fitting retention vs. cable jacket material

	Fitting A	Fitting B
CATVD	59.8 lbs.	67.7 lbs.
CATVX	67.1 lbs.	71.8 lbs.
CATV	71.6 lbs.	74.9 lbs.

Table 4: Typical fitting retention vs. braid prep length

	Typical crimp-type fitting
1/8 inch braid	36.4 lbs.
3/16 inch braid	42.0 lbs.
1/4 inch braid	50.8 lbs.
5/16 inch braid	58.5 lbs.
3/8 inch braid	59.8 lbs.

upon the cable/connector interface. Notice that the 40 percent braid coverage did not meet the 40 pound minimum retention requirement. You may wish to consider this when you decide what cable to purchase for long system life and reliable delivery of the CATV signal.

Table 3 compares the connector's cable retention ability as it relates to various jacket composition as defined in the NEC cable designation. The "D" rated jacket is the standard composition that has been used for years. The "X" and "V" ratings refer to the cable's flame resistance qualities and relates directly to the amount of plasticizers in the jacket's composition. More plasticizers make the cable jacket more flexible. Less plasticizers

Figure 4a

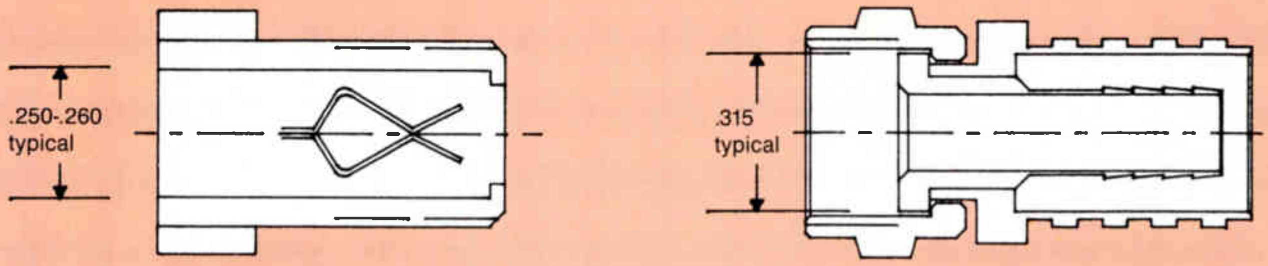
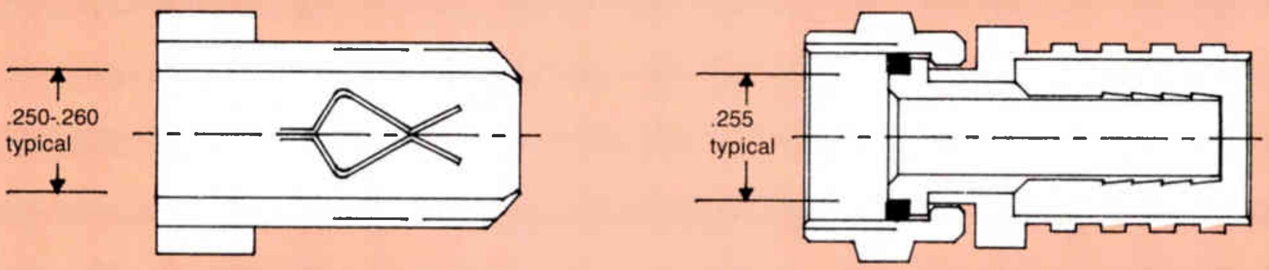


Figure 4b



make the cable better for flame resistance purposes but also makes it less flexible (hence, a more difficult fitting installation). This is demonstrated by the numbers in the table.

Cable preparation

Correct cable preparation is an integral part in the F interface's performance. Improper preparation can reduce the cable/connector retention ability and/or compromise the junction's environmental seal. If insufficient braid is prepared, the connector's retention force is reduced significantly. If too much braid is left, it can protrude from the rear of the fitting, providing a moisture path. Additionally, braid that extends beyond the connector body is both unattractive and dangerous; it can prick a

FM stereo multiplex signals

By Clyde Robbins
Senior Staff Scientist
Jerrold Division, General Instrument Corp

Frequency modulation (FM) improves received signal-to-noise (S/N) ratios compared with amplitude modulation (AM). The improved S/N results from the non-linear effect of wideband FM modulation. For optimum improvement, the receiver must have sufficient bandwidth to receive the multiple FM sidebands generated at harmonics of the modulating frequency about the carrier.

FM is particularly effective for audio, which has a relatively narrow bandwidth but requires a high S/N to make the received noise unnoticeable. The bandwidth required to receive the FM signal without distortion is approximated by Carson's Rule:

Bandwidth = 2(peak deviation + maximum modulation frequency) **(1)**

For a 15 kHz monaural FM signal causing maximum legal deviation, the bandwidth will be:

BW = 2(75 kHz + 15 kHz) = 180 kHz

For an FM stereo multiplex signal, a bandwidth estimate is:

BW = 2(75 kHz + 53 kHz) = 256 kHz

A typical FM stereo receiver IF bandwidth is 280 kHz. For noise bandwidth purposes, this is usually rounded to 300 kHz.

The improvement in FM received S/N is a result of the coherent power summation of all the sidebands while the noise in the receiver bandwidth adds incoherently. The improvement in S/N can be expressed as:

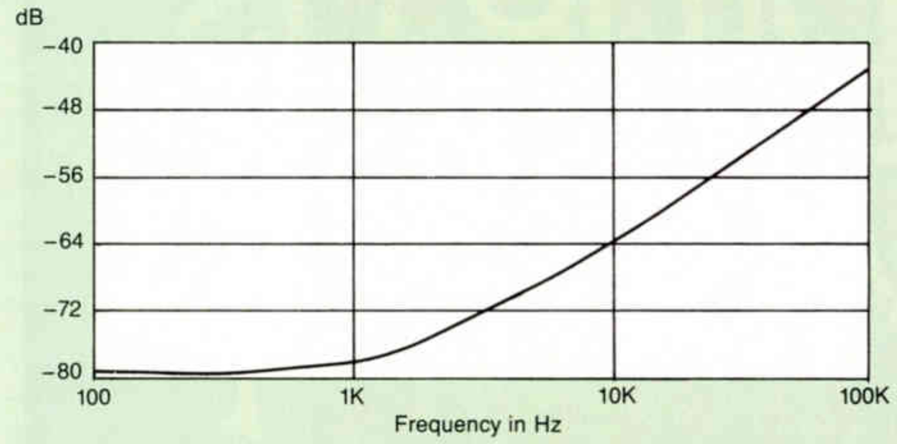
S/N = C/N + FM improvement **(2)**

while:

FM improvement = 10log3(peak deviation ÷ modulating frequency)^2 **(3)**

Note that the improvement decreases with increasing modulating frequency for a fixed peak deviation. The FM improvement decreases at a 20 dB/decade rate when operating above the residual noise floor of the detector. Figure 1 shows the typical noise output spectrum of an audio FM detector with a 40 dB C/N input.

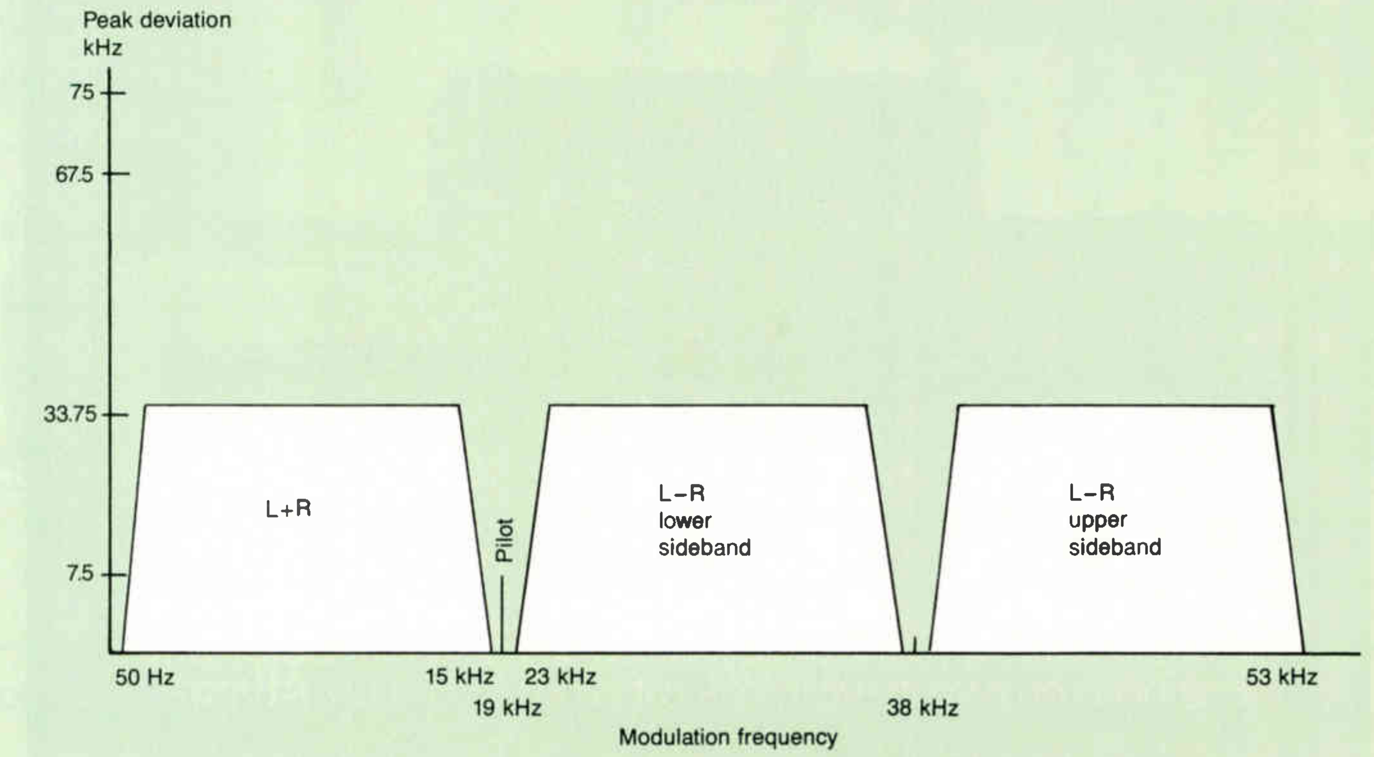
Figure 1: Noise relative to 67.5 kHz peak deviation at 40 dB FM C/N

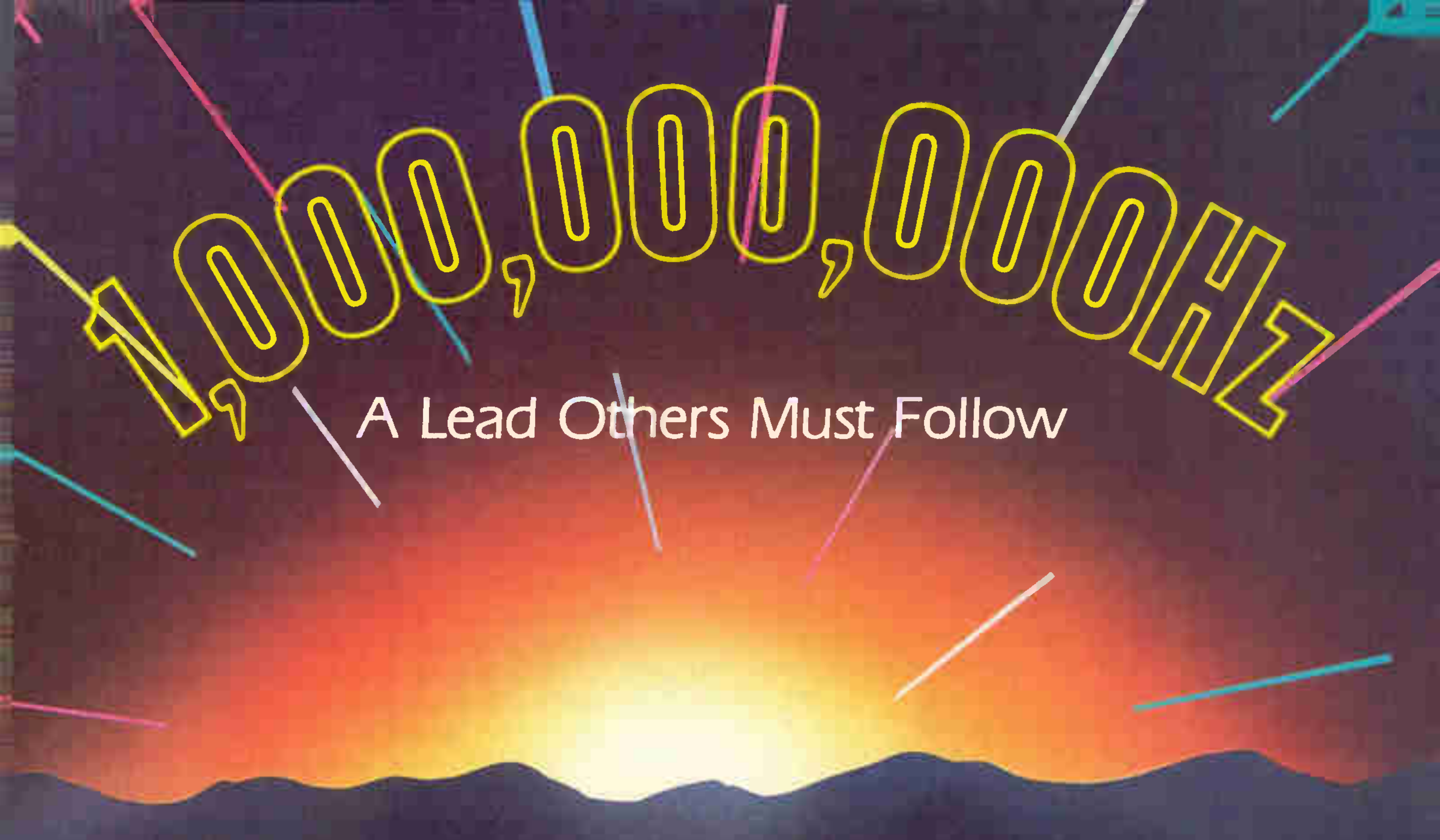


Pilot signal

The FM stereo multiplex system includes a pilot signal for stereo detection at 19 kHz that consumes 10 percent of the allowed 75 kHz peak deviation, or 7.5 kHz. So 67.5 kHz is left available for audio deviation. Left and right audio signals are pre-emphasized and added together to form the sum channel from 50 Hz to 15 kHz. The dif-

Figure 2: Multiplex baseband spectrum (full deviation, one-channel driven)





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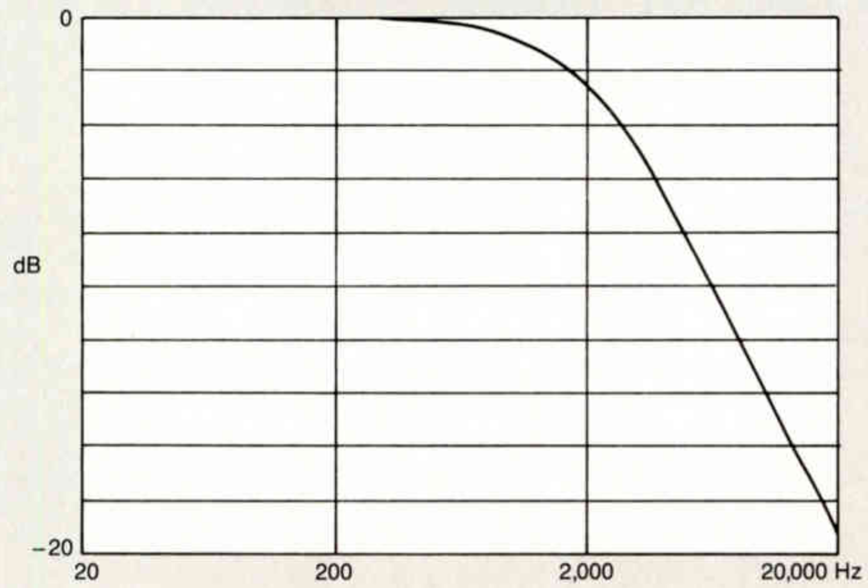


Figure 3: Maximum audio level vs. frequency

ference between left and right signals is used to generate a 38 kHz double sideband suppressed carrier (DSB-SC) AM signal. The maximum amplitude of (and therefore the peak deviation from) this DSB-SC modulated difference signal is equal to the amplitude of the sum signal. Figure 2 shows a spectral representation of this multiplex signal.

Pre-emphasis is used to counteract the FM receiver 20 dB/decade increase in noise with frequency. "75 μs pre-emphasis" means that signals above 2.1 kHz are increased in amplitude at a 20 dB/decade rate in the transmitter, while the signal and noise are attenuated in the receiver at the same rate. Pre-emphasis can be used because the power spectrum of audio is typically not "white" but decreases dramatically with frequency above about 1 kHz. De-emphasis significantly reduces FM detector noise but limits the dynamic range of high frequency signals. The S/N improvement from de-emphasis is approximately 12 dB.

Figure 3 is an allowable input level mask for an FM modulator without dynamic compression. Many FM broadcasters use both broadband and high frequency compression to maximize the "loudness" of their signal without overmodulating.

Figure 4 is a simplified block diagram of a stereo FM multiplex receiver. The spectrum input of the stereo input decoder is the combination of Figures 1 and 2. The S/N of the L−R DSB-SC signal at the input decoder is:

S/N = C/N + 10log3(67.5 kHz/38 kHz)²
= C/N + 10 dB FM improvement

The output of the L−R detector is 3 dB improved relative to the noise level of subcarrier input, due to the upper and lower sidebands adding coherently and the noise adding non-coherently. Note from Figure 1 that the input noise spectrum across the 23 to 53 kHz band is sloped but the output noise (folded and added around 38 kHz) is white. De-emphasis is less effective on the white noise L−R output than on the L+R output. The de-emphasis improvement is only 6 dB for L−R.

L+R S/N = C/N + FM improvement + de-emphasis improvement
= C/N + 10log3(67.5 kHz/15 kHz)² + 12 dB de-emphasis improvement
= C/N + 30 dB

while:

L−R S/N = C/N + 10 dB FM improvement + 3 dB DSB improvement + 6 dB de-emphasis improvement
= C/N + 19 dB

Since the noise level is greater than 10 dB higher in the L−R signal, the L+R noise can be ignored and the desired expression for stereo FM is:

FM stereo S/N = C/N + 19 dB

In the CATV environment the system C/N is often expressed in terms of video carriers. Assuming that the FM carriers are set 15 dB below video:

FM C/N = video C/N − 15 + 10log(4 MHz/300 kHz)
= video C/N − 4 dB

and:

FM stereo S/N = video C/N − 4 dB + 19 dB FM MPX improvement
= video C/N + 15 dB

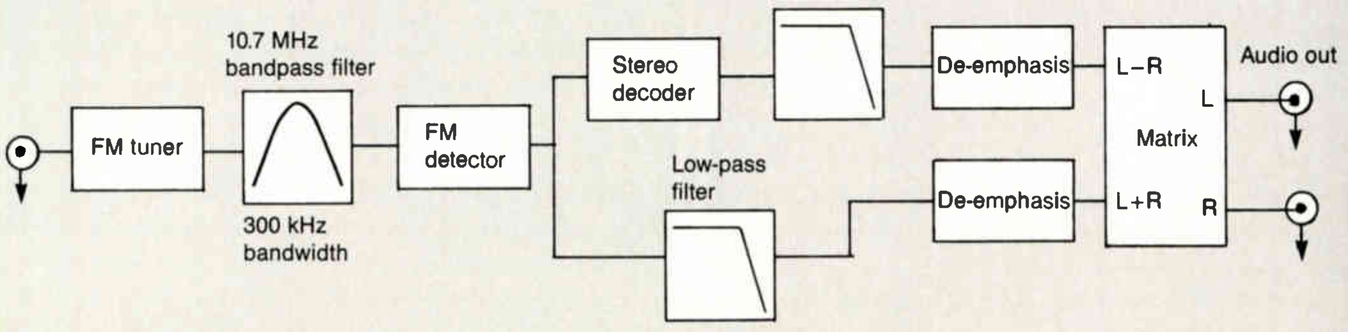
For stereo audio performance comparable to a cassette deck with noise reduction, the system C/N must be 45 dB. At 40 dB system C/N some hiss will be noticeable during quiet passages. To maintain good quality FM stereo audio, care in system design and operation is required.

Acknowledgment: Special thanks go to Ned Mountain of Wegener Communications for spotting and correcting the errors in my article in the February issue of "CT." I stated that FM stereo S/N = C/N + 7 dB, which is incorrect and led to my regrettable conclusion that FM stereo on cable was only slightly better than AM radio. On a good system FM stereo can provide good audio, provided that the subscriber's FM receiver is also capable of good performance.

References

1) *Communications Systems*, "An Introduction to Signals and Noise in Electrical Communication," Carlson, McGraw-Hill, 1968, pgs. 254-263.
2) *Multichannel Television Sound*, Volume 1-A, Appendix G, Attachment A, NAB Publication, 1983.

Figure 4: FM stereo multiplex receiver



20 YEARS OF SERVICE

SCTE: 1969-1989

A concise history of the SCTE

By William Riker
Executive Vice President

And Howard Whitman
Manager of Editorial and Promotion
Society of Cable Television Engineers

The Society of Cable Television Engineers, which celebrates its 20th anniversary this year, began as many great entities do, with the written word.

In an editorial in the November 1968 edition of *Cablecasting* magazine, Charles Tepfer wrote of the lack of recognition awarded cable system engineers. William Karnes of National Trans-Video wrote a letter in response to this piece stating that system engineers should be acknowledged for their valuable contribution to the young and growing cable industry. This suggestion drew resounding support from others in the industry, resulting in *Cablecasting*'s publication of an application for membership in the newly named Society of Cable Television Engineers.

Words became action on June 22, 1969, as the fledgling Society held its first general meeting in conjunction with the National Cable Television Association convention (held in the San Francisco Hilton Hotel, site of Cable-Tec Expo '88). Seventy-nine people, today recognized as charter members of the Society, were in attendance. Elections for officers were held at this meeting, which also saw the presentation of the temporary bylaws that would evolve into the national bylaws observed by the Society to this day. Eleven regions also were identified for the purpose of establishing local chapters.

It was at that first meeting that Ronald Cotten of Concord TV Cable suggested that the Society incorporate as a non-profit association. This incorporation also would extend to the regional chapters. The group elected temporary officers: Cotten (president), Karnes (vice president) and Tepfer (secretary/treasurer). Karnes moved that a temporary board of directors be constituted of the three officers and the regional chairmen until a permanent board could be elected by the membership.

"Over 1,000 (BCT/E) candidates have enrolled and have sat for a total of over 5,000 individual examinations."

Local chapters

Organization of local chapters began in 1970 but were delayed by problems with correspondence, dues and miscommunication. It is interesting to note that the SCTE was perceived by some as having the hidden purpose of unionizing all technical personnel in the industry. There was also concern voiced in the industry that there were no standards established for admission to the Society. These concerns ultimately led to the establishment of the Society's entrance requirements.

Karnes remained president in 1971, with Austin Coryell serving as vice president. The Society once again met in conjunction with the NCTA show, this time in Washington, D.C., in July of that year. Approximately 110 members were in attendance, but the Society's total membership was over 500 at this point. The development of a certification program remained an important concern to the membership, which grew to 675 in 1972.

The SCTE had gained additional prestige in the industry by 1973, the year in which it was invited to participate in the NCTA's presentation of Outstanding Achievement Awards. That year's new officers included Bob Bilodeau (president), Steven Dourdoufis (Eastern vice president), Robert Cowart (Western vice president) and Tepfer (secretary/treasurer). Bilodeau guided a national membership drive aimed at more experienced CATV personnel.

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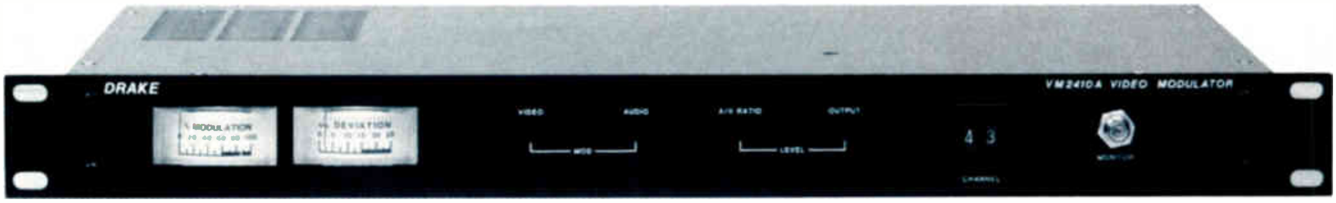

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SCTE: 1969-1989

20 YEARS OF SERVICE

(corporate) member of the Society in 1974. Sustaining membership has since served as a means of allowing individual organizations to show their support of the Society through annual financial contributions.

1974 also saw a surge in interest in the Society. Membership was nearing the 1,000 mark and local chapters were revitalized while new chapters were organized. SCTE changed its bylaws to establish senior and student members as new grades of membership. The SCTE also incorporated in 1974, officially becoming the Society of Cable Television Engineers Inc.

First published in March 1975, the Society's monthly newsletter, *The Interval*, gave the SCTE new visibility in the industry while publicizing its activities on a timely basis. 1975 also was the year in which the SCTE Member of the Year Award was officially introduced to recognize an individual who had made a significant contribution to the Society. Dourdoufis was honored for his efforts in 1974, but James Collins became the first formal recipient of the award in 1975.

Other milestones: The SCTE held its first National Engineering Conference in 1976. In 1977, the Society opened its first full-time office in Washington, D.C., and hired its first paid staff (SCTE had been all-volunteer until this time). 1979 saw the publication of the first *SCTE Membership Directory*, which was distributed to the Society's 1,000 active members.

The Society fell upon hard times during the early 1980s and few records exist. However, picking up from 1983, the chronicle continues:

The Society's first Cable-Tec Expo was held May 6-8, 1983, in Dallas. This annual training and CATV hardware conference has subsequently been held in such diverse locations as Nashville, Tenn. (1984), Washington, D.C. (1985), Phoenix (1986), Orlando, Fla. (1987) and San Francisco (1988). The SCTE returns to Orlando for its 1989 conference.

The Satellite Tele-Seminar Program series was created in 1984 to provide technical training videotapes to cable systems across the country. System operators are encouraged to downlink and record these programs for their present and future training needs. The Satellite Tele-Seminar series has uplinked over 75 hours of instructional programming to the industry to date. Also in 1984, *Communications Technology* became the Society's official trade journal.

In 1985, the BCT/E Certification Program was introduced at the expo with 90 attendees becoming the first BCT/E candidates. The program was created to encourage personal development in CATV technology, recognize individuals for the demonstration of knowledge and assist

management in their employee evaluation and promotion processes. Since its introduction, over 1,000 candidates have enrolled and have sat for a total of over 5,000 individual examinations.

The Technical Tuition Assistance Program was created in 1985 by the board of directors. This SCTE scholarship program has provided educational opportunities to 24 of its members by awarding them tuition assistance for correspondence courses from the National Cable Television Institute. In 1988, the program awarded tuition assistance for university courses to deserving members for the first time.

In 1986, the number of local SCTE chapters and meeting groups reached 30, doubling the total from one year before. These groups continue to hold low cost, high quality technical training seminars across the country, bringing educational opportunities to industry personnel at all levels. As of this writing, the SCTE has 29 chapters and 20 meeting groups.

Several of the Society's charter members meet in Nashville, Tenn., in 1978.

1987 marked the first time in the Society's history that it has owned its own office space. The new national headquarters building, located in Exton, Pa., officially opened in January with a grand opening celebration. The purchase of the property was made possible in part by generous contributions to the Society's New Building Fund.

Another SCTE milestone, the certification of the first BCT/E participant to successfully complete the program, Ron Hranac of Jones Intercable, was reached in 1987. Hranac was certified at the program's technician level. Les Read of Sammons Communications, who completed the program later that year, was the first person to be certified at the engineer level.

Hall of Fame

In 1988, SCTE created a Hall of Fame to recognize individuals who have tirelessly given of themselves and shared their knowledge with others for a major portion of their lives. The first inductee, Cliff Paul, received the honor at Cable-Tec Expo 1988. This expo, held in San Francisco, broke all previous attendance records. Over 1,300 industry technicians and engineers from across the country were in attendance, more than doubling the number of attendees at the expo only three years earlier.

The Society's membership figures provide a chronicle of its growth. Although the SCTE experienced strong growth from 1977 to 1979, the past four years really tell the story. The Society has effectively doubled in size since 1984, when the year-end membership figure was 2,500. This figure grew to 2,700 in 1985, 3,200 in 1986 and 3,800 in 1987, with SCTE reaching the milestone figure of 5,000 members by the end of 1988. This growth serves as testimonial to the value of the organization at this point in the ongoing development of the cable industry.

Acknowledging in print all the individuals whose tireless efforts have helped make these outstanding achievements a reality would fill this magazine. Yet, it is this dedication and belief in the professional development of industry technical personnel that has enabled the Society to make such tremendous advances. We look forward to many more years of service to the industry.

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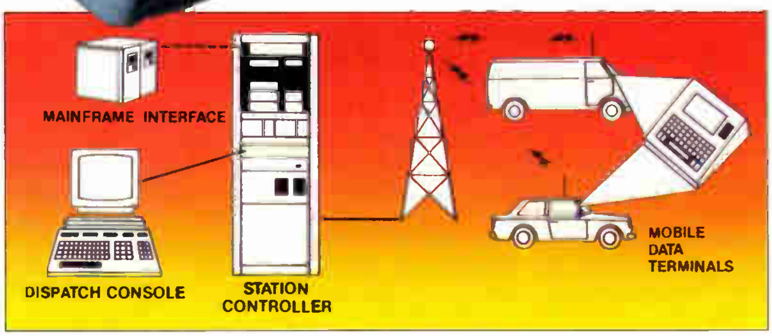

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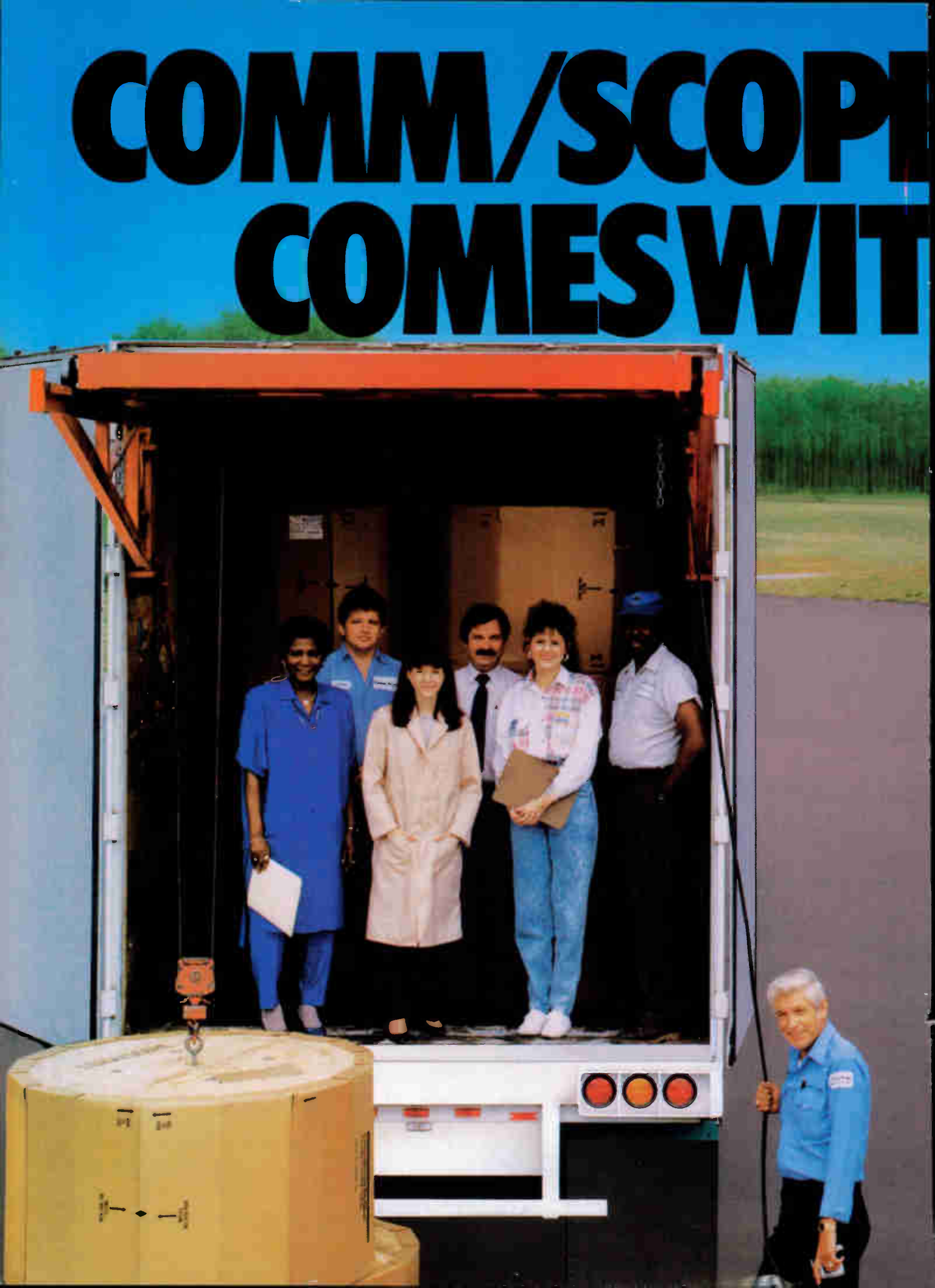
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Reader Service Number 81.

Introducing fiber in a coaxial world

This is the first of a series on the costs and benefits of fiber-optic technology.

By John W. Linebarger
Engineering Manager, Jones Intercable Inc.

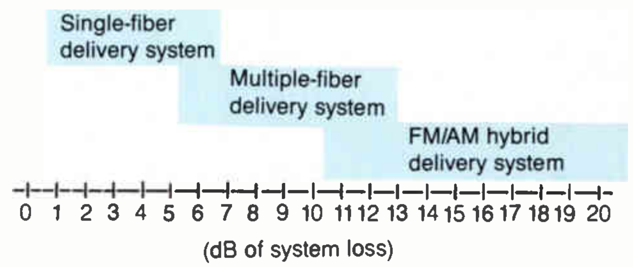
There is considerable dialogue today concerning fiber optics and how the technology can be used in our industry. It is fairly easy to become lost in a sea of specifications, claims and promises. This series examines just some of the many considerations in the specification of frequency and amplitude modulation over fiber systems in existing CATV plant. FM over fiber is a well-proven technology currently in use in many cable installations; AM over fiber promises to be the new kid on the block in a very short time. The industry is now recognizing AM over fiber as one answer to many current system problems as well as a vehicle to enable us to provide future analog and digital services to our customers.

Fiber technology gives the operator a host of benefits that impact every area, including:

- decreasing cascades to improve distortion and noise characteristics for 450 and 550 MHz systems.
- creating the ability to expand the traditional system for greater channel capacity far beyond today's 550 MHz, perhaps up to 1 GHz.
- better management of outages and the reduction of numbers of subs affected by plant failures by redundant path and backup switching.
- elimination of microwave and off-air pickup where weather outages are significant.
- elimination of headend sites, towers, regulations and licensing along with the associated maintenance and costs.
- ability to provide analog and digital video and data services.

All domestic fiber CATV systems are analog FDM (frequency division multiplex) transporting AM and/or FM signals. FM/FDM has been the only practical fiber format available until recently. Now there is a choice of FM-only, FM/AM mixes and AM-only systems. (Each of these will be explained later.)

Modern CATV fiber systems use a single-mode fiber delivery technology available from several equipment and cable vendors. Virtually every manufacturer of FM or AM over fiber termination equipment has currently designed around fiber systems operating at 1,310 nanometer wavelength using a standard 8 micron fiber. Attenuation and availability of fiber have been the primary force driving this wavelength. Attenuation at 1,310 nm is near 0.4 dB/km; however, systems operating on the lower loss 1,550 nm wavelengths are being strongly considered. The use of 1,550 nm allows longer reach with fiber; attenuations are lower by about 0.1 dB/km or 0.3 dB/km (see accompanying figure and table).



Fiber technology vs. system loss

The primary differences between the use of fiber by telco and CATV applications are in the modulation techniques, multiplexing and the resulting equipment located on either end of the fiber. Other subtle differences are in types of connectors and installation techniques used by the different services.

Data transmission is in a TDM (time division multiplex) digital format, while CATV requires analog AM or FM channels in an FDM format. The data and telephone industries have solid specifications for transmission quality and construction of systems, while for AM we are still trying to determine how many fibers to use and what our specifications should be.

What are the choices? 1) FM for point-to-point video, audio and data as in the interconnection of headends to hub sites; 2) AM-only for point-to-multipoint with no intermediate system such as FM or other electronics packages; or 3) FM/AM coupled with AM for point-to-point followed by point-to-multipoint as in the distribution of plant signals in an AM format from a hub site.

And what is the future choice? Digital video and audio from point-to-multipoint for interconnect of hubs perhaps even to the subscriber's neighborhood, or eventually directly to the sub's premises.

FM fiber systems and equipment

Analog FM fiber systems have been in existence for about eight years. The primary users of this technology have been those wishing to transport video, audio and data modulated on FM carriers. The cable industry has used the technology since equipment has been available for signal transportation for point-to-point applications. Major uses have been the joining together of a headend to multiple hubs in a manner similar to microwave. Other uses have included linking of TVRO sites to headends and I-Net (institutional network) applications.

FM is a straightforward technology. Systems are usually specified to meet or exceed RS-250-B specifications for medium-haul video. FM is capable of delivering very high quality video signals with as many as 20 carriers on one fiber. There are several vendors of this type of equipment; about 90 percent are American manufacturers. For the most part, all manufacturers deliver similar specifications.

FM over fiber typically operates with cable losses exceeding 20 dB. With 0.5 dB/km considered a safe loss factor, FM can extend some 40 km. This is enough distance to connect most headends to hubs. Should the FM fiber link need to be repeated, this can be accomplished with back-to-back fiber receiver/transmitter pairs. Being FM, the technology allows a degree of tolerance for repeating. Due to the relatively long distances (loss budget), FM is very easy to design from a loss point of view. Most fiber systems do not approach the loss limits of FM and can therefore hold a few dB in reserve. Exceptions to the rule include those networks where optical splitting occurs (such as in the well-publicized Ohio Bell installation).

The main emphasis now with this technology is the engineering of new products to achieve costs and other savings. The costs of the older technology discrete FM fiber systems are fairly high. Newer technology is rapidly decreasing in price as can be expected with time and cost saving equipment improvement. The major thrust is now to reduce size, power and heat requirements.

There are now FM products available that offer options where none existed before. In the past we were forced into the discrete FM modulator/FM demodulator pairs followed by a traditional CATV modulator set. For a 54 channel system, for example, the cost to transport FM signals over fiber and then modulate to AM would have cost nearly $500,000 for a headend to hub. Now, with integrated equipment, space requirements can be cut from as many as eight racks down to one or two. System cost can be cut by roughly 30 percent or more and hub costs can be reduced by 75 percent. Further economies can be achieved by optically splitting transmitter outputs, thereby amortizing the cost of headend equipment over multiple fiber links.

AM fiber systems and equipment

Televisions demand AM video signals; accordingly, the cable operator and engineers feel comfortable with AM. The ideal situation is where we can deliver very good AM signals throughout our systems. We can now do just that. During the past year developments have occurred in the application of fiber to the AM world we live in. These new developments now allow us to carry AM signals on-channel in a cost-effective manner deep into our service areas. For the first time we have the ability to technically improve our system performance without the addition of hubs or new headends.

The AM-only approach allows us to transmit from a headend multiple channels to individual neighborhoods. There are no format or frequency conversions, just AM through a totally passive fiber network. The AM-only architecture does not have many of the requirements as does an FM point-to-point system. Real estate, power, rack space and air conditioning are no longer necessary since the AM systems being delivered today fit com-

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AM seemingly is the preferred technology. However, it suffers from a problem that FM is immune from. AM-only is limited in system reach. As of the writing of this article, there are two applications of AM fiber products on the marketplace. One has a maximum reach (loss budget) of near 6 dB, the other has a reach of near 12 dB.

The technology limited to 6 dB can carry 60 channels on one fiber, whereby the 12 dB system utilizes three fibers for the same job with 18-20 channels per fiber. Between the two technologies, the break point is generally around 6 to 7 dB of total system fiber loss; it is very much tied to operating specifications and the use of different technologies of lasers and receivers. Specifications vary greatly from vendor to vendor based on the number of fibers, channels per fiber as well as the kind of lasers and detectors.

AM-only technology allows the use of existing modulators and all other headend support equipment. The main impact is the addition of laser transmitters. In some installations this can be significant. For the single-fiber approach, one transmitter is required per link; for the multiple-fiber approach, up to four are used. The actual transmitter counts are based on the amount of optical coupling (fiber sharing) and numbers of channels carried.

In the Jones Intercable fiber CAN (Cable Area Network) in Broward County, Fla., a total of 78 lasers will be placed in the headend. This equates to 26 discrete fiber feeds leaving the headend with three active fibers per feed. Broward County is installing the Catel TransHub III system that utilizes four receivers in each fiber node, although only three will be used initially. The system and equipment are designed to serve every customer with AM-only. This is made possible with loss budgets approaching 12 dB including the optical couplers. Many nodes are optically coupled, thereby sharing transmitters. Without this sharing the number would approach 150 transmitters.

The cost for an AM-only system approaches that of feedforward supertrunks, making this a "real" technology for the industry. From the FM example shown earlier, costs for the same 54 channels of termination equipment for AM-only would look like:

	Single-fiber (6 dB loss)	**Multiple-fiber** (12 dB loss)
Laser transmitter	$10,000	$ 7,000 × 3
Fiber receiver	$20,000	$13,000 × 1
Totals	$30,000	$34,000

The multiple-fiber approach assumes current usage of 54 channels.

Total electronics cost for one link (single-fiber) would be approximately $30,000, while the multiple-fiber approach would cost $34,000. If you approached cost from a loss point of view, the cost per dB for the single-fiber would be $5,000, while the multiple-fiber would be $2,833 per dB, yielding a savings of $2,166 per dB. For a true comparison the cost of additional strands of fiber would need to be included.

Most manufacturers are adding features such as status monitoring, reverse paths on fiber, redundant switching and a host of others. These include tilt networks, pads, power directors and equalizers.

Anything as seemingly convenient as an AM fiber system must have disadvantages. AM certainly has its share being much more sensitive to the common maladies of the cable system suffering from noise, distortions and optical reflections. Given the same system loss, AM cannot produce FM picture quality. A typical AM system whose total link loss is 11 dB yields 50 dB signal-to-noise (S/N) with a composite triple beat (CTB) of − 65 dB. Shorter cable runs (less link loss) yield considerably better S/N, improving as much as 6 dB with slightly better CTB.

FM/AM systems and equipment

FM/AM is simply the FM approach teamed with AM equipment to yield a fiber-based system capable of extended fiber reach over that of either separately. A typical system would consist of the linking together of hubs with FM-based fiber followed by a conversion to AM. At the hub site AM on-frequency channels would be mixed into one or more composite

AM system loss example

Transmitter launch = 0 dBm

	Loss	System level
Pigtail connector loss	0.25	−0.25
Pigtail splice loss	0.25	−0.50
Future cable repair	0.25	−0.75
4 km fiber	1.60	−2.35
Splice loss	0.25	−2.60
Future cable repair	0.25	−2.85
4 km fiber	1.60	−4.45
Splice loss	0.25	−4.70
Future cable repair	0.25	−4.95
4 km fiber	1.60	−6.55
Splice loss	0.25	−6.80
Fiber receiver splice	0.25	−7.05
Fiber receiver pigtail	0.25	−7.30

groups, converted to light and fed to the system as in the AM-only situation.

This combination of equipment could yield a network extending as much as 32 dB from a central headend with very good distortion characteristics derived for the FM portion of the network. At the FM termination point, the system is essentially free of the effects of CTB distortions. Repeating of an FM link one time could yield a network whose reach could be some 52 dB. This would equate to a straight line system reaching 104 km at 0.50 dB/km.

The FM/AM approach yields total system flexibility in network design. Placing the FM/AM equipment where short AM cable runs can meet the requirements offers the designer many benefits. If the proposed layout based on AM-only yields a maximum system loss of 15 dB actual with reserve considered, the designer is forced into a FM/AM design. If then the decision is to employ FM/AM, the hub can be located such that no nodal site is over 5 dB for a single-fiber approach or 10 dB for a multiple-fiber approach. Comfortable reserve and the exposure of longer cable runs can be minimized. This hybrid system approach will allow the relatively easy connection of multiple hubs and solid AM performance with good system specifications.

The FM/AM approach in larger systems allows the interconnection of hubs for all of the features such as commercial insertion, as described earlier. The downside is cost and the maintenance of equipment, as would be the case in any headend.

All FM/AM approaches require similar facilities as can be found in the traditional building-type hub. Specific requirements should be adequate space, proper HVAC (heating, ventilation and air conditioning), reliable power and a clean environment. It also helps to be able to get to the site in times of trouble coupled with mud, snow and other related obstacles.

Some vendors offer an FM/AM hybrid equipment approach that is more cost-effective than the traditional FM/AM. For example, Catel has the TransHub I (TH I), a system that is the same as most others on the transmit end yet has the FM demodulator and AM modulator on separate 2-inch wide plug-in cards. Others are doing something similar by reducing the amount of electronics needed between the FM and AM components of the system. The benefit to the industry is the resulting cost savings. The costs for a FM/AM system architecture vary among vendors. For a worst-case application where separate FM modulators, FM demodulators and AM modulators would be required, the costs break down as follows:

54 FM modulators	@	$3,000 each	=	$162,000
54 FM demodulators	@	$3,000 each	=	$162,000
Three optical transmitters	@	$6,000 each	=	$ 18,000
Three optical receivers	@	$5,000 each	=	$ 15,000
54 AM modulators	@	$1,700 each	=	$ 91,800
		Total		$448,000

Total hub site, $268,800; total transmit site, $180,000; total for one link, $448,000. This is a composite number that includes racks, installation and miscellaneous items but not equipment for the scrambling of pay channels.

Costs for the integrated approach of an FM/AM system are considerably less and offer other benefits in terms of space required, scrambled channels, air conditioning, maintenance and power requirements. For the TH I, the MSO costs are roughly:

54 FM modulators	@	$3,000 each	=	$162,000
Three optical transmitters	@	$6,000 each	=	$ 18,000
Three optical receivers	@	$5,000 each	=	$ 15,000
54 TransHub I channels	@	$1,500 each	=	$ 81,000
		Total		$276,000

Total hub site, $96,000; total transmit site, $180,000; total for one link, $276,000. This includes miscellaneous items as mentioned before. The average cost for a TH channel assumes that eight channels are processed as scrambled. The system is capable of passing scrambled channels through the FM and AM portions of the system, eliminating the need for external scramblers in the hub site. Economies in the sharing of transmitters (optical coupling) reduce each optional headend cost by one-half or one-third per link based on number of splits.

Digital video and fiber

Digital video has been in service for several years serving point-to-point needs in the telecommunications and private user networks. Costs for this technology are rapidly decreasing as the cost of VSLI (very large scale integrated) circuits is being reduced. For example, a video time base corrector five years ago cost $10,000+ for the basic instrument. Today we can purchase the same instrument with digital video effects for under $5,000; with the digital effects considered, this is an 80 percent decrease in cost in approximately five years. The same is true of the electronics that will make digital video feasible in CATV.

Fiber is the ideal transportation medium for digital video and audio. Fiber technology for digital is evolving at a very rapid rate. Once installed, fiber does not change. The termination equipment is the key to increasing capacity on existing networks. For example, telco fiber systems installed two or more years ago typically operated with data rates from 140 Mbps (megabits per second) to 450 Mbps. Today many systems are operating at or upgrading to 1.2 Gbps (gigabits per second). As pointed out earlier, cable operators are installing identical fiber strands as the telcos. By adding roughly the same termination equipment, we also can carry 1.2 Gbps.

What this means for video is that a digital fiber system can span a straight line distance of up to approximately 60 km or 32 dB of fiber loss without a repeater. After this distance fiber dispersion effects start making 1's look like 0's and 1's start having difficulty with RZ (returning-to-zero states). When this happens, a $10,000 repeater is installed and the system stretches to 120 km, and so on. Digital services can be repeated time after time and the video put in one end is the same as the video at the other end!

Video can easily be digitized. There are two methods used in the transportation of digital video, compressed or uncompressed. Compressed video requires less bandwidth than uncompressed. NTSC video requires 90 Mbps for pixel-by-pixel transmission. Compressed video is typically two for one encoding, requiring only 45 Mbps for transmission. Data providers and telcos refer to 45 Mb as DS-3 (digital service). Further encoding can occur, perhaps as much as 10 for one.

There are tradeoffs in the compression of video. With two for one compression and little screen movement, only an expert could tell that the video is compressed. With 10 for one compression, anyone can tell. The more compression used, the more pictures will become fragmented and appear jerky. This can be observed on foreign TV conversions to NTSC. Although not exactly the same, a more dramatic example can be seen where network broadcasts are interrupted for short durations and frame synchronizers freeze video for moments at a time.

Some manufacturers are looking very closely at digital video today for the CATV marketplace. Sources indicate that digital video will replace FM over fiber in as little as six months to two years. In fact, if $15,000+/channel is not too much to pay now, digital video is available today. At that cost the financial constraints would probably limit this technology for point-to-point applications. In the very near future we will be able to transport a digital video channel over fiber for somewhere near $5,000 per channel!

This is the cost for an FM channel now.

If allowed to speculate for a moment, in one to two years existing single-mode fiber will be operating at 2.4 to 4.8 Gbps. If the industry chose to transmit digital video uncompressed at 90 Mbps, one fiber could conceivably carry 50 or more channels of video. Use of other wavelengths could escalate this to 100+. This equates to roughly 74,000 voice (telephone) channels. The limits are in the equipment hooked to either end of the fiber. Most of the limits are cost but technology is catching up. The VideoCiphers in practically every headend convert digital audio to analog right now.

Digital TV is a very real technology right now. In a few months, articles like this will be mostly digital and AM fiber. If I could be allowed to speculate again: In six to 18 months we will see products on the market putting 32 digital video channels on one fiber using two wavelengths. In the hub, the final output will be our traditional AM channels. Get ready, digital is peeking around the corner!

Technology and architecture

There are two fundamental decisions to be made in CATV fiber network planning. The first is what technology to use, in terms of fiber termination equipment (AM, FM, FM/AM); the other is what architecture to use. Different system sizes and shapes strongly influence both decisions. Most have already read about the technologies available but even the best technology decision can be frustrated by the wrong architecture.

When the cable industry specifies and designs a coax system, many boilerplate figures are used to establish cost, homes per mile and many other standard numbers relating to a "mile" of plant. In the deployment of a fiber CAN in an existing system, it is difficult to define a standard mile (or standard kilometer, for that matter). There is no typical system. There are cable systems that fit comfortably around a central headend that may be classified as "typical." But many systems are not symmetrical and are broken up into multiple headends, jagged plant and the odd longer-than-normal trunk run.

Every cable system must be examined individually where fiber is being considered. A high degree of customer tailoring must be considered in the design phase. Before the engineer can specify using FM, AM or a combination of both, fairly detailed examination of the existing plant and any future requirements must occur. If the desire is to limit fiber technology to AM-only and the loss budget is vendor-limited, for example, 6 or 7 dB of loss, the engineer must determine that every node can be reached with a combined system loss of 5 to 6 dB including splices, spare cable, jumpers and other factors affecting loss.

Some loss has to be allocated to the eventual fiber cut and the resulting loss caused by the repair. Splice loss in fiber cable can range from a low of less than 0.1 dB to an unlimited high. A typical system loss of 0.25 dB will work most of the time. If there is no way to pull in slack to a cable cut, two splices must be used to repair a cable cut.

In cut prone areas, it will take a short period of time to start delivering worse pictures than that of a coax-only system. Keep in mind that fiber is typically installed splice-free in runs of 4 km or more. The relatively easy span replacement of coax turns out to be a very difficult task with the replacement of several kilometers of fiber. Your selection of a numerical "comfort factor" combined with actual fiber and connector losses may be the point at which multiple-fiber AM systems or a hybrid FM/AM system is chosen for a particular application.

Providing for today and beyond

For what the cable industry needs today and beyond, AM or hybrid FM/AM fiber systems are the answer to provide our subscribers with very good and reliable service while providing engineers a method to cost-effectively deliver the quality, overcome the current and impending cascade limitations and dramatically increase system reliability. There is little doubt that in a couple of years (or maybe next week) some laser manufacturer will make huge progress in the production of lasers that will make much of what I have said here obsolete. In fact, by the time this goes to press, there is a very good likelihood that some of this information will be old. "Old" in the fiber world is one week. This technology is changing and developing so fast you risk becoming not so smart very quickly! ■

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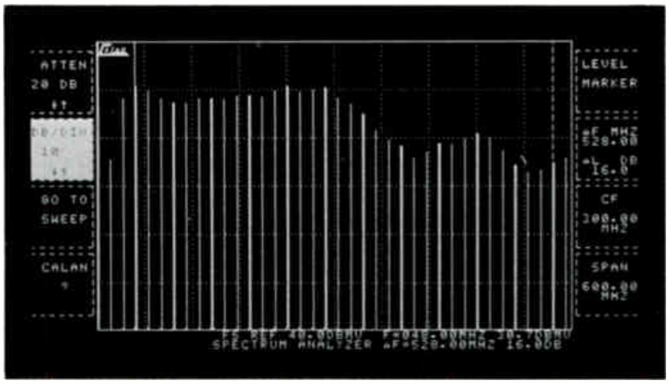
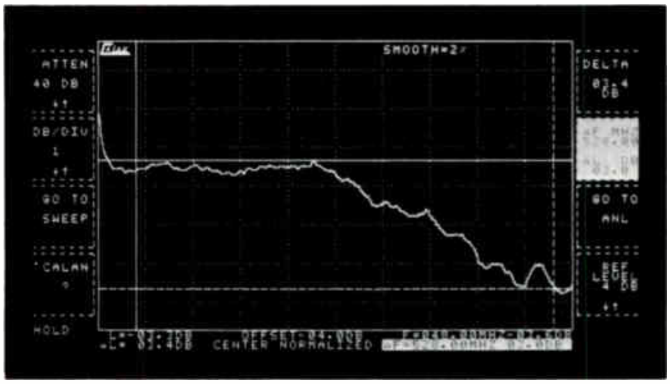
PICTURE 1
Spectrum Display



PICTURE 2
Frequency Response



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Small systems—The last frontier

This is the fifth in a series of articles designed to help the small system operator or entrepreneur avoid some basic (and perhaps fatal) mistakes. This installment concludes a discussion of designing and operating a small system plant.

By Bill Grant
President, GWG Associates

And Lee Haefele
President, Haefele TV

Since revenue is limited and cost is the keynote, the small system operator must seriously evaluate any operating or maintenance practices that are expensive and sophisticated. A question to consider: Does a particular procedure really improve or ensure transmission quality and bottom-line profit, and is it essential? There seems to be a national preoccupation with high technology, a fascination with acronyms and buzzwords and a predisposition to doing things in a highly sophisticated manner simply because it is possible to do so. For the small system operator this is a luxury that simply cannot be afforded. In extreme cases, it may even be fatal to the entire venture.

In our experience, if the operator can establish firm control of transmission levels throughout the system—perhaps by designs using a higher density of system self-regulation in the form of more AGC/ASC (automatic gain/slope control) equipment—then all that is truly necessary is a program to monitor these levels regularly. Levels can be adequately monitored through the use of a signal level meter alone. More sophisticated procedures can be eliminated entirely or conducted very infrequently. We see no real reason to expect that system transmission quality will be drastically impaired or altered if transmission levels remain unchanged.

Perhaps many in the industry take exception to this statement but we recommend and endorse "shirt sleeve" practicality over the purely theoretical approach. The small system operator usually has little option. In our opinion, maintaining the transmission system by monitoring signal levels alone is a realistic, practical and adequate procedure.

System irregularities may subsequently develop that may not necessarily be clearly evidenced as transmission level changes. Such problems as broken cable sheaths, unterminated cable ends and defective connectors are examples of these. An effective technique for diagnosis and location of such problems is the use of RF leakage detectors. Even with a basic understanding of the technology and a little practice or training, these relatively simple and inexpensive devices can be very useful indeed.

Basic economics

Although this discussion has been limited to the cable transmission portion of the system (subsequent installments will discuss headends and signal acquisition as well as the business aspects of system operation), we need to relate all this to basic economics and costs.

There are a lot of variables in the cost of any plant regardless of the design philosophy applied. It may be useful to speak in terms of scale of cost reduction rather than in specific figures. After applying the single-cable design to a number of smaller systems that had previously been designed with the conventional trunk/feeder technique, the single-cable design was found to be less expensive in every instance. But how much less?

In applications that placed most of the plant within a small community or town, the savings were about 30 percent or more. In those portions that were largely out of town (along rural roads, for example) savings were more typically 40 percent or so. Since these studies were made there have been new product developments that lead us to believe these numbers can be improved upon, but we have no data to support this. Keep in mind that we are only talking about the distribution plant. The total project must include the cost of signal acquisition (headend) as well as all service drop and subscriber terminal costs. What does this translate to when considering an actual application?

If system costs are related to cost per subscriber produced—a common practice in the industry—then a conventional design producing a paying subscriber at an arbitrary cost of, say, $700 might be constructed at a cost of $400 or $500 per sub using the single-cable design. This is not the entire story, however. First, it ignores any of the subtle but long-term advantages of lower maintenance costs. Second, people who have some familiarity with the industry may do much better than this.

One possibility that we have seen effectively applied, for example, is to purchase used amplifiers from larger systems undergoing rebuild or upgrade. Such units can be extremely inexpensive. Although they may not be the higher gain units best suited for the single-cable design, they can still be utilized effectively in smaller system applications. A word of caution here: There may be a lot of used equipment available and prices may seem very attractive indeed, since there is little market for most of this equipment. But you can be badly burned. If your CATV experience has been entirely with larger trunk/feeder systems, you may not have had direct experience with the type of equipment involved here. In this case, we strongly suggest that you seek the advice of someone who has. Full-sized, used trunk/bridger amplifiers also may consume up to 50 percent more operating power than smaller, less sophisticated units. This may even require more AC power supplies in a system.

We went to some lengths to review the trunk/

feeder design in this series in order to technically substantiate the single-cable design alternative. A logical question is what size system will lend itself best to a single-cable design and what size system would a trunk/feeder design approach best be utilized. We gave this much thought and some years back even conducted a series of design and cost comparisons in an effort to resolve this. At that time it was our conclusion—and we qualify this as an opinion—that in any system involving fewer than, say, 1,500 homes the single-cable design would always prove in.

That conclusion may still be valid in itself, but we think there are some new factors and considerations that enter into it. Given the new fiber-optic transmission technology, it is now technically possible to transport many signals throughout a town or city to a multiplicity of distribution hubs with very little noise or distortion introduced and with no intermediate amplifier requirements in the transportation system at all.

In effect, a large urban area might now be considered as simply a number of much smaller distribution systems. With no great stretch of the imagination, perhaps entire cities or urban systems could be designed and constructed as single-cable plant. If plant costs can be reduced hundreds of dollars per mile of plant and a system involved, say, 500 miles (as many do), then the savings would certainly be significant. This is to say nothing of the reduction in system operating and maintenance costs that might be possible. It is an interesting thought and might be the subject of further study in itself.

Given a single-cable design, there are still many variable factors that might determine plant costs. You might "shoestring" the construction yourself since there is not really a lot of plant to build. Or you might hire a contractor for the entire project. It is really very difficult to accurately cite costs per mile here but with some qualification we will attempt to make some estimates anyway.

We believe it is possible to construct new plant (including placing a new supporting messenger) within the cost range of $4,000 to $6,500 per mile. Using self-support cable we believe the cost range could be $3,500 to $5,500 per mile. This is for plant in place, energized, aligned and tapped for service but excluding any headend or subscriber service drop costs. These estimates include some nominal plant makeready costs that are not usually very high in rural areas. However, it should be noted that unusual plant conditions may exist in some places and the makeready costs could be significant in these instances.

Equipment guidelines

Without imposing equipment specifications we would like to offer some guidelines or recommendations for consideration. Amplifiers should present 30 or 32 dB of usable gain and be two-stage designs to optimize noise figure. As well, gain and slope control should be available interstage. Switching regulating power supplies in the amps are more efficient and may better accommodate subsequent system rearrangements or extensions. It is very convenient if the same amplifier housings can accept modules for either manual or auto-regulating stations. Make certain that plug-in equalizers are available for the transmission spectrum you propose to provide.

System AC power supplies should be pole-mounted units, but you will need to know how the manufacturer specifies the unit efficiency. For example, a 15 ampere unit may be specified to be 80 percent efficient at full load, but when operating at only 4 or 5 amperes it may be only 40 or 50 percent efficient. Many smaller systems will only draw 3 to 7 amperes from a single AC power supply because of the unique geography of such plant. This may seem to be an obscure point, but in some cases the difference can be as much as $50 more in power cost per AC power supply per month.

In system passive devices such as taps or couplers it makes sense to use all the same type units in a single station to simplify spare parts stocking. We do not install any eight-port taps at all for the same reason; we use two four-port units instead.

Let us be perfectly clear about this design approach. No one has invented the wheel here and we make no claims of originality. All we have done (or hoped to do) is to show the practicality of applying a particular technology in a slightly different way in order to better satisfy slightly different requirements.

There is a practical, technically sound approach to smaller systems and it can and has made possible some applications that were previously considered economically impractical. This may represent new areas of opportunity (at least it could if the technology is fully understood and intelligently applied).

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■ **SUPER FLEXIBLE.** Flexibility is synonymous with ADCART. Insert on virtually any number of channels. Assign VCRs to fit your avails: two on two channels, four on one channel, or four VCRs between two channels. . . without overlapped avails. You'll even have an auto-record capability, which has already made the ADCART the de facto standard in new interconnect design.

■ **SMALL STUFF.** The ADCART has many other features, some of which you probably never thought about. To name a few: stereo audio, with computer-controlled audio-level matching; TBC-switching; stereo simulator inputs; super-capacitor memory backup; non-volatile memory for system configuration data; and premium plug-in interface connectors to simplify installation and maintenance. Add to this an award-winning electronics package and numerous other features and you have the best cost-benefit ratio in the business. . . *by far.*

■ **DON'T WAIT.** If you're thinking ad insertion, take a close look at ADCART before you buy. If you don't, you'll hate yourself once you see one operate. Even if you have a system now -- regardless of the brand -- you owe it to yourself to look at the ADCART. Looking doesn't cost you a cent, but relying on outdated equipment can cost you plenty.

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Comments on HDTV

By Dan Pike
Vice President of Engineering, Prime Cable

They say that Albert Einstein favored these two sayings: "Never accept a complicated answer when a simple one will do" and "Complex subjects should be made as simple as possible, but no simpler." A discussion of HDTV (high definition TV) invokes both of these. I have some comments not needlessly overcomplicated yet not simplified beyond accuracy.

The subject of HDTV is sufficiently complex that you could spend your full time just keeping track of the activity. There are between one dozen and two dozen legitimately proposed systems ranging in definition from improved, expanded and advanced to real high definition, using channel bandwidths from 6 to 30 MHz and having from 525 to 1,250 scan lines per frame. Also involved are various aspect ratios, horizontal and vertical resolutions and compatibility to NTSC.

The best of these systems produce video as good or better than film. It is interesting, though, that improvements to present-day NTSC are thought to be possible, making NTSC appear to the untrained observer to be about as good as 35mm film or at least as good as RGB.

Added burdens

As if the technical complexity wasn't enough, HDTV has now taken on the added weight and burden of the international trade balance, national and world economics, military development, employment, the digital revolution, the telcos, congressional politics, pop journalism and no telling what else (I haven't read the newspaper today).

HDTV standards that have been announced for this country deal with production, not transmission. This concerns the people who decide to shoot their work on film or tape. The transmission formats we've always used have been independent of those production formats. Just because some of those groups have picked one production format, it doesn't necessarily affect the future transmission standard.

The Federal Communications Commission will attempt to make a decision after another two or three years of testing and hearings. In the meantime, it has said that we won't make obsolete the 160 million TV sets now in use—although you'll probably need to buy a new set to realize the full improvements just like when color was added.

Cable Television Laboratories and the National Cable Television Association will follow the HDTV developments and advise their members whether CATV interests are better served by some but not others, or what changes will need to be made to cable systems to carry the signals. Recent tests in Washington, D.C., with the MUSE signal and the ones last year in Los Angeles were designed as early pass/fail indicators, with more rigorous work to be done at a later time.

On the market

Consumers can already buy what are called "IDTV" or improved definition TV sets. These use extra processing to achieve progressive scan and other desirable features. They tend to be larger sets and often brighter and clearer. They may be viewed by people at closer distances. As they are presently high-end sets, you can assume they are viewed by interested observers.

If your service is marginal, this will be noticed more than by someone with an old, small TV set. My advice is to be sure your service meets or exceeds NCTA recommended practices for noise and distortion (43 dB C/N and 53 dB CTB). To have the same signal-to-noise ratio as a new Super-VHS tape machine, for example, you'll need to be a little better than present NCTA recommended values.

You can observe the sales of such equipment in the community you operate in as a leading indicator to judge how your customers feel. But in general, the feeling is that consumers want these improvements, at a reasonable price, and over the next few years we will probably want to provide them.

So keep HDTV on your planning horizon. Keep current on the developments and look forward to bringing these improvements to your customers. Just like you did a few years ago, when you built that first earth station at the tower.

This article was presented as part of a discussion at the 1989 Texas Show.

550MHZ
17

Calculating performance in the trunk

By Scott Loder
CATV System Design Manager, Texscan Corp.

A question that often comes up in CATV system design is how to achieve acceptable noise and distortion performance when working with long trunk cascades. Conventional push-pull trunk amplifier performance is not always good enough to ensure good pictures at system extremities. Two alternative technologies that have been developed are power addition and feedforward. Power addition architecture employs two push-pull hybrids in parallel to give a net improvement of 4 to 5 dB in distortion over conventional push-pull. Feedforward uses two push-pull hybrids and distortion-cancelling circuitry to realize a 14 to 15 dB improvement over conventional push-pull.

So, if you are faced with a trunk run that is too long to use normal push-pull trunk amplifiers, how do you choose an alternative? And once you have chosen, how do you know how much is enough? Since power addition and feedforward are more expensive and consume more power, it is important not to use more than you absolutely have to.

Do the math

The only way to do this is to sit down with your calculator and do the math. The place to start is to look at the distortion performance of your feeder network. Since carrier-to-composite triple beat (CTB) ratio usually is the limiting distortion, you must know the CTB performance of your bridger and line extenders. If your bridger and line extenders are currently operating with an output of +39/46 at Ch. 2/Ch. YY, then the CTB for each is probably around −62 dBc. This can be found in the manufacturer's specifications. The calculation to find the CTB performance of the combination of bridger and line extender looks like the following:

$$20\log(10^{(A/20)} + 10^{(B/20)}) = \text{feeder CTB} \qquad \textbf{(1)}$$

where:

A = the CTB performance of the bridger and
B = the CTB performance of the line extender

Using −62 dBc as both A and B, then the calculation looks like:

$$20\log(10^{(-62/20)} + 10^{(-62/20)}) = -56$$

So −56 represents the CTB performance of the feeder.

We now need to find the minimum trunk CTB performance that can be combined with the CTB performance of the feeder that will still yield acceptable worst-case end-of-line CTB performance. Since −53 dBc is usually regarded as the cutoff point for CTB, the question becomes what, when combined on a voltage basis with the feeder contribution (−56), will give no worse than −53. You can proceed with trial and error and use up a lot of paper and computer time, or you can use the following formula:

"Since...(CTB) is the limiting distortion, you must know the CTB performance of your bridger and line extenders."

$$20\log(10^{(D/20)} - 10^{(E/20)}) = C \qquad \textbf{(2)}$$

where:

D = the limit for CTB performance,
E = the feeder CTB performance and
C = the CTB performance that must be met by the trunk

C is the number we are looking for; if we plug into D and E the values from earlier, it looks like:

$$20\log(10^{(-53/20)} - 10^{(-56/20)}) = -63.69$$

So −63.69 represents the CTB performance that, when combined with the feeder contribution of −56, will give −53. In other words, we have calculated the minimum performance we can have from the trunk and still achieve acceptable CTB performance. The trunk amplifier technology that we choose, when cascaded the distance necessary, must yield CTB performance of −63.69 dBc or better.

The performance at the end of the trunk needs to be at least −63.69 dBc. We know that the trunk cascade will degrade the performance of a single amplifier by 20logN, where N is the number of amplifiers in cascade. If we subtract this number algebraically from what we need at the end of the cascade, we will know the least number we can start with. For instance, if the trunk cascade is going to be 30, then:

$$-63.69 - 20\log(30) = -93.23$$

This tells us that the trunk module we use must have CTB performance at least this good.

Supposing conventional push-pull has a −85 dBc CTB, power addition has a −89 dBc CTB and feedforward has a −99 dBc CTB. The numbers for the different technologies should be compared to what is necessary. In the example,

conventional push-pull and power addition can be seen to be lacking. The mathematics dictate the use of feedforward; however, the CTB performance of feedforward is far better than what we need. A combination of feedforward and less expensive conventional push-pull may do it for us. Now we need a way to elegantly calculate exactly how many feedforwards and conventionals will combine to give as close to a 93.23 as possible.

If we let X be the number of conventional push-pull amps and Y the amount of feedforward amps in the cascade, then:

$-85 + 20\log X =$ conventional trunk CTB performance $= C$
$-99 + 20\log Y =$ feedforward trunk CTB performance $= F$

We calculated that, when combined on a voltage basis, these two must be at least as good as -63.69. Therefore, the following must be true:

$$20\log(10^{(C/20)} + 10^{(F/20)}) = -63.69$$

Substituting $-85 + 20\log X$ for C and $-99 + 20\log Y$ for F and simplifying gives:

$$10^{(-85/20)}X + 10^{(-99/20)}Y = 10^{(-63.69/20)}$$

This is the first of two simultaneous equations. The other will say that the quantity of feedforwards in the cascade plus the quantity of conventionals in the cascade equals the total cascade, like:

$$X + Y = 30$$

When these two equations are solved simultaneously, X will be equal to the amount of conventional amps and Y will be equal to the amount of feedforward amps in the cascade. In this case, Y = 22.95 and represents the minimum number of feedforwards that must be used in the cascade. The amount of feedforwards should be rounded up, and in this case would equal 23, with the balance of seven being conventional push-pull.

The general form for the equations into which you can substitute your own system's parameters is as follows:

$$10^{(C/20)}X + 10^{(F/20)}Y = 10^{(T/20)} \qquad (3)$$

$$X + Y = N$$

where:
C = conventional push-pull CTB
F = feedforward CTB
X = number of feedforwards necessary
Y = number of conventional push-pulls necessary
T = minimum CTB performance for the trunk
N = number in the cascade

There are some factors that can cause confusing results when the equations are solved:

1) If you get an answer like 0 = −37, then try the math again; your calculator malfunctioned.
2) If Y, the number of feedforward amps necessary, comes out to be negative, then the cascade is short enough and the feeder levels low enough that feedforward is not necessary. You can make your distortion numbers using conventional push-pull trunk amps all the way.
3) If X, the number of conventional amps necessary, comes out to be negative, then the cascade is too long, or the feeder levels too high or both. In this case, if your system allows, try lowering bridger and line extender levels. This will improve the CTB performance of the feeder and consequently lower the performance that the trunk must provide. Recalculate using a higher value for T in the first equation. If your system does not want to reduce feeder levels, or if you try that and still get a negative number for Y, then you must improve the performance of your feeder by using improved technology in it.

The first choice

Power addition is the first choice here. Using CTB performance for power addition bridger and line extender, recalculate the contribution of the feeder, as in Equation 1. Using that, recalculate the number that must be met for trunk performance as in Equation 2. If even power addition does not do the job, then your time has not been wasted: At this point you have mathematically proved the necessity of a microwave link, fiber optics or a new headend.

Assuming that you come up with a workable amount of feedforwards and conventional push-pull amplifiers, the last step is to check the carrier-to-noise ratio for the cascade.

SCTE: 1969-1989

20 YEARS OF SERVICE

Happy Anniversary, SCTE!

By Ron Hranac
President, Society of Cable Television Engineers

Twenty years ago this month the SCTE was officially born when a group of industry engineers gathered at the organization's first general meeting. The meeting was held in the San Francisco Hilton on June 22, 1969, during that year's NCTA convention. Ron Cotten, then of Concord TV Cable, was elected SCTE's first president. Coincidentally, the Society celebrated its 19th anniversary and held Cable-Tec Expo '88 in the very same hotel last year.

In the SCTE's *1988/1989 Membership Directory and Yearbook*, Executive Vice President Bill Riker reprinted the minutes of that first meeting (originally published in *Cablecasting* magazine), along with a list of the first national board of directors. In his "Executive Vice President's Report," Riker also compiled a summary of some of the Society's important milestones. Looking over the group's accomplishments, you will see some of the reasons why the SCTE is where it is today.

For example, in 1975 our monthly newsletter, *The Interval*, was introduced, and the following year the SCTE held its first National Engineering Conference. In 1983, the Engineering Conference was combined with the first expo in Dallas and the two have been held jointly ever since. Our Satellite Tele-Seminar Program series started in 1984. In 1985 was the introduction of both the BCT/E Certification Program and the Technical Tuition Assistance Program. By 1987, the Society had grown to the point where it could purchase its own national headquarters office (this year we bought the office next to our existing one and doubled our national headquarters size). And in 1988, Cliff Paul was the first inductee into SCTE's newly created Hall of Fame.

From the first meeting in 1969, with 79 organizing charter members in attendance—our national membership has grown to more than 5,200. Interestingly, 11 regional chapters were established at that first meeting and a chairman for each chapter was selected. Over the years, though, that structure evolved into the Chapter and Meeting Group Program we now know. Today there are 49 local groups.

Come a long way

The SCTE has come a long way during the past 20 years; it has had its share of ups and downs, but that is part of growing. Today our Society is recognized as a professional organization with ties that reach beyond our national boundaries. SCTE is the industry leader in CATV technical education and certification; our activities with interface practices may one day make us the "UL" of cable TV.

"Today our Society is recognized as a professional organization with ties that reach beyond our national boundaries."

At this year's expo in Orlando (June 15-18) we will be celebrating our 20th anniversary. On Friday, June 16 from 6-10 p.m. at Sea World, we will—as part of our "anniversary party"—honor charter members and past presidents. This will be a great opportunity to say thanks to the folks who made it happen. More important, it will be an opportunity to thank *you*—the more than 5,200 people who are the Society of Cable Television Engineers.

Happy anniversary, SCTE!

Off-air Ch. 6

By Steven I. Biro
President, Biro Engineering

This is the fifth in a series of maps with technical and program parameter listings for off-air Channels 2-69, designed to be used when the cable system experiences co-channel interference. With this information, the headend technician can pinpoint the closest (i.e., the most probable) offenders, determine their directions and start the verification process with the rotor-mounted search antenna. Based on the tabulated technical information, the search can be concentrated on the most powerful stations or those that have the highest transmitting antenna towers.

The computer program for the maps was developed and data for the listings was collected by the staff of Biro Engineering, Princeton, N.J. The information is accurate as of Sept. 1, 1988.

Key to listing
Call letters: Ch. 6 station identification

City: Station location or the area served by the station

Network affiliation:

C/N	CBS and NBC programming
A/N	ABC and NBC programming
ED	Educational station (PBS)
IND	Independent station
CBC	Canadian Broadcasting Corp.
CTV	Canadian Television Network
RRQ	Reseau Radio Quebec
TVA	Canadian Independent Programming
SRC	Societe Radio-Canada
SP	Spanish language programming

Power: The effective visual radiated output power (in kilowatts)

Offset: The offset frequency of the station

0	No offset
–	−10 kHz offset
+	+10 kHz offset

HAAT: Transmitting antenna height above average terrain (in feet)

Call letters	City	Network affiliation	Power	Offset	HAAT
WBRC	Birmingham, Ala.	ABC	100	–	1120
KUAT	Tucson, Ariz.	ED	36	+	3630
KEMV	Mountainview, Ark.	ED	100	–	1390
KVIQ	Eureka, Calif.	CBS	100	–	1740
KVIE	Sacramento, Calif.	ED	100	0	1870
KSBY	San Luis Obispo, Calif.	NBC	100	+	1780
KRMA	Denver	ED	100	–	880
KREZ	Durango, Colo.	C/N	6	+	361
WCIX	Miami	IND	100	0	1800
WCPX	Orlando, Fla.	CBS	100	–	1465
WJBF	Augusta, Ga.	ABC	100	+	1375
WCTV	Thomasville, Ga.	CBS	98	0	2040
KIVI	Nampa, Idaho	ABC	61	0	2660
KPVI	Pocatello, Idaho	ABC	100	–	1530
WRTV	Indianapolis	ABC	100	0	990

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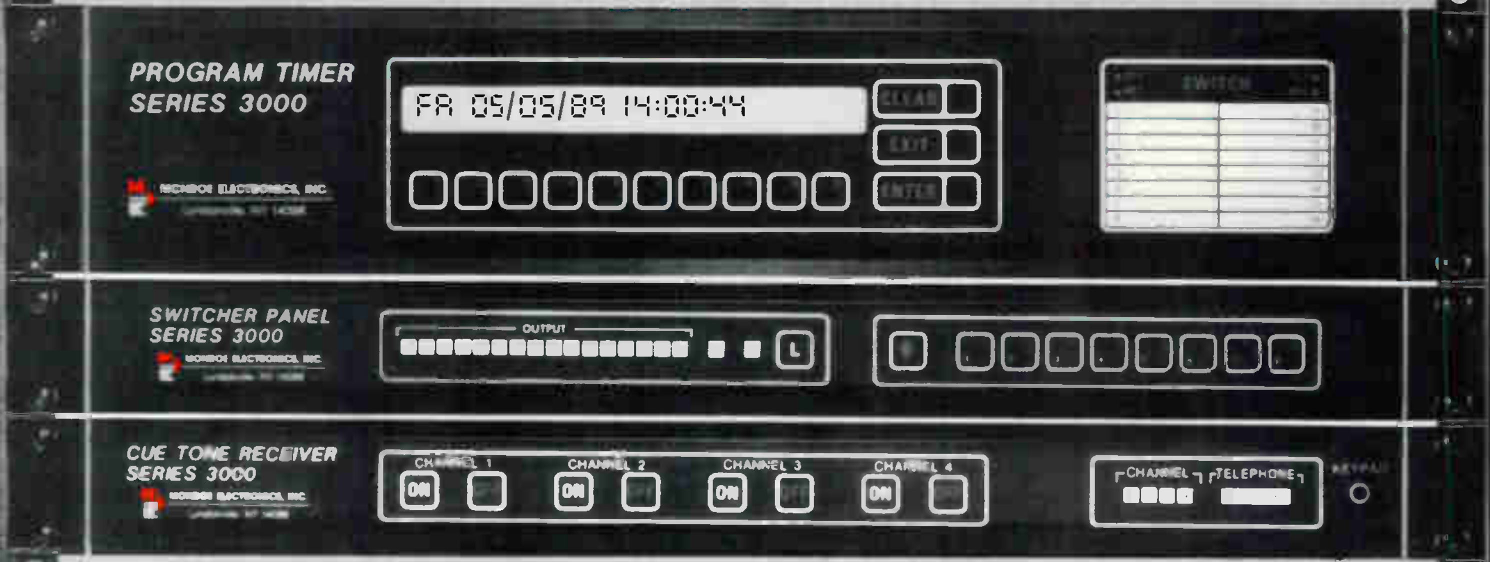

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  - 4X1 Matrix A/V Module
- Front panel control
- Front panel module status indicators

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- Front panel control
- Front panel decoder status indicators

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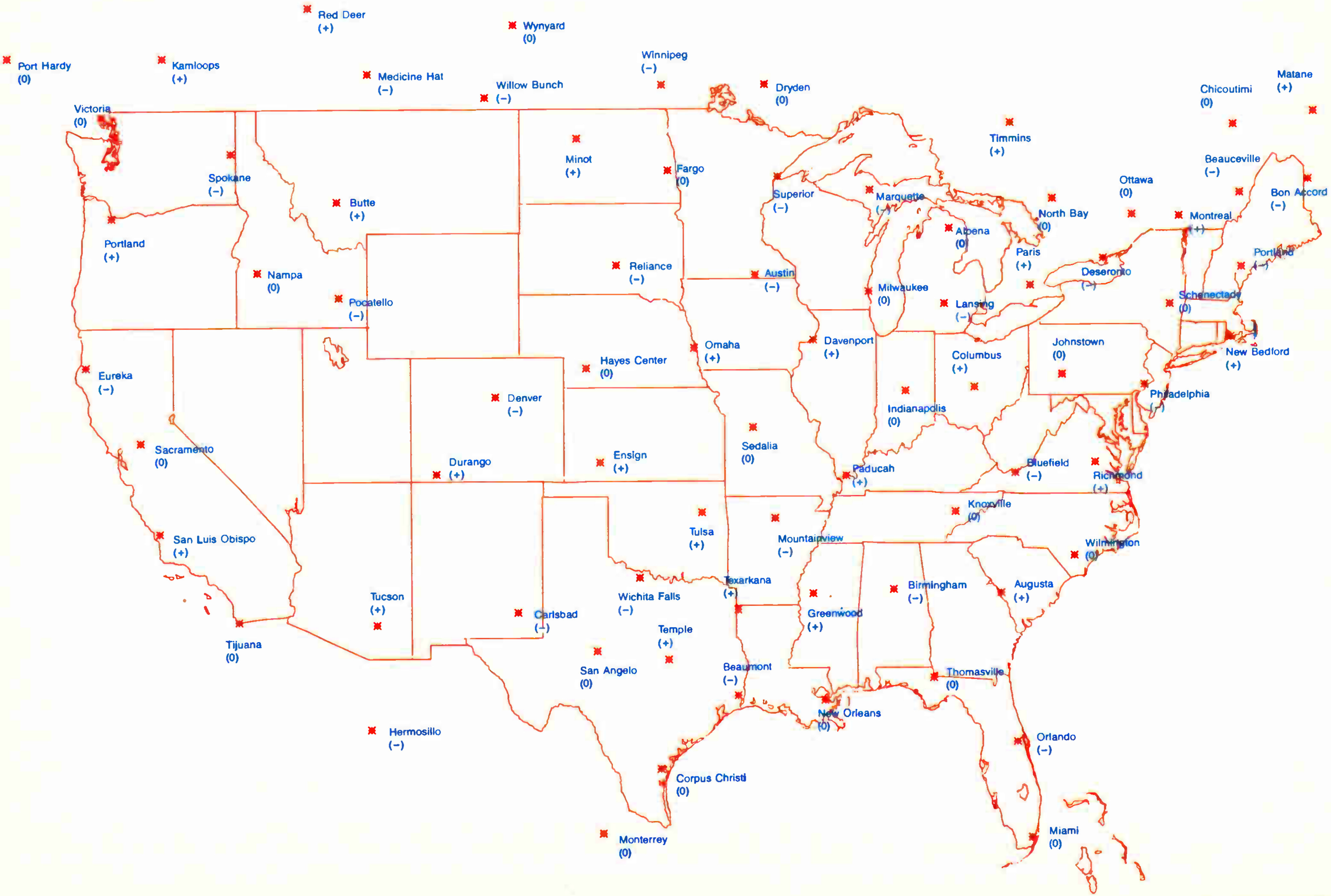
Reader Service Number 104.

Call letters	City	Network affiliation	Power	Offset	HAAT
KWQC	Davenport, Iowa	NBC	100	+	1342
KTVC	Ensign, Kan.	CBS	100	+	717
WPSD	Paducah, Ky.	NBC	100	+	1600
WDSU	New Orleans	NBC	100	0	930
WCSH	Portland, Maine	NBC	100	–	2000
WLNE	New Bedford, Mass.	CBS	100	+	930
WCML	Alpena, Mich.	ED	100	0	1470
WLNS	Lansing, Mich.	CBS	100	–	1000
WLUC	Marquette, Mich.	C/N	100	–	978
KAAL	Austin, Minn.	ABC	100	–	1050
WABG	Greenwood, Miss.	ABC	100	+	1960
KMOS	Sedalia, Mo.	ED	100	0	770
KTVM	Butte, Mont.	A/N	100	+	1936
KWNB	Hayes Center, Neb.	ABC	100	0	737
WOWT	Omaha, Neb.	NBC	100	+	1380
KVIO	Carlsbad, N.M.	ABC	100	–	1198
WRGB	Schenectady, N.Y.	CBS	93	0	1020
WECT	Wilmington, N.C.	NBC	100	0	1930
WDAY	Fargo, N.D.	ABC	100	0	1150
KSRE	Minot, N.D.	ED	100	+	1060
WSYX	Columbus, Ohio	ABC	100	+	535
KOTV	Tulsa, Okla.	CBS	100	+	1885
KOIN	Portland, Ore.	CBS	100	+	1760
WJAC	Johnstown, Pa.	NBC	71	0	1120
WPVI	Philadelphia	ABC	74	–	1094
KPLO	Reliance, S.D.	CBS	100	–	1112
WATE	Knoxville, Tenn.	ABC	100	0	1490
KFDM	Beaumont, Texas	CBS	100	–	960
KRIS	Corpus Christi, Texas	NBC	100	0	650
KIDY	San Angelo, Texas	IND	100	0	910
KCEN	Temple, Texas	NBC	100	+	1890
KTAL	Texarkana, Texas	NBC	100	+	1580
KAUZ	Wichita Falls, Texas	CBS	100	–	1021
WTVR	Richmond, Va.	CBS	100	+	840
KHQ	Spokane, Wash.	NBC	87	–	2150
WVVA	Bluefield, W. Va.	NBC	50	–	1220
WITI	Milwaukee	CBS	100	0	1000
KBJR	Superior, Wis.	NBC	100	–	1010
CHAT	Medicine Hat, Alberta	CBC	58	–	700
CKRD	Red Deer, Alberta	CBC	100	+	980
CBCB	Fort Fraser, British Columbia	CBC	1	0	1350
CHKM	Kamloops, British Columbia	CTV	4	+	501
CBUT	Port Hardy, British Columbia	CBC	1	0	345
CFKT	Prince Rupert, British Columbia	CTV	2	+	1950
CHEK	Victoria, British Columbia	CTV	100	0	1628
CBWT	Winnipeg, Manitoba	CBC	100	–	1027
CHSJ	Bon Accord, Maritime Provinces	CBC	100	–	1088
CJCH	Caledonia, Maritime Provinces	CTV	100	+	633
CJCB	Inverness, Maritime Provinces	CTV	9		1017
CHCN	New Castle, Maritime Provinces	CBC	13	0	348
CJON	St. Johns, Newfoundland	CTV	110	+	594
CJOH	Deseronto, Ontario	CTV	100	–	671
CBWT	Dryden, Ontario	CBC	20	0	500
CICA	North Bay, Ontario	ED	95	0	670
CKGN	Ottawa, Ontario	IND	13	0	149
CIII	Paris, Ontario	IND	100	+	1037
CFCL	Timmins, Ontario	CBC	100	+	575
CBVN	Beauceville, Quebec	CBC	20	–	525
CJPM	Chicoutimi, Quebec	CBC	100	0	850
CBGA	Grande Vallee, Quebec	SRC	3	–	810
CBGA	Matane, Quebec	SRC	4	+	705
CBMT	Montreal	CBC	100	+	820
CKCK	Willow Bunch, Saskatchewan	CTV	18	–	864
CHSS	Wynyard, Saskatchewan	CBC	11	0	614
XEWH	Hermosillo, Mexico	SP	7	–	175
XET	Monterrey, Mexico	SP	80	0	3230
XETV	Tijuana, Mexico	SP	100	0	1170
WIPR	San Juan, Puerto Rico	ED	54	+	2865



Red Deer (+)
Wynyard (0)
Port Hardy (0)
Kamloops (+)
Medicine Hat (–)
Willow Bunch (–)
Winnipeg (–)
Dryden (0)
Matane (+)
Chicoutimi (0)
Victoria (0)
Timmins (+)
Spokane (–)
Minot (+)
Fargo (0)
Butte (+)
Superior (–)
Marquette (–)
Beauceville (–)
Ottawa (0)
Bon Accord (–)
North Bay (0)
Montreal (+)
Alpena (0)
Portland (+)
Paris (+)
Portland (–)
Deseronto (–)
Reliance (–)
Austin (–)
Nampa (0)
Milwaukee (0)
Schenectady (0)
Pocatello (–)
Lansing (–)
Omaha (+)
Davenport (+)
Johnstown (0)
New Bedford (+)
Hayes Center (0)
Columbus (+)
Eureka (–)
Denver (–)
Philadelphia (–)
Indianapolis (0)
Sedalia (0)
Sacramento (0)
Ensign (+)
Durango (+)
Paducah (+)
Bluefield (–)
Richmond (+)
Knoxville (0)
Tulsa (+)
San Luis Obispo (+)
Mountainview (–)
Wilmington (0)
Texarkana (+)
Tucson (+)
Wichita Falls (–)
Birmingham (–)
Augusta (+)
Carlsbad (–)
Greenwood (+)
Temple (+)
Tijuana (0)
San Angelo (0)
Beaumont (–)
Thomasville (0)
New Orleans (0)
Hermosillo (–)
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June

June 3: SCTE Razorback Chapter technical seminar for installers, Days Inn, Little Rock, Ark. Contact Jim Dickerson, (501) 777-4684.

June 3: SCTE Snake River Meeting Group technical seminar. Contact Jerry Ransbottom, (208) 232-1879.

June 3-6: Electronic Industries Association's Summer Consumer Electronics Show, McCormick Center, Chicago. Contact (202) 457-8700.

June 5-7: Magnavox CATV technical seminar, Dallas. Contact Amy Haube, (800) 448-5171.

June 5-8: Siecor Corp. technical seminar on fiber-optic installation and splicing for LAN, building and campus applications, Hickory, N.C. Contact (704) 327-5539.

June 6: SCTE Chattahoochee Chapter BCT/E testing. Contact Jack Connolly, (912) 741-5068.

June 6-7: Trellis Communications seminar on fiber-optic networks, Holiday Inn Airport, Hartford, Conn. Contact Richard Cerny, (603) 898-3434.

June 8: SCTE Chesapeake Chapter technical seminar on data networking and architecture, Holiday Inn, Columbia, Md. Contact Tom Gorman, (301) 252-1012.

June 8: SCTE Upstate New York Chapter technical seminar on CLI and signal leakage, Burgundy Basin Inn, Rochester, N.Y. Contact Ed Pickett, (716) 325-1111.

June 8-9: ComNet Engineering seminar on broadband LANs, Sheraton Premiere, Tysons Corner, Va. Contact John Gutierrez, (512) 892-2085.

June 10: SCTE Mount Rainier Meeting Group BCT/E testing, Viacom, Everett, Wash. Contact Sally Kinsman, (206) 867-1433.

June 10: SCTE Wyoming Meeting Group technical seminar. Contact Matt Forgas, (307) 324-2286.

June 12-14: Center for Professional Development seminar on fiber-optic communications, Arizona State University, Tempe, Ariz. Contact Susan Alexander, (602) 965-1740.

June 12-16: European Fiber-Optic Communications and LAN Exposition, International Congrescentrum RAI, Amsterdam, The Netherlands. Contact (617) 232-3111.

June 15: SCTE Central California Meeting Group technical seminar on microwave vs. hard cabling. Contact Andrew Valles, (209) 453-7791.

Planning ahead

Aug. 27-29: Eastern Show, Atlanta Merchandise Mart, Atlanta.
Sept. 20-22: Great Lakes Expo, Convention Center, Columbus, Ohio.
Oct. 3-5: Atlantic Show, Convention Center, Atlantic City, N.J.
Oct. 17-19: Mid-America Show, Hilton Plaza Inn, Kansas City, Mo.
Dec. 13-15: Western Show, Convention Center, Anaheim, Calif.

June 15-18: Cable-Tec Expo '89, Orange County Convention Center, Orlando, Fla. Contact (215) 363-6888.

June 16: SCTE Heart of America Chapter technical seminar, Holiday Inn Sports Complex, Kansas City, Mo. Contact Wayne Hall, (816) 942-3715.

June 19-21: Magnavox CATV technical seminar, Orlando, Fla. Contact Amy Haube, (800) 448-5171.

June 20: SCTE Hudson Valley Chapter technical seminar on CATV analyzer measurements, Hewlett-Packard, Albany, N.Y. Contact Robert Price, (518) 382-8000.

June 20-21: InfoLAN seminar on broadband local area networks, Hyatt Burlingame Hotel, San Francisco. Contact (800) 526-7469.

June 20-22: C-COR Electronics technical seminar, Pittsburgh. Contact Binky Lush, (814) 238-2461.

June 22: SCTE Florida Chapter's South Florida Group technical seminar, Holiday Inn, Fort Lauderdale, Fla. Contact Denise Turner, (813) 626-7115.

June 22-23: European Satellite Broadcasting Conference, Queen Elizabeth II Centre, London. Contact 01-868-4466.

June 23: SCTE Miss/Lou Chapter technical seminar, Biloxi, Miss. Contact Charles Thibodeaux, (504) 641-9251.

June 26-28: New York State Cable TV Commission technical seminar on upgrades and rebuilds, Roaring Brook Ranch Resort, Lake George, N.Y. Contact (518) 474-1324.

June 26-29: Siecor Corp. technical seminar on fiber-optic installation and splicing for cable TV applications, Hickory, N.C. Contact (704) 327-5539.

June 27: SCTE Satellite Tele-Seminar Program, "Fiber optics: Here and now," 12-1 p.m. ET on Transponder 7 of Satcom F3R. Contact (215) 363-6888.

June 29: SCTE Wheat State Meeting Group technical seminar, Canterbury Inn, Wichita, Kan. Contact Mark Wilson, (316) 262-4270.

July

July 9-13: National Conference of Standards Laboratories workshop and symposium, Sheraton Tech Center, Denver. Contact Ken Armstrong, (303) 440-3339.

July 10-13: Siecor Corp. technical seminar on fiber-optic installation and splicing for LAN, building and campus applications, Hickory, N.C. Contact (704) 327-5539.

July 11: SCTE Central Illinois Chapter technical management seminar, Sheraton Inn, Bloomington, Ill. Contact Tony Lasher, (217) 784-5518.

July 11: SCTE Chattahoochee Chapter technical seminar on basic troubleshooting, Statesboro, Ga. Contact Jack Connolly, (912) 741-5068.

July 11: SCTE Florida Chapter's Central Florida Group technical seminar, Holiday Inn North, Lakeland, Fla. Contact Denise Turner, (813) 626-7115.

July 12: SCTE Florida Chapter's Gulf Coast Group technical seminar. Contact Denise Turner, (813) 626-7115.

July 12: SCTE Upstate New York Meeting Group technical seminar, Buffalo, N.Y. Contact Ed Pickett, (716) 325-1111.

July 12: Exhibition of Fiber Optics and Optoelectronics, Beijing Institute of Posts and Telecommunications, Beijing, China. Contact (617) 232-3111.

July 12-14: North Dakota State Cable Association annual convention, Doublewood Inn, Fargo, N.D. Contact Bill Debacker, (701) 280-0033.

July 13: SCTE Upstate New York Meeting Group technical seminar, Auburn, N.Y. Contact Ed Pickett, (716) 325-1111.

July 13: SCTE Central California Meeting Group technical seminar. Contact Andrew Valles, (209) 453-7791.

July 14: SCTE Mount Rainier Meeting Group technical seminar on data. Contact Sally Kinsman, (206) 867-1433.

July 15: SCTE Cactus Chapter technical seminar. Contact Harold Mackey Jr., (602) 866-0072.

July 18-20: Florida Cable Television Association annual convention, The Registry Resort, Naples, Fla. Contact (904) 681-1990.

July 19: SCTE Razorback Chapter technical seminar, Days Inn, Little Rock, Ark. Contact Jim Dickerson, (501) 777-4684.

July 19: SCTE Dairyland Meeting Group technical seminar on signal security and theft, Royale Hotel, West Bend, Wis. Contact Jeff Spence, (414) 738-3180.

July 19: SCTE Great Plains Meeting Group technical seminar on headend maintenance, satellite technology and off-air signals. Contact Jennifer Hays, (402) 333-6484.

Courtesy Colorado Cable Television Association

"Focusing on the '90s" is the theme of this year's Colorado show.

July 19-21: Colorado Cable Television Association annual convention, Marriott's Mark Resort, Vail, Colo. Contact (303) 863-0084.

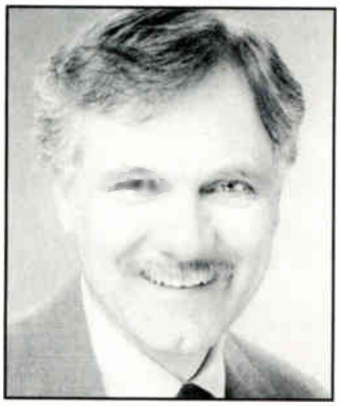
July 20: SCTE Rocky Mountain Chapter's "Cable games" and technical seminar on CLI, Marriott's Mark Resort, Vail, Colo. Contact Rikki Lee, (303) 792-0023.

July 21: SCTE Heart of America Chapter technical seminar, American Cablevision, Kansas City, Mo. Contact Wayne Hall, (816) 942-3715.

July 25: SCTE Satellite Tele-Seminar Program, "High definition television technology (Part I)," 12-1 p.m. ET on Transponder 7 of Satcom F3R. Contact (215) 363-6888.

July 26: SCTE Piedmont Chapter technical seminar. Contact Rick Hollowell, (919) 968-4631.

July 26: SCTE Michiana Meeting Group technical seminar. Contact Dave Miller, (219) 259-8015.



Dawson

Texscan Corp. appointed **William Dawson** as vice president and general manager of **Texscan MSI**. He was most recently vice president of quality for Texscan Corp. Contact: 124 N. Charles Lindbergh Dr., Salt Lake City, Utah 84116, (801) 359-0077.

Midwest CATV named **Rex Porter** vice president for the Western region. He was previously director of CATV sales for Pyramid Industries. Contact: P.O. Box 271, Charleston, W.V. 25321, (304) 343-8874.

Ron Ebert was appointed national service director for General Instrument's **Jerrold Division**. Prior to this, he was national service manager.

Jim Barthold was named public relations manager. Most recently, he was senior creative writer.

Kurtis Whitt was promoted to sales national account manager responsible for Cox Cable. He was previously account manager for Florida, Georgia and South Carolina. Contact: 2200 Byberry Rd., Hatboro, Pa. 19040, (215) 674-4800.

Anixter Bros. appointed **Roland Watkins** senior vice president of engineering and product management. He was most recently vice president of engineering and product management.

Jim Warren was named senior vice president of sales, major markets. Before this, he was vice president of sales and marketing.

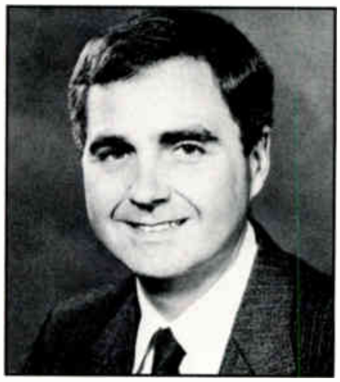
Carl Putnam was appointed Midwest regional vice president. He was previously regional vice president of operations for the West region.

The company promoted **Marlowe Taylor** to Southeast regional vice president. He was formerly vice president of operations for the company's West region. Contact: 4711 Golf Rd., 1 Concourse Plaza, Skokie, Ill. 60076, (312) 677-2600.

Cable Link promoted **Chris Chambers** to CAD product manager. Prior to this he was systems analyst for the company. Contact: 280 Cozzins St., Columbus, Ohio 43215, (614) 221-3131.

Comm/Scope Inc. promoted **Dawn Simpson** to district sales manager for the Midwest including Illinois, Kansas and Missouri. Prior to this she was sales marketing support analyst specializing in international sales.

The company also named **Bill Davis** to the position of district sales manager for the upper Midwest. He was previously owner of William J. Davis Co. Contact: P.O. Box 1729, 1375 Lenoir-Rhyne Blvd., Hickory, N.C. 28602, (704) 324-2200.



Mountain

Wegener Communications promoted **Ned Mountain** to vice president of marketing. Before this, he served as director of marketing.

Elias Livaditis was named vice president of engineering. He was previously manager of telecommunications products. Contact: Technology Park/Johns Creek, 11350 Technology Circle, Duluth, Ga. 30136, (404) 623-0096.

F-fitting interface

(Continued from page 88)

Connector-to-terminal compatibility

The depth of the F-nut varies from 0.187 to 0.300 inch on connectors and up to 0.375 inch on some traps. Although these numbers seem small, they may create a problem for equipment manufacturers who must design F-ports capable of supporting the entire range. Therein lies the problem: Some manufacturers have limited the range that their equipment can accommodate. Consider the following scenario. Some installers like to cut the center conductor flush with the end of the F-nut. In shallow nut configurations this will leave only 0.187 inch of center conductor. This is often too short to mate with many F-port contact fingers. Conversely, another installer may trim the center conductor 1/8 inch beyond the end of the F-nut. On a longer F connector with a 0.300 inch nut depth, this center conductor could extend into the port 0.425 inch, which is well past the foldover point of many of port terminals. This length could cause the center conductor to deflect off the terminal and short itself out. This problem can be solved if all of the connector and equipment manufacturers will agree on standard port dimensions (a process that has begun under the auspices of the Interface Practices Committee of the Society of Cable Television Engineers) and if all of the CATV personnel will follow established cable prep procedures.

Another issue concerns the F-port itself, which may differ considerably in length, shape and material. Some F-81s and taps may have port lengths of only 1/4 inch, while others may have port lengths of 9/16 inch or more. Port shapes also vary; some are accurately machined brass, while others are rolled or crimped die cast zinc. Another area of difference is the distance from the end of the port to the internal center conductor contacts. All of these variances cause problems in attempting to design a single interface that is universally compatible. Standardization also will serve to eliminate many of the problems in this area.

Two other major compatibility problems exist. First, some F-ports are too short to allow the F-nut to seat itself completely. This problem is made worse when the two devices are so close in length as to appear tight initially but fail to provide sufficient torque to prevent the nut from backing off over time, temperature and vibration. The second problem arises from the rolled or crimped end on many F-ports. This end can be damaged by F connectors that have O-rings in the base of the nut. The size of the F-fitting post may be such as to permit its intrusion into the body of the F-port, which may cause irreparable harm and improper contact pressure. This problem is illustrated in Figure 4. Figure 4a pictures the typical crimp-type F-fitting and the machined end of the F-port. Figure 4b shows the front seal-type F-fitting and the crimped or rolled end of a typical F-port. Moderate tightening (25 to 30 inch pounds) of this interface can drive the connector post into the port, causing the "polyset" to interfere with the spring contacts, as shown in Figure 4c. This problem can be corrected by relocating the O-ring to the area illustrated in Figure 4d.

One final note: Some of the newer F-fittings are not compatible with existing security devices. This incompatibility is especially noticeable on short F-ports where such devices may feel secure but can actually be loosened easily. Some connector manufacturers provide special shields and devices that are specifically designed for use with their connectors.

Making a better interface

The information presented in this article was derived from a series of tests performed by four cable operators. The tests may not have been perfect but the effort to understand the F-fitting interface is sincere. We welcome any additional information that would help us in making a better interface and in improving customer service. The SCTE Interface Practices Committee provides a viable forum for manufacturers and users to exchange ideas and information. All interested parties are encouraged to get involved.

Just as with the rest of the CATV plant, the drop system is constantly changing and improving. The technical arm of this industry must ensure that our training and information keep pace with these changes; otherwise we could be building problems into our plants rather than continuing to improve their performance.

COMM
TECHN
Official trade journal

One Piece F-Fit

BELDEN

Foam Dielectric, APA Bonded Foil Tape, PVC "CATVD" Jacket

59 Series

Braid Coverage	Part Number	GILBERT Fitting	GILBERT Crimp	LRC Fitting	LRC Crimp	PPC Fitting	PPC Crimp	PYRAMID Fitting	PYRAMID Crimp
53% Braid	9102 9103 9067	GF-59-AHS-290 or GF-59-AHS-USA	.324 .360	F-59-CH	.324	CFS-59-4H	.324	F-59-ALM	.324
67% Braid	9104 9105	GF-59-AHS-290 or GF-59-AHS-USA	.324 .360	F-59-CH	.324	CFS-59-4H	.324	F-59-ALM	.324
95% Braid	9108 9019	GF-59-AHS-312 or GF-59-AHS-USA	.324 .360	F-59-QS	.324	CFS-59-2H	.324	N/A	
Tri-Shield (53%)	9110 9111	GF-59-AHS-290 or GF-59-AHS-USA	.324 .360	F-59-CH	.324	CFS-59-4H	.324	N/A	
(77%)	9052 9053 9063	GF-59-AHS-290 or GF-59-AHS-USA	.324 .360	F-59-CH	.324	CFS-59-4H	.324	N/A	
(95%)	9054 9055	GF-59-AHS-312 or GF-59-AHS-USA	.324 .360	F-59-QS	.324	CFS-59-2H	.324	N/A	

6 Series

Braid Coverage	Part Number	GILBERT Fitting	GILBERT Crimp	LRC Fitting	LRC Crimp	PPC Fitting	PPC Crimp	PYRAMID Fitting	PYRAMID Crimp
61% Braid	9116 9117 9066	GF-6-AHS-322 or GF-6-AHS-USA	.324 .360	F-56-CH	.324	CFS-56	.324	F-56-ALM	.324
Tri-Shield (61%)	9118 9119 9056 9057	GF-6-AHS-342 or GF-6-AHS-USA	.324 .360	F-56-CH	.324	CFS-56	.324	N/A	
(77%)	9058 9059 9062 9074	GF-6-AHS-342 or GF-6-AHS-USA	.324 .360	F-56-CH	.324	CFS-56	.324	N/A	
(95%)	9060 9061	GF-6-AHS-342 or GF-6-AHS-USA	.324 .360	F-56-CH	.324	CFS-56-3H	.384	N/A	

COMM/SCOPE

Foam Dielectric, APA Bonded Foil Tape, PVC "CATVD" Jacket

59 Series

Braid Coverage	Part Number	GILBERT Fitting	GILBERT Crimp	LRC Fitting	LRC Crimp	PPC Fitting	PPC Crimp	PYRAMID Fitting	PYRAMID Crimp
53% Braid	F5953BV F5953BVM F5953BEF	GF-59-AHS-290 or GF-59-AHS-USA	.324 .360	F-59-CH	.324	CFS-59-4H	.324	F-59-ALM	.324
67% Braid	F5967BV F5967BVM F5967BEF	GF-59-AHS-290 or GF-59-AHS-USA	.324 .360	F-59-CH	.324	CFS-59-4H	.324	F-59-ALM	.324
95% Braid	F5995BV F5995BVM F5995BEF	GF-59-AHS-312 or GF-59-AHS-USA	.324 .360	F-59-HB	.324	CFS-59-2H	.324	N/A	
Tri-Shield (67%)	F59TSV F59TSVM	GF-59-AHS-312 or GF-59-AHS-USA	.324 .360	F-59-HB	.324	CFS-59-4H	.324	N/A	
Quad-Shield	F59SSV F59SSVM F59SSEF	GF-59-AHS-312 or GF-59-AHS-USA	.324 .360	F-59-QS	.324	CFS-59-2H	.324	F-59-ALS	.324

6 Series

Braid Coverage	Part Number	GILBERT Fitting	GILBERT Crimp	LRC Fitting	LRC Crimp	PPC Fitting	PPC Crimp	PYRAMID Fitting	PYRAMID Crimp
60% Braid	F660BV F660BVM F660BEF	GF-6-AHS-322 or GF-6-AHS-USA	.324 .360	F-56-CH	.324	CFS-56	.324	F-56-ALM	.324
90% Braid	F690BV F690BVM F690BEF	GF-6-AHS-342 or GF-6-AHS-USA	.324 .360	F-56-CH	.324	CFS-56-3H	.384	N/A	
Tri-Shield (60%)	F6TSV F6TSVM	GF-6-AHS-322 or GF-6-AHS-USA	.324 .360	F-56-CH	.324	CFS-56	.324	N/A	
Quad-Shield	F6SSV F6SSVM F6SSEF	GF-6-AHS-342 or GF-6-AHS-USA	.324 .360	F-56-QS	.324	CFS-56-2H	.384	F-56-ALS	.324

Compiled by Barry Smith, SCTE Interface Practices Committee

...NG CROSS-REFE...

Environmentally Sealed F-F...

BELDEN

...oam Dielectric, APA Bonded Foil Tape, PVC "CATVD" Jacket

May require special cable prep dimensions.

...es

...art Number	GILBERT Fitting	GILBERT Crimp	LRC* Fitting	PPC Fitting	PPC Crimp	RAYCHEM* Fitting
...102 ...103 ...067	GFWL59-AHS-USA	.360	SNS-59-NS	CFSS-59-4HS	.324	EZF-59
...104 ...105	GFWL59-AHS-USA	.360	SNS-59-NS	CFSS-59-4HS	.324	EZF-59
...108 ...109	GFWL59-AHS-USA	.360	SNS-59-NS	CFSS-59-2HS	.324	EZF-59
...110 ...111	GFWL59-AHS-USA	.360	SNS-59-NS	CFSS-59-4HS	.324	EZF-59
...052 ...053 ...063	GFWL59-AHS-USA	.360	SNS-59-NS	CFSS-59-4HS	.324	EZF-59
...054 ...055	GFWL59-AHS-USA	.360	SNS-59-NS	CFSS-59-2HS	.324	EZF-59

...s

...art Number	GILBERT Fitting	GILBERT Crimp	LRC Fitting	PPC Fitting	PPC Crimp	RAYCHEM Fitting
...116 ...117 ...066	GFWL6-AHS-USA	.360	SNS-6-NS	CFSS-56-5HS	.384	EZF-6
...118 ...119 ...056 ...057	GFWL6-AHS-USA	.360	SNS-6-NS	CFSS-56-5HS	.384	EZF-6
...058 ...059 ...062 ...074	GFWL6-AHS-USA	.360	SNS-6-NS	CFSS-56-5HS	.384	EZF-6
...060 ...061	GFWL6-AHS-USA	.360	SNS-6-NS	CFSS-56-3HS	.384	EZF-6

...manufacturer's prep and/or installation tools.

COMM/SCOPE

...oam Dielectric, APA Bonded Foil Tape, PVC "CATVD" Jacket

May require special cable prep dimensions.

...es

Part Number	GILBERT Fitting	GILBERT Crimp	LRC* Fitting	PPC Fitting	PPC Crimp	RAYCHEM* Fitting
...5953BV F5953BVM ...5953BEF	GFWL59-AHS-USA	.360	SNS-59-NS	CFSS-59-4HS	.324	EZF-59
...5967BV ...5967BVM ...5967BEF	GFWL59-AHS-USA	.360	SNS-59-NS	CFSS-59-4HS	.324	EZF-59
F5995BV F5995BVM F5995BEF	GFWL59-AHS-USA	.360	SNS-59-NS	CFSS-59-2HS	.324	EZF-59
F59TSV ...59TSVM	GFWL59-AHS-USA	.360	SNS-59-NS	CFSS-59-2HS	.324	EZF-59
F59SSV ...59SSVM ...59SSEF	GFWL59-AHS-USA	.360	SNS-59QS-NS	CFSS-59-2HS	.324	EZF-59

...s

Part Number	GILBERT Fitting	GILBERT Crimp	LRC Fitting	PPC Fitting	PPC Crimp	RAYCHEM Fitting
F660BV ...660BVM F660BEF	GFWL6-AHS-USA	.360	SNS-6-NS	CFSS-56-5HS	.384	EZF-6
F690BV F690BVM F690BEF	GFWL6-AHS-USA	.360	SNS-6-NS	CFSS-56-3HS	.384	EZF-6
F6TSV F6TSVM	GFWL6-AHS-USA	.360	SNS-6-NS	CFSS-56-5HS	.384	EZF-6
F6SSV F6SSVM F6SSEF	GFWL6-AHS-USA	.360	SNS-6QS-NS	CFSS-56-3HS	.384	EZF-6

...manufacturer's prep and/or installation tools.

TIM...

Foam Dielectric, APA Bo...

59 Series

Braid Coverage	Part Number	GILBERT Fitting
53% Braid	2345 2347 2374	GFWL59-AHS-US...
67% Braid	2183 2185 2186	GFWL59-AHS-US...
95% Braid	2545 2547 2574	GFWL59-AHS-US...
Tri- (53%) Shield	2602 2603 2604	GFWL59-AHS-US...
(80%)	2607 2608 2609	GFWL59-AHS-US...
Quad-Shield	2245 2247 2274	GFWL59-AHS-US...

6 Series

Braid Coverage	Part Number	GILBERT Fitting
60% Braid	2360 2364 2386	GFWL6-AHS-US...
90% Braid	2560 2564 2586	GFWL6-AHS-US...
Tri- (60%) Shield	2622 2623 2624	GFWL6-AHS-US...
(80%)	2627 2628 2629	GFWL6-AHS-US...
Quad-Shield	2260 2264 2286	GFWL6-AHS-US...

* Requires manufacturer's prep ar...

Foam Dielectric, APA B...

59 Series

Braid Coverage	Part Number	GILBER... Fitting
53% Braid	5901 5902 5903	GFWL59-AHS-U...
67% Braid	5910 5911 5912	GFWL59-AHS-U...
95% Braid	5960 5961 5962	GFWL59-AHS-U...
Quad-Shield	5950 5951 5952	GFWL59-AHS-U...

6 Series

Braid Coverage	Part Number	GILBER... Fitting
60% Braid	6000 6001 6002	GFWL6-AHS-US...
90% Braid	6060 6061 6062	GFWL6-AHS-US...
Quad-Shield	6050 6051 6052	GFWL6-AHS-US...

* Requires manufacturer's prep ar...

Pull-out Wall Chart

COMMUNICATIONS TECHNOLOGY'S

F-FITTING CROSS-REFERENCE CHART

NOTICE OF DISCLAIMER

The following manufacturers and the SCTE Interface Practices Committee make no representation or warranty, expressed or implied, with respect to the sufficiency, accuracy or utility of any information or opinion contained herein. The SCTE Interface Practices Committee expressly advises that any use of or reliance on said information or opinion is at the risk of the user. The manufacturers and the SCTE Interface Practices Committee shall not be liable for any damage or injury incurred by any person arising out of the sufficiency, accuracy or utility of any information or opinion therein. Transcription, duplication, reproduction or disclosure of this information without the inclusion of this notice is unauthorized.

While the connectors listed are the manufacturer's recommendations based on various parameters such as pull strength, aesthetics, ease of assembly, cable trim specifications, etc., *it is not a negative recommendation if manufacturers and connectors are not included.* This tabulation is a starting point for the proper selection of a cable and connector combination.

When publishing data of this nature, problems of a remarkably short useful life occur almost immediately. Therefore, the SCTE Interface Practices Committee recommends contacting the appropriate manufacturer for the most current information available. Another way to determine an acceptable connector and cable combination is to send samples of the cable along with requirements to your connector supplier.

While every effort has been made to ensure the accuracy of this cross-reference chart, the fittings indicated apply specifically to the typical PVC jacketed service entrance cables of the National Electrical Code (NEC) Classification "CATVD." For drop cables classified "CATVX" and CATV," please contact the manufacturers or your sales representative for proper fitting compatibility.

BELDEN ELECTRONIC WIRE AND CABLE	(800) 235-3362
BEN HUGHES/CABLE PREP	(203) 526-4337
CABLEMATIC/RIPLEY CO. INC.	(203) 653-2200
COMM/SCOPE INC.	(800) 982-1708
GILBERT ENGINEERING	(800) 528-0199
LRC ELECTRONICS INC.	(800) 332-8428
PRODUCTION PRODUCTS CO.	(800) 468-2288
PYRAMID INDUSTRIES INC.	(800) 528-4529
RAYCHEM	(415) 361-2288
SARGENT/ROSTRA TOOL CO.	(203) 488-8665
TIMES FIBER COMMUNICATIONS INC.	(800) 832-2288
TRILOGY COMMUNICATIONS INC.	(800) 874-5649

UNICATIONS
OLOGY'S **F-FITT**

he Society of Cable Television Engineers

ng & Crimp

TIMES FIBER

Foam Dielectric, APA Bonded Foil Tape, PVC "CATVD" Jacket

Series

age	Part Number	GILBERT Fitting	Crimp	LRC Fitting	Crimp	PPC Fitting	Crimp	PYRAMID Fitting	Crimp
	2345 2347 2374	GF-59-AHS-290 or GF-59-AHS-USA	.324 .360	F-59-CH	.324	CFS-59-4H	.324	F-59-ALM	.324
	2183 2185 2186	GF-59-AHS-290 or GF-59-AHS-USA	.324 .360	F-59-CH	.324	CFS-59-4H	.324	F-59-ALM	.324
	2545 2547 2574	GF-59-AHS-312 or GF-59-AHS-USA	.324 .360	F-59-HB	.324	CFS-59-2H	.324	N/A	
53%)	2602 2603 2604	GF-59-AHS-290 or GF-59-AHS-USA	.324 .360	F-59-CH	.324	CFS-59-4H	.324	N/A	
30%)	2607 2608 2609	GF-59-AHS-312 or GF-59-AHS-USA	.324 .360	F-59-HB	.324	CFS-59-2H	.324	N/A	
	2245 2247 2274	GF-59-AHS-312 or GF-59-AHS-USA	.324 .360	F-59-QS	.324	CFS-59-2H	.324	F-59-ALS	.324

eries

age	Part Number	GILBERT Fitting	Crimp	LRC Fitting	Crimp	PPC Fitting	Crimp	PYRAMID Fitting	Crimp
	2360 2364 2386	GF-6-AHS-322 or GF-6-AHS-USA	.324 .360	F-56-CH	.324	CFS-56	.324	F-56-ALM	.324
	2560 2564 2586	GF-6-AHS-342 or GF-6-AHS-USA	.324 .360	F-56-CH	.324	CFS-56-3H	.384	N/A	
0%)	2622 2623 2624	GF-6-AHS-322 or GF-6-AHS-USA	.324 .360	F-56-CH	.324	CFS-56-1H	.324	N/A	
0%)	2627 2628 2629	GF-6-AHS-342 or GF-6-AHS-USA	.324 .360	F-56-CH	.324	CFS-56	.324	N/A	
	2260 2264 2286	GF-6-AHS-342 or GF-6-AHS-USA	.324 .360	F-56-QS	.360	CFS-56-2H	.384	F-56-ALS	.324

TRILOGY

Foam Dielectric, APA Bonded Foil Tape, PVC "CATVD" Jacket

Series

age	Part Number	GILBERT Fitting	Crimp	LRC Fitting	Crimp	PPC Fitting	Crimp	PYRAMID Fitting	Crimp
	5901 5902 5903	GF-59-AHS-290 or GF-59-AHS-USA	.324 .360	F-59-CH	.324	CFS-59-4H	.324	F-59-ALM	.324
	5910 5911 5912	GF-59-AHS-290 or GF-59-AHS-USA	.324 .360	F-59-CH	.324	CFS-59-4H	.324	F-59-ALM	.324
	5960 5961 5962	GF-59-AHS-312 or GF-59-AHS-USA	.324 .360	F-59-HB	.324	CFS-59-2H	.324	N/A	
	5950 5951 5952	GF-59-AHS-312 or GF-59-AHS-USA	.324 .360	F-59-QS	.324	CFS-59-2H	.324	F-59-ALS	.324

eries

age	Part Number	GILBERT Fitting	Crimp	LRC Fitting	Crimp	PPC Fitting	Crimp	PYRAMID Fitting	Crimp
	6000 6001 6002	GF-6-AHS-322 or GF-6-AHS-USA	.324 .360	F-56-CH	.324	CFS-56	.324	F-56-ALM	.324
	6060 6061 6062	GF-6-AHS-342 or GF-6-AHS-USA	.324 .360	F-56-CH	.324	CFS-56-3H	.384	N/A	
	6050 6051 6052	GF-6-AHS-342 or GF-6-AHS-USA	.324 .360	F-56-QS	.360	CFS-56-2H	.384	F-56-ALS	.324

59 Seri

Braid Coverage
53% Braid
67% Braid
95% Braid
Tri- (53%) Shield
(77%)
(95%)

6 Serie

Braid Coverage
61% Braid
Tri- (61%) Shield
(77%)
(95%)

* Requires

59 Ser'

Braid Coverage
53% Braid
67% Braid
95% Braid
Tri- (67%) Shield
Quad-Shield

6 Serie

Braid Coverage
60% Braid
90% Braid
Tri- (60%) Shield
Quad-Shield

* Requires

RENCE

ting

Hex Crimp Tools

ES FIBER

ed Foil Tape, PVC "CATVD" Jacket

May require special cable prep dimensions.

	LRC*	PPC		RAYCHEM*
imp	Fitting	Fitting	Crimp	Fitting
.360	SNS-59-NS	CFSS-59-4HS	.324	EZF-59
.360	SNS-59-NS	CFSS-59-4HS	.324	EZF-59
.360	SNS-59-NS	CFSS-59-2HS	.324	EZF-59
360	SNS-59-NS	CFSS-59-4HS	.324	EZF-59
360	SNS-59-NS	CFSS-59-4HS	.324	EZF-59
360	SNS-59QS-NS	CFSS-59-2HS	.324	EZF-59

	LRC	PPC		RAYCHEM
mp	Fitting	Fitting	Crimp	Fitting
360	SNS-6-NS	CFSS-56-5HS	.384	EZF-6
360	SNS-6-NS	CFSS-56-3HS	.384	EZF-6
360	SNS-6-NS	CFSS-56-5HS	.384	EZF-6
360	SNS-6-NS	CFSS-56-5HS	.384	EZF-6
360	SNS-6QS-NS	CFSS-56-3HS	.384	EZF-6

r installation tools.

LOGY

d Foil Tape, PVC "CATVD" Jacket

May require special cable prep dimensions.

	LRC*	PPC		RAYCHEM*
p	Fitting	Fitting	Crimp	Fitting
50	SNS-59-NS	CFSS-59-4HS	.324	EZF-59
360	SNS-59-NS	CFSS-59-4HS	.324	EZF-59
360	SNS-59-NS	CFSS-59-2HS	.324	EZF-59
360	SNS-59QS-NS	CFSS-59-2HS	.324	EZF-59

	LRC	PPC		RAYCHEM
mp	Fitting	Fitting	Crimp	Fitting
360	SNS-6-NS	CFSS-56-5HS	.384	EZF-6
360	SNS-6-NS	CFSS-56-3HS	.384	EZF-6
360	SNS-6QS-NS	CFSS-56-3HS	.384	EZF-6

r installation tools.

Ben Hughes/Cable Prep

Part Number	Minor Hex	Hex	Major Hex
HCT-659	.262		.324
HCT-USA			.360
HCT-611	.324		.410
HCT-6QS	.324		.360
HCT-660	.324		.384
HCT-986	.324		.360

Gilbert

Part Number	Minor Hex	Hex	Major Hex
G-CRT-659	.262		.324
G-CRT-660	.324		.384
G-CRT-804	.262	.324	.384
G-CRT-986	.324		.360
G-CRT-USA			.360

LRC

Part Number	Minor Hex	Hex	Major Hex
CT-601	.260		.324
CT-596	.262		.324
HCT-6QS	.324		.360
CT-611-QS	.360		.470

PPC

Part Number	Minor Hex	Hex	Major Hex
HCT-659	.262		.324
HCT-911	.262		.410
HCT-660	.324		.384
HCT-611	.324		.410

Ripley/Cablematic

Part Number	Minor Hex	Hex	Major Hex
CR-596-B	.262		.324
CR-596-Q	.324		.384
CR-596-11	.324		.410
CR-596-QL2	.068	.324	.360
CR-324	.068		.324
CR-360			.360
CR-596-QL	.324		.359

Sargent/Rostra

Part Number	Minor Hex	Hex	Major Hex
3150-CCT	.262	.324	.384
3152-CCT	.068	.178	.324
3154-CCT	.324		.360
3350-CCT	.262	.324	.384
3354-CCT	.324		.360
4158-CCT	.068/.100	.324	.360

Identify the fittings and hex crimp sizes you need, then find the appropriate tool from the above list.

SCTE

Interface Practices Committee

208, Englewood, Colo. 80155, (303) 792-0023.


CATV
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EIA RS-250B video performance standards

By Ron Hranac
Jones Intercable Inc.

EIA RS-250B television transmission standards are based on performance objectives agreed to by AT&T and the TV networks for guaranteed specifications for coast to coast video networks. These standards are in effect "broadcast quality" and define performance objectives for short-haul, medium-haul, satellite, long-haul and end-to-end video systems.

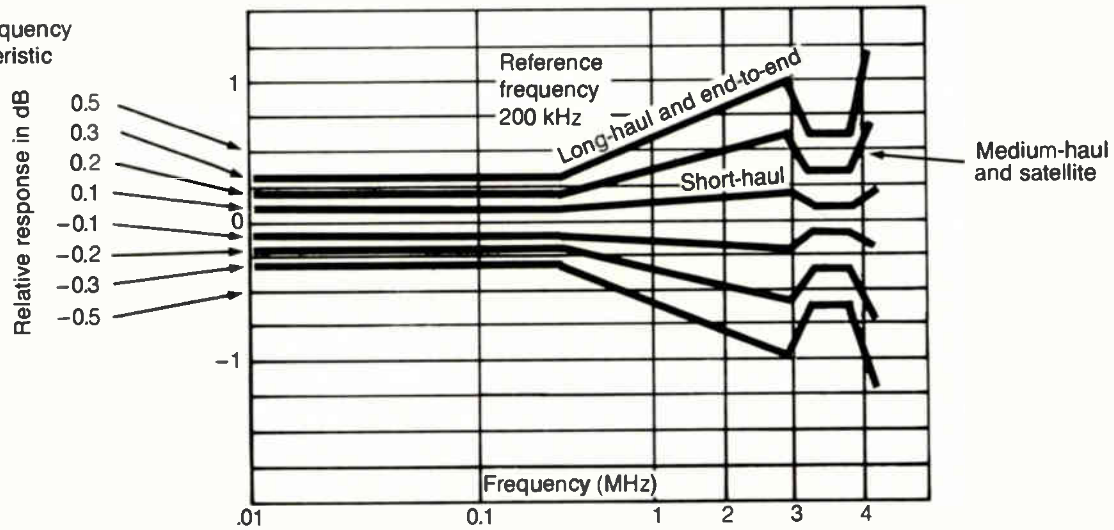
Although other standards also are available, many manufacturers of communications equipment still refer to "RS-250B performance" in their specifications.

Video performance parameter	RS-250B performance standard				
	Short haul	**Medium haul**	**Satellite**	**Long haul**	**End-to-end**
Chrominance-to-luminance gain inequality	±1 IRE unit	±4 IRE units	±4 IRE units	±7 IRE units	±7 IRE units
Chrominance-to-luminance delay inequality	±20 nanoseconds	±33 nanoseconds	±26 nanoseconds	±54 nanoseconds	±60 nanoseconds
Field time distortion	3 IRE units peak-to-peak	3 IRE units peak-to-peak	3 IRE units peak-to-peak	3 IRE units peak-to-peak	3 IRE units peak-to-peak
Line time distortion	0.5 IRE unit peak-to-peak	1 IRE unit peak-to-peak	1 IRE unit peak-to-peak	1.5 IRE units peak-to-peak	2 IRE units peak-to-peak
Short time distortion	4 IRE units peak-to-peak	4 IRE units peak-to-peak	4 IRE units peak-to-peak	6.5 IRE units peak-to-peak	7 IRE units peak-to-peak
Long time distortion (bounce)	8 IRE units peak, three second settling time	8 IRE units peak, three second settling time	8 IRE units peak, three second settling time	8 IRE units peak, three second setting time	8 IRE units peak, three second settling time
Insertion gain variation (hourly)	±0.15 dB	±0.3 dB	±0.2 dB	±0.45 dB	±0.5 dB
Insertion gain variation (over 1 second)	±0.1 dB	±0.15 dB	±0.15 dB	±0.25 dB	±0.3 dB
Luminance non-linearity	2 percent	4 percent	6 percent	8 percent	10 percent
Differential gain	2 percent	5 pecent	4 percent	8 percent	10 percent
Differential phase	0.5 degree	1.3 degrees	1.5 degrees	2.5 degrees	3 degrees

61

Video performance parameter	RS-250B performance standard Short haul	Medium haul	Satellite	Long haul	End-to-end
Chrominance-to-luminance intermodulation	1 percent	2 percent	2 percent	4 percent	4 percent
Chrominance non-linear gain	1 percent	2 percent	2 percent	4 percent	5 percent
Chrominance non-linear phase	1 degree	2 degrees	2 degrees	4 degrees	5 degrees
Dynamic gain of the picture signal	2 percent	3 percent	4 percent	5 percent	6 percent
Dynamic gain of the sync signal	3 percent	4 percent	5 percent	6 percent	7 percent
Transient sync signal non-linearity	1 percent	2 percent	3 percent	4 percent	5 percent
Signal-to-noise ratio (10 kHz to 5 MHz)	67 dB	60 dB	56 dB	54 dB	54 dB
Signal-to-low frequency noise ratio (0 to 10 kHz)	53 dB	48 dB	50 dB	44 dB	43 dB
Signal-to-periodic noise ratio (300 Hz to 4.2 MHz)	67 dB	62 dB	64 dB	58 dB	57 dB
Signal-to-impulse noise ratio	not set	not set	not set	not set	not set
Continuity of video service	99.99 percent objective	99.99 percent objective	99.99 percent objective	99.99 percent objective	99.99 percent objective
Color burst amplitude (Based on gain/frequency specification)	40 IRE units ±0.5 IRE unit	40 IRE units ±2.0 IRE units	40 IRE units ±2.0 IRE units	40 IRE units ±3.0 IRE units	40 IRE units ±3.0 IRE units

Gain/frequency characteristic



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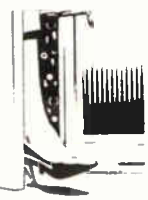

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9/10 point Helvetica medium body copy

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Publisher's Policy

1. Advertisements costing less than $200 must be paid in advance.
2. Deadline will be 1st of each month prior to publication date.
3. Ad copy must be submitted in typed format.
4. Cancellation date will be the 1st of each month prior to publication date. No cancellations accepted after this date. Cancellations must be received in writing.
5. The contents of advertisements are subject to publisher's approval.

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CT 6/89

Workstations, semiconductors and ATV

By Walter S. Ciciora, Ph.D.
Vice President of Technology
American Television and Communications Corp.

Advanced television (ATV) and high definition television (HDTV) are consumer electronics systems to be used primarily for entertainment video delivered by cable, broadcast, prerecorded media such as tapes and disks, and perhaps by direct broadcast satellite (DBS).

Some low definition thinking has been applied to high definition TV and the results could be disastrous. In devoting time, energy and other resources to the wrong questions, we could ignore relevant issues.

Workstations

Workstations are high-end personal computers intended as productivity-improving devices for professional "knowledge workers." They include high resolution color displays, fast processors, massive memory and special applications programs. As just one example, complex multilayer printed circuit boards are now laid out on these workstations. The resulting design is transmitted by modem to firms that specialize in rapid creation of the printed circuit board's "art work" and the actual boards themselves. A dozen boards are express-mailed back in a matter of days.

The market share leaders for this equipment include Sun, Apollo and Hewlett-Packard. Apollo, the first major producer, has fallen on hard times and was recently purchased by Hewlett-Packard. Low-end workstations are priced in the tens of thousands of dollars while the more common versions reach hundreds of thousands of dollars. Their productivity-improving potential has made them indispensable. Essentially no engineering group engaged in product design can be competitive without them. The alternative is to employ many more engineers and take much longer to complete projects.

The fundamental nature of these machines is that they include high resolution displays of modest size, tremendous quantities of memory, fast processors and ergonomic factors meant to minimize fatigue over long hours of work. In at least one sense, they are inadequate for ATV. In several ways they are gross overkill.

The displays for workstations are way too small for ATV or HDTV. The work done by HBO and Massachusetts Institute of Technology clearly indicates that consumers cannot tell the difference between good old NTSC and HDTV when viewed from a distance of more than five picture heights. Since home viewing distance is determined by viewing room size and furniture placement, this translates into the need for a large screen: 60, 70, perhaps 80 inches of diagonal measure. Workstations are viewed from a distance of a foot or so; 19- or 25-inch diagonal measure is more than adequate.

Brightness of consumer displays must be much higher than is required of workstations. Consumers are less willing to control the ambient light environment to suit the TV set. Workstation environments are designed to suit the workstation. The nature of the displays used in workstations and in consumer ATV will always be very different.

Workstation processing is very generalized and extensive. While ATV will require substantial signal processing, it will be very specialized and very different from that employed in workstations. The primary emphasis of ATV signal processing is bandwidth reduction and motion artifact minimization. A 30 MHz studio signal needs to be squeezed into a 6 MHz channel. Technical tradeoffs must be made so that the resulting motion artifacts will be acceptable. For terrestrial broadcast, this must be accomplished with a minimum of interference to and from existing TV services. There is little in common between the demands of ATV and workstation signal processing.

Semiconductors

The semiconductor business is critical to national defense. Much has been made of the impact on this business if the United States is not a major producer of ATV products. Perhaps this impact has been exaggerated.

While ATV signal processing will be semiconductor intensive, the receiver production expenses are likely to be dominated by the display costs over the entire life cycle of the product. The semiconductor costs are more amenable to "learning curve" price reductions than are the display costs. Semiconductor costs will become a smaller and smaller fraction of the total cost as the product matures.

"Some low definition thinking has been applied to high definition TV and the results could be disastrous."

One of the major differences between the ATV proponents is the quantity of semiconductor signal processing required by their approaches. The more clever approaches require only a fraction of the semiconductors needed by the more brute force proposals.

Business imperatives

The consumer electronics business always has been and likely always will remain a mass marketing business that is very competitive, highly price sensitive and whose customers are very unsophisticated from a technical perspective. The workstation and PC business is directly opposite in nearly every one of these attributes. While the two businesses will move closer together, they likely will always have a large gulf between them. Certainly, that gap will not close in our lifetimes.

One thing is certain: Workstation and PC manufacturers will not find the margins in the consumer electronics business attractive. While the production volumes are huge, the capital investments in tooling and inventory are massive. Development, sales training, promotion and marketing costs are large. But profits are slim and erratic.

RCA was attracted to the computer business by its large margins and potential size. It learned through bitter experience that this business was fundamentally different from its areas of expertise. Workstation and computer manufacturers would learn the same lesson trying to go the other direction. But they will not find high margins to motivate them to try the experiment.

Workstations are attractive to the political forces at work in ATV and HDTV because the United States is a world leader in this technology. The United States lost its leadership in consumer electronics long ago. If ATV and HDTV could be made into workstation issues rather than consumer electronics issues, maybe the United States has a chance to dominate this exciting new market. Unfortunately this is fuzzy thinking that will more likely result in wasted time, energy and other resources.

options, configurations and affixment types.

Included in the catalog are indexes of printed circuit board and hermetic coax connectors, as well as a guide to 210 between-series adapters and over 500 connectors qualified to MIL-C-39012 and MIL-A-55339. Also provided is a 27-page guide to coax and twinax interconnection products for local area networks including balun transformers and automatic coax terminators.

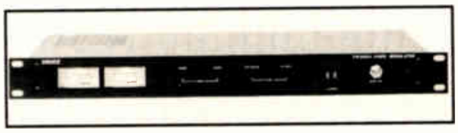
For more details, contact Amphenol Corp., RF/Microwave Operations, 1 Kennedy Ave., Danbury, Conn. 06810, (203) 743-9272; or circle #113 on the reader service card.

Test receiver

Avcom's Model PTR-25 is a portable battery-operated satellite test receiver, with its receiving circuitry derived from the company's COM-2 and COM-3 satellite receivers. The built-in 4.5-inch black and white TV is said to offer reduced power consumption and longer battery life than comparable color units. A range of outputs is available from the PTR-25 to provide signals for large TV monitors, video recorders and audio amplifiers.

A signal strength meter is located on the front panel and an audible signal strength function is provided for dish peaking without any need to monitor the meter or display. As the signal approaches maximum strength the pitch of the audible tone rises and allows the dish to be peaked to a fraction of a dB.

For additional details, contact Avcom, 500 Southlake Blvd., Richmond, Va. 23236, (804) 794-2500; or circle #122 on the reader service card.



Modulator

A new audio/video modulator from R.L. Drake, the Model VM2410A, is said to have a lower noise floor that allows it to be used by commercial operators with larger, multiple modulator installations. The product uses IF loop-throughs, permitting operation with various types of scrambling decoders and IF stereo processors.

The modulator is a vestigial sideband unit with access to 60 channels, including all standard and cable channels up to 400 MHz. While providing access to multiple channels, the VM2410A eliminates adjacent channel interference with its video low-pass filter and IF SAW filter.

For further details, contact R.L. Drake Co., P.O. Box 112, Miamisburg, Ohio 45342, (513) 866-2421; or circle #126 on the reader service card.

Sync repeater

Falcone International is offering its new quad sync repeater, designed to eliminate problems encountered in synchronizing videotape sources to network. According to the company, the unit retains quality of incoming video signals while boosting power in order to drive two 75 ohm loads. One source connects directly to the insertion equipment, the other to the sync input of the videotape player.

For more details, contact Falcone International, P.O. Box 3067, Marietta, Ga. 30060, (404) 427-9496; or circle #111 on the reader service card.

Fiber-optic links

Ortel Corp. introduced two fiber-optic links, Model 5515A (10 GHz) and Model 5515B (12 GHz). These links will transmit microwave signals with any type of modulation over single-mode fiber for distances of 20 km and beyond. The link consists of a Model 3515A/B laser transmitter and a 4515A/B photodiode receiver. The heart of the transmitter is the Model 1515A/B laser module; the receiver is built around the Model 2515A/B photodiode.

Designed for analog signal transmission, the system is usable beyond X-band. Specifications include flat response, wide dynamic range, −40 to +70°C operation and 50 ohm coaxial SMA input/output. Typical applications include antenna remoting, microwave delay lines, high speed data buses and wideband analog data links.

For further information, contact Ortel Corp., 2015 W. Chestnut St., Alhambra, Calif. 91803, (818) 281-3636; or circle #137 on the reader service card.

In the summertime

(Continued from page 80)

together. That type of thinking was great, but it did not protect us. We were still getting some damage here. This tower out here is a conduit for lightning. Our strike wiped out our UPS and antenna controllers."

Barr started thinking, "Let's go one step further. Let's look into what can be done to eliminate the lightning actually hitting the place." This lightning season the teleport will have a new lightning dissipation array. He said, "We don't want to be hit again."

Getting through the summer

Here's what we can do to get through the "good ol' summertime" unscathed.

1) Protect the outside plant from the direct and secondary effects of lightning, spikes and "dirty power" with the AmpClamp technology.
2) Protect towers by implementing the most appropriate of the previously described grounding techniques that may be lacking.
3) If that isn't enough consider a dissipation array.
4) Protect large buildings with a Faraday cage to NFPA 78 or the Prevectron ionization system (installed by qualified people) and get a UL inspection certificate.
5) Protect headends by one or more of these methods.

References

1) *Mobile Radio Technology*, April 1988.
2) *Electronic Media*, April 10, 1989.

Resources

National Fire Protection Association, Batterymarch Park, Quincy, Mass. 02269-9990, (800) 344-3555.

Consultations, ground planes, Prevectron ionization system, installations to NFPA 78, clamps, etc.
Lightning and Grounding Systems, 11098 Jasper Rd., Lafayette, Colo. 80026, (303) 665-5259.

Dissipation arrays, consultations, Chem-Rods.
Lightning Eliminators & Consultants Inc., 6687-T Arapahoe Rd., Boulder, Colo. 80301, (303) 447-2828.

Cadwelding and Cadweld molds
Erico Products Inc., 34600 Solon Rd., Cleveland, Ohio 44139, (216) 248-0100.

Sectional rods
Blackburn, 1525 Woodson Rd., St. Louis, Mo.
Galvan, P.O. Box 369, Harrisburg, N.C., 28075

FO cable locator

Metrotech Corp. introduced an updated version of its system for locating underground fiber-optic cable. The Focal II fiber-optic locating system features a permanent 50 watt transmitter that generates two customer-selected frequencies within the 150 Hz to 9.999 kHz range. Frequency setting can be made at the factory or in the field.

The Focal II transmitter microprocessor automatically monitors and controls the output, impedance and current, tripping an alarm system when necessary. The LCD alternately displays the line voltage, current, frequency, impedance, time of day and time remaining until automatic shutoff.

Two receivers are available. The Model 650F passive/active receiver can receive two active frequencies—9.82 kHz and 153 Hz are standard (optional adjustment to two frequencies between 150 Hz and 9.999 kHz is available) and two passive frequencies—50/60 Hz and 14-22 kHz. The Model 850 receiver, which receives 9.82 kHz, features a patented visual and audible left/right guidance system that directs the user toward the cable, automatic gain control and LCD display of field strength and pushbutton cable depth measurement.

For further information, contact Metrotech Corp., 670 National Ave., Mountain View, Calif. 94043, (415) 940-4900; or circle #118 on the reader service card.

AD INDEX

F-Connector Chart

Exponentialism

By Archer S. Taylor

Senior Vice President of Engineering, Malarkey-Taylor Associates

> *"No one in their right mind...would intentionally call for help from the notorious Four Horsemen of the Apocalypse."*

Suppose you put $1 into a savings fund that pays interest compounded daily at the rate of 1 percent per day. In *n* days this dollar would grow exponentially according to the algorithm $(1.01)^n$. By the end of the first year you would have nearly $38, growing at the rate of $9.28 a month. That's not bad, but after two years, you would have over $1,400, growing at $370 a month. Where the mind starts to boggle, though, is that after five years, you would have $77 million, growing at $20 million a month! Let's not talk about 10 years; that is even wilder than the national debt.

This exercise is intended simply to dramatize the meaning of exponential growth, known as "compounding" in the financial world. Wouldn't it be great to find an investment that would grow at the rate of 1 percent a day? Keep hope alive!

But let's change the terms a bit. Instead of dollars, let's talk about people. Let's say that every year a baby is born to someone of every 50 male/female pairs. That would mean average annual population growth at a modest 1 percent, ignoring deaths for the sake of the argument. Back in the days before either the wheel or television had been invented, population growth provided more hands to forage for food and fight off predators and other enemies. But when the total population reaches a billion souls, as in China today, 1 percent annual growth amounts to over 10 million more people every year. This is almost like adding a New York City every year. At China's present annual growth rate of 1.3 percent, down from 1.8 percent in the 1970s, China's population would double (to 2 billion) in only 54 years.

The population of the world is now over 5 billion, growing at 2 percent annually. At this rate, it will be over 10 billion in just 35 years; 20 billion in threescore and 10 years!

This is exponential growth. It is serious and dangerous. How can we feed another 5 billion people when we can't even feed the present 5 billion? Where will we put them? After all, the surface of the planet is finite and most of it is uninhabitable oceans, deserts, barren rock or ice. Is there enough fresh, clean water to go around? How about the oxygen supply after we cut down the oxygen-generating forests to make room for food culture?

Zero growth

There is a simple solution. Just change the annual rate of growth to zero: Zero Growth. That will do it, as can clearly be seen from the exponential algorithm. Like other simple solutions to complex problems of human ecology, however, Zero Growth is easier said than accomplished.

Even if it were possible, the impact of Zero Growth on family life, demographics, world and national economies and social and political structures is almost unfathomable. Several years ago, China ordained that no couple may give birth to more than one child. Thus far, they have been mostly unable to enforce it in the face of eons of social and religious practices and belief. And the problems of "the only child" will ripple around through many generations of Chinese people.

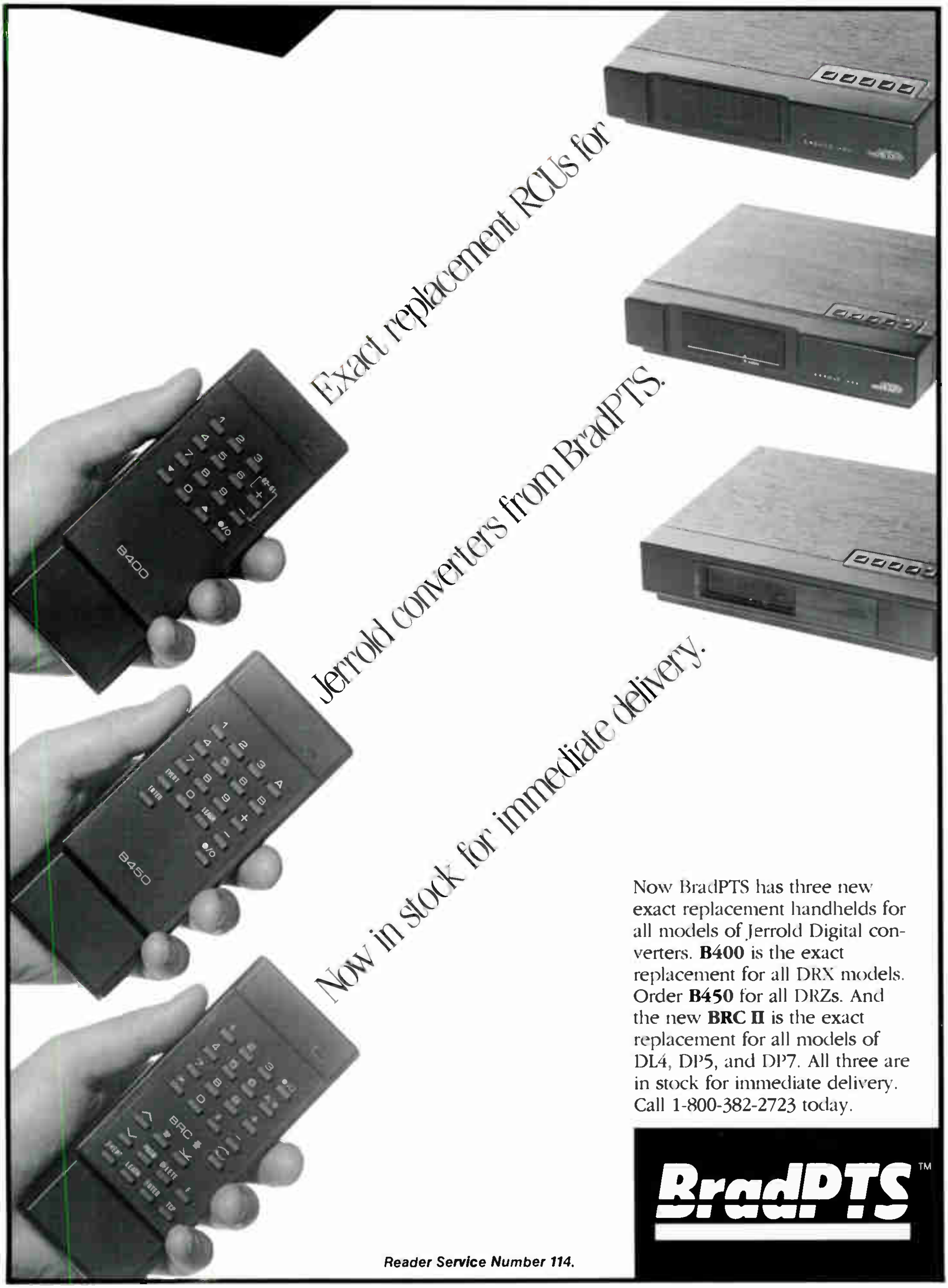
There are some natural growth inhibitors that might slow down this frightening exponential growth. No one in their right mind, however, would intentionally call for help from the notorious Four Horsemen of the Apocalypse: Famine, Pestilence, Disease, War. To the contrary, an enormous part of worldwide human endeavor and product is dedicated to finding the means to arrest the depredations wrought by the Four Horsemen.

Two other, far less venal, forces appear (statistically at least) to be associated with lower growth rates. Unfortunately, statistics is no more than a way to organize our ignorance in the matter. So, we can only speculate on why it is that the wealthier and better educated sectors of the population tend to have lower birth rates. Perhaps they are too busy learning and accumulating money to waste time procreating. Or maybe it is what they eat or don't eat.

Would it not be prudent, notwithstanding our lack of understanding, to suggest education and improved economic health as potential tools that might be capable of heading off the seemingly inevitable exponential catastrophe? Or at least helping to do so?

Do we have the collective will and good judgment, in our own self-defense, to devise the means and provide the funds to enhance the worldwide level of education and economic health before it is too late? Will we ever recognize the voracious exponential monster as the true enemy?

Or do we wait for the Four Horsemen to do their thing?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