December 1989

Training and new technologies

IT INSTALLER TECHNICIAN

The training and educational magazine for cable television technical personnel.

IT INSTALLER TECHNICIAN

A Transmedia Publication

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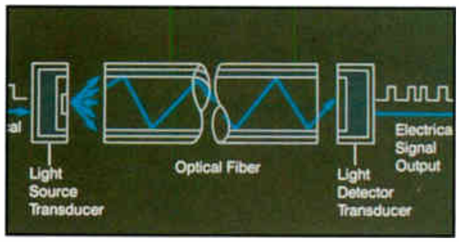
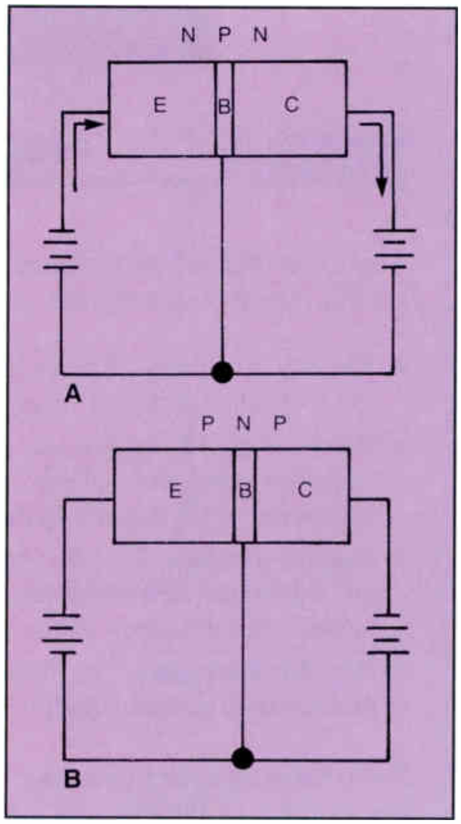
Contents

Departments



Optical fiber 15



Basic electronics 26

Out of Focus 39

Features

Cover

Learning about new technologies can take your career to the outer limits. Art by Geri Saye.

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Launching a new decade

A new decade waits outside the door; opportunities for growth and change accompany it. During the '80s, CATV technology made one or two minor quantum leaps, such as:

- Fiber optics lighting the way to future improvements in picture quality, channel upgrading and digital delivery.
- Innovative approaches—MultiPort and on- and off-premises devices—addressing the issue of consumer friendliness.
- Formats being developed that ensure cable's ongoing participation in delivering advanced TV signals.
- Plus technology providing the means to eliminate signal leakage, to keep our systems properly maintained and to serve our subscribers better.

In order for our industry to stay competitive, everyone must join together in a commitment of progress and never-ending improvement. At Transmedia, we feel the same way. And so, starting next month, we will merge *Installer/Technician* into the pages of *Communications Technology*. More than ever, there is a need to address the entire technical community within the pages of one journal.

Now, in one publication, we will reach *all* technical levels, from the installer to the chief tech to the vice president of engineering. By combining engineering articles with more basic instruction, we will create lines of communication among all technical personnel, opening the lines for better service to cable's customers.

But the good news doesn't stop there. I'm also very excited to announce that with the combination of these two magazines, *CT*'s circulation will jump from 15,000 to 25,000. What a thrill it is to be able to reach—and better serve—an even greater number of readers!

The 1990s and beyond

Once again, Anaheim, Calif., will come alive with the annual Western Show Dec. 13-15 at the convention center. This year's theme is (appropriately enough) "Creating a new decade of television."

Technical sessions will take a look at the challenges the cable industry faces in the coming decade.

I'm sure you'll also find time to examine all the great new products on display on the show floor. And, of course, the *CT Daily* will be there to keep you abreast on what's happening. If you have a show-related announcement or product, just give the written information to one of our staff (there will be 13 of us there, so it shouldn't be too hard to find one) or just leave it in the press room by 2:30 p.m. on Wednesday and Thursday.

Fond farewells

At this time I'd like to say goodbye to two familiar names who have been part of *CT* for several years. Walt Ciciora began his "Ciciora's Forum" column in April 1987; each month, without fail, he has informed, entertained and even scared us with emerging technology issues such as HDTV, telcos, digital downloading and consumer friendliness. This month he closes his series by summarizing the main points of the past three years of columns. We'll miss him.

We'll also miss Rikki Lee, who has stepped down as editor of *CT*; this is her last issue. Rikki is gearing up for some exciting things of her own: On Jan. 2, she launches Rikki T. Lee Written Communications Services, a consulting firm that will offer editing, writing, proofreading, promoting, training and other services to the CATV technical community. Call Rikki at (303) 321-7551. And she'll continue to write "Specs" for our sister publication *MSO*. Good luck, Rikki, and thanks for the memories.

And to all, a Merry Christmas and Happy Hanukkah.

Paul R. Levine

News

Vision Cable, cops to put CAP on crime

BERGEN COUNTY, N.J.—Vision Cable recently developed the Cable Alert Patrol (CAP) as a boost to Crime Watch, a neighborhood crime prevention program. This statewide CAP community service program of the New Jersey Cable Television Association is supported by the state's police chiefs association and crime prevention officers' association.

Vision's field personnel who regularly drive and work in the area and the company's dispatchers have been trained by a local police chief in identifying and reporting suspicious situations. Their work in homes, on the ground and on overhead poles could add eyes and ears in more places for crime prevention. In addition, the company's radio equipped trucks will carry the Crime Watch eye logo to provide a recognized and safe haven for children needing assistance.

SCTE membership now exceeds 6,000

EXTON, Pa.—The Society of Cable Television Engineers' national membership recently shot past 6,000, representing a drastic increase from the 1988 year-end count of 5,000 and the 1987 figure of 3,800. The 1989 total indicates that an average of nearly 100 members joined each month of the year.

"Reaching the 6,000 mark is an important event in the Society's history," said SCTE Executive Vice President Bill Riker. "It indicates the broadband industry's increased appreciation of the training and service the Society provides. Membership in the Society has become very important to industry personnel in the years since its formation, and as SCTE concludes its 20th year of existence, we will strive to sustain the excellence that has become synonymous with the Society of Cable Television Engineers."

New SCTE seminar rides into Dallas

DALLAS—The Society of Cable Television Engineers roped 'em here again with "Technology for technicians II" at the Harvey Hotel Nov. 13-15. Following its successful predecessor last year (geared toward installer/techs, service techs and field supervisors), this advanced seminar was designed for broadband industry maintenance techs, chief techs and system engineers.

SCTE Director of Chapter Development and Training Ralph Haimowitz instructed attendees on topics including mathematics and measurements; amplifier systems; powering; coaxial cable; common cable system faults; system operations and maintenance concepts; and CLI tests and measurements. Hands-on laboratories at the end of each day allowed participants to sample the latest signal level meters, leakage detectors and spectrum analyzers.

Like last year, attendees received a training handbook and a solar-powered calculator. They also were treated to two cocktail parties by the Texas Cable Television Association.

Attendees examine test equipment during a lab session at "Technology for technicians II."

Texas system loses three leaky channels

WASHINGTON, D.C.—As reported by the National Cable Television Association, on Sept. 19 the Federal Communications Commission reacted swiftly to what the Federal Aviation Administration termed "a case of harmful interference with air traffic." After a complaint from FAA officials, the FCC Field Operations Bureau traced a case of alleged interference to a cable system in Texas. The 22-channel system was monitored for leakage; major leaks were discovered. The FCC ordered the system to stop using three channels immediately.

Upon further investigation, it was discovered that certain pieces of the leak detection equipment were being incorrectly operated. However, the FCC had no trouble in making the equipment perform correctly. It found several large, unlogged leaks in the first few minutes of inspection. With the new signal leakage rules coming into effect on July 1, 1990, the FCC has shown it takes the matter seriously. It urges cable systems to bring their properties into compliance or fines and loss of rights to certain frequencies could result.

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Fiber optics: The next decade

The Society of Cable Television Engineers is currently planning "Fiber optics 1990," a three-day conference on this vitally important topic. This conference will be held March 21-23, 1990 at the Doubletree Hotel and Monterey Conference Center in Monterey, Calif.

SCTE has scheduled a total of 23 outstanding technical sessions to be presented by some of the industry's most prominent technical leaders. The preliminary schedule for the conference is as follows:

Tuesday, March 20

4-7 p.m.—Registration

Wednesday, March 21

7:30 a.m.-5 p.m.—Registration

8-8:15 a.m.—Welcome—Bill Riker, SCTE

8:15-8:45 a.m.—Introduction—Pete Petrovich, Lightwave Cablevision

8:45-9:45 a.m.— "How Fiber Decreases Long Term Costs and Prevents Service Loss" with John O'Hare, Creamer Dickson Basford

10-11 a.m.— "Real World Application of Fiber-Optic Technology" with Andy Paff, Anixter Cable TV

11 a.m.-noon— "Strategic Planning for Fiber Optics in Cable TV" with Robert Yates, DTI Telecom

Noon-1 p.m.—Lunch

1-2 p.m.— "Practical Considerations in the Testing of Fiber-Optic Cables at the System Level" with Paul Wilson, Comm/Scope

2-3 p.m.— "Business and Strategic Implications of Fiber Technology for the Cable TV Industry" with James Chiddix, ATC

3:15-4:15 p.m.— "Telephone Company Broadband Services Architectures," with Gary Kim, Multichannel News

4:15-5:15 p.m.— "Application of the Jones Cable Area Network Fiber-Optic Concept" with Robert Luff, Jones Intercable

6-8 p.m.—Welcome reception sponsored by Anixter Cable TV, AT&T and Texscan

Thursday, March 22

8-9 a.m.— "Trends in Optical Fiber Technology" with Dan Phillen, AT&T Bell Laboratories

9-10 a.m.— "A Case Study in the Application of Fiber Technology for the Cable TV Industry" with Ronald Wolfe, ATC

10:15-11:15 a.m.— "A Digital Solution for Cable TV" with David Jordan and Ken Regnier, C-COR

11:15 a.m.-12:15 p.m.— "Practical Realization of a 16-Channel Fiber-Optic Digital Supertrunk for CATV" with John Griffin, General Instrument/Jerrold Division

12:15-1:15 p.m.—Lunch

1:15-2:15 p.m.— "Laser Structures for AM Transmission—Today and Tomorrow" with Herze Laor, consultant

2:15-3:15 p.m.— "Semiconductor Laser Development for CATV Application" with Charlie Roxco and Edward Flynn, AT&T Bell Laboratories

3:30-4:30 p.m.— "Coherent Systems for CATV" with David Huber, General Instrument

4:30-5:30 p.m.— "Use of Frequencies Above 1 GHz on Analog Fiber-Optic Links" with Hermann Gysel, Synchronous Communications

Friday, March 23

8-9 a.m.— "Laboratory vs. Field Measurements of AM Optical Links—Reconciling the Differences" with Louis Williamson, ATC

9-10 a.m.— "Economics of Fiber Deployment in CATV Systems" with James Caldwell, Catel CATV Division

10:15-11:15 a.m.— "Lightning Damage Susceptibility of Fiber-Optic Cables" with Richard Clinage, Siecor

11:15 a.m.-12:15 p.m.— "Engineering and Construction of Fiber-Optic Routes" with Daniel Pope, AT&T Bell Laboratories

12:15-1:15 p.m.—Lunch

1:15-2:15 p.m.— "Fiber-Optic Cable Standards and Testing" with Sanford Lyons, Siecor

2:15-3:15 p.m.— "AM Fiber-Optic Cable Systems" with David Fellows, Scientific-Atlanta

3:30-4:30 p.m.— "Telephone's View of Video Transport" with Gaspare Lovasco, Pacific Bell

4:30-5:30 p.m.— "Broadband AM Lightwave Transmission Systems" with Carl McGrath, AT&T Bell Laboratories

Registration fees for the conference are as follows: $195 (SCTE member), $295 (non-member) and $235 (non-member joining SCTE). A special registration for Wednesday only is available for $75. Reservations must be received by Feb. 20, 1990. Attendance is limited to 250, so early registration is advised.

For further information and registration materials for "Fiber optics 1990," please contact SCTE national headquarters at (215) 363-6888 or write to: 669 Exton Commons, Exton, Pa. 19341.

SCTE chapters and meeting groups

As a service to SCTE members, the following is an up-to-date listing of the Society chapters and meeting groups, with each group's contact person and phone number. Members should take this opportunity to join a local group.

For more information on becoming a member, contact Pat Zelenka at the SCTE national headquarters, (215) 363-6888.

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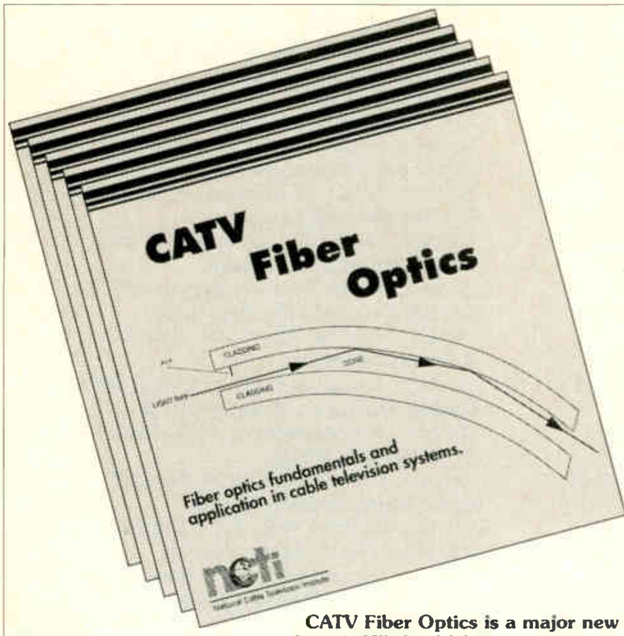

CATV Fiber Optics is a major new course from NCTI. Its 22 lessons cover virtually all aspects of fiber optics and its use in cable TV.

Now you can learn Fiber Optics from the industry's broadband training source!

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Fiber Optics is undeniably a part of cable television technology. If your system isn't already involved in fiber, chances are it will be in the next three years. And, if you're like most of us, your training and experience is in coaxial cable-based systems, not optics.

CATV Fiber Optics, can bring you into the age of optics. It provides you with a thorough understanding of fiber concepts from transmission and attenuation to bandwidth and dispersion. It will bring you up to speed with the application of fiber from cabling basics and types of lasers, to amplifiers and splicing. Finally, it will complete your knowledge of fiber use in cable television systems with a review of fiber architectures, modulation techniques, RF interfaces, components, testing and monitoring, construction and maintenance.

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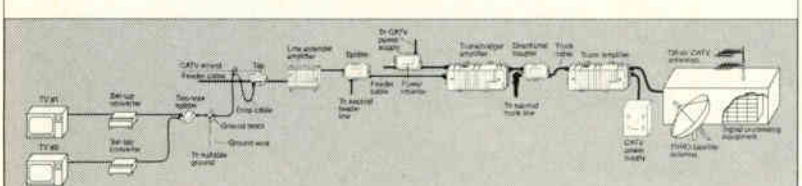

NCTI offers five career path courses to help develop your expertise in all areas of the cable plant.

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Service Tech
System Tech
Advanced Tech

In addition, NCTI's CATV System Overview provides an excellent opportunity for non-technical and new employees to learn about the technical side of the cable business, and Broadband RF Technician provides employees with extensive electronics training a complete understanding of cable television technology. Use the coupon at the right to order your FREE Training Kit. TODAY!

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Reader Service Number 12.

Optical fiber: The link to the future

By Scott A. Esty
Marketing Development Supervisor
Telecommunications Products Division, Corning Inc.

The picture is clear: cable TV engineers have discovered the performance advantages of optical fiber. Developed more than 20 years ago, optical fiber as a transmission medium has come into its own. More than 7 million miles of optical fiber are already in place, including several successful operating CATV systems. Optical system technology, including design, installation and operations procedures, are routine and established (Figure 1).

Compared to coaxial cable, optical fiber offers a number of important performance advantages:

- Greater signal-carrying capacity: The enormous bandwidth of fiber enables cable operators to multiply their channel capacities.
- Cost-effectiveness: Fiber's low signal attenuation enables cable operators to increase the allowable distance between amplifiers and use fewer remote electronics, resulting in fewer system failures and a reduced maintenance budget.
- Efficient system upgrades: Fiber systems can be designed for easy and inexpensive expansion by changing electronics.
- Easy installation: Fiber is lightweight, small and flexible.
- More secure signal: It is nearly impossible to tap fiber without detection.

What is optical fiber?

Optical fiber, hair-thin strands of ultra-pure glass, takes the age-old concept of communicating with light to its full potential. Glass is an ideal medium for transmitting light for communications. Scientists found that light could be confined within glass by a phenomenon called total internal reflection (explained later in this article).

In early tests, however, impurities in the glass absorbed too much of the light being transmitted. The challenge: to develop glass pure enough so that one percent of the light was retained at the end of one kilometer of glass fiber.

That breakthrough occurred in 1970, when researchers produced the first commercially viable fiber. The glass optical fibers were made from pure silicon dioxide (silica) and other pure chemical dopants.

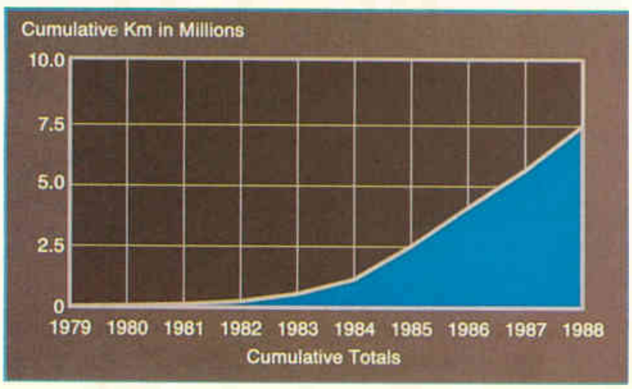
Today, fiber's optical performance extends beyond original expectations. The combination of lower optical loss and improved system electronics results in system lengths beyond 100 kilometers or 60 miles (Figure 2).

As mentioned before, the operation of an optical fiber is based on the principle of *total internal reflection*, which confines light within the fiber. Optical fiber consists of two different glasses, the core glass and the cladding glass. The core glass has a higher index of refraction than the cladding glass. This difference in the indices of refraction of the two materials causes light entering the core at angles less than or equal to the critical angle to reflect back into the core.

These modes of light are then guided to the other end of the fiber as they are reflected or bounced within the core. Modes of light entering the core at angles greater than the critical angle will be refracted into the cladding and eventually out of the fiber (Figure 3).

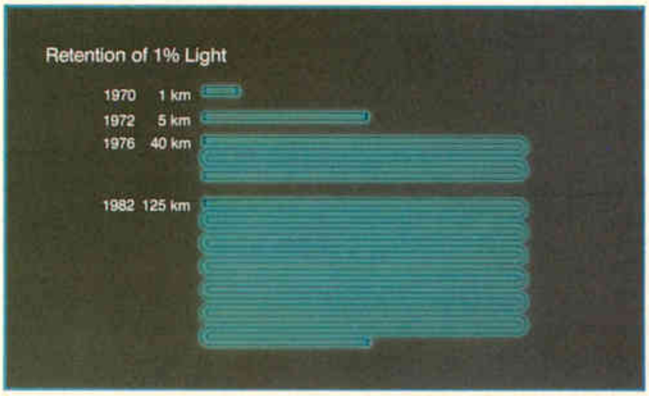
A basic optical fiber link consists of a light source, an optical fiber as the transmission medium and a detector. An electrical signal modulates the light source, which can be a light-emitting diode (LED) or laser, on and off for FM or dim to bright for AM. The light source transducer converts the incoming electrical signal into an optical signal (electrons into photons). At the re-

Figure 1: Total use of fiber in North America



Courtesy of Corning Inc.

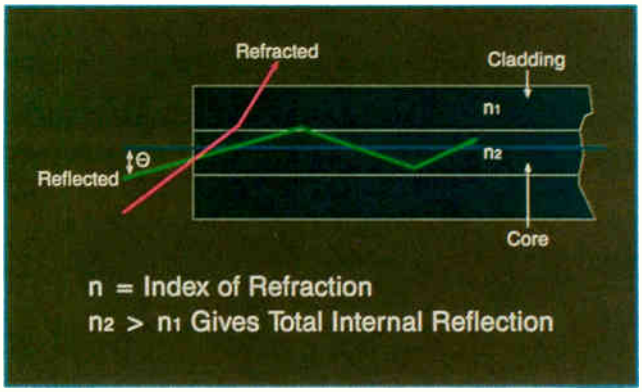
Figure 2 Fiber technology advances



Courtesy of Corning Inc.

Courtesy of Corning Inc.

Figure 3: Principle of total internal reflection



ceiving end, the transducer converts the optical signal back into an electrical signal (light power into electrical current, Figure 4).

OVD fiber making breakthrough

As previously mentioned, lower optical loss was one of the keys enabling long unamplified distances. This goal has been reached through improvements made in fiber manufacturing, both in process and product consistency, over the last 19 years.

The process developed to achieve this breakthrough was the inside vapor deposition (IVD) process. In this method, vaporized chemicals are deposited on the inside of a premade melted glass tube. The premade tube becomes the outer part of the finished fiber. This process was licensed, and a form of it (the modified chemical vapor deposition process or MCVD) is used today by some fiber manufacturers. This process is primarily limited to making the depressed-clad single mode fiber design.

The IVD process has an inherent limitation: fibers with an outer surface made from a melted glass tube contain impurities or flaws that can weaken their mechanical strength. To overcome this problem, scientists developed and patented an improved process, the outside vapor deposition (OVD) process, that eliminates the premade silica tube. In the OVD process, ultra-pure glass soot is deposited on the outside of a rod that later is removed.

Since they don't rely on melted-tube dimensions, OVD fibers have much longer lengths (up to 25 kilometers) and much better geometric control of such essential physical parameters as core concentricity and outside surface roundness, which translates to easily repeatable low loss splices whether mechanical or fusion techniques are used.

Two families of fiber

There are two families of optical fiber: single-mode and multi-mode. Multimode fibers allow more than one mode, or ray of light, to propagate at a desired wavelength. In single-mode fiber, only one mode of light propagates at a desired wavelength (Figure 5).

The pulse of light, or mode, traveling through a single-mode fiber extends beyond the physical core diameter. It travels in part of the cladding region at normal operating wavelengths. So, it is important for the cladding glass, as well as the core glass, to be extremely pure.

Because it's easier to maintain the discreteness of each light pulse when only one mode propagates through the fiber, single-mode fiber has greater bandwidth (information-carrying capacity) than multimode fiber. Using single-mode fiber, light modulations can be packed closer together in time, increasing signal content. This high signal-carrying capacity makes single-mode fiber better suited for CATV applications.

Other characteristics of single-mode fiber that make it more suitable for cable TV systems include its low signal attenuation (rate of light loss) and its natural immunity to ingress noise. For these reasons, this article concentrates on single-mode fiber and its performance parameters.

There are four key optical performance parameters of a single-mode fiber: attenuation, dispersion, mode-field diameter and cutoff wavelength. Attenuation is loss of light, or decrease of signal strength or power, as light travels through a fiber.

Dispersion refers to the spreading or distortion of each signal of light as it travels through a fiber. This can lead to bandwidth limitations over long transmission distances.

Mode-field diameter refers to the diameter of the spot of light traveling through a single-mode fiber. This parameter is controlled to ensure low splice and connector losses while maximizing coupling efficiency and bend performance. The nominal mode-field diameter of a single-mode fiber is around 8 to 10 microns; the associated nominal core diameter is slightly less.

Cutoff wavelength defines the wavelength above which a single-mode fiber supports only one mode of light. This parameter makes single-mode operation possible in the 1310 and 1550 nm (nanometer) wavelength regions.

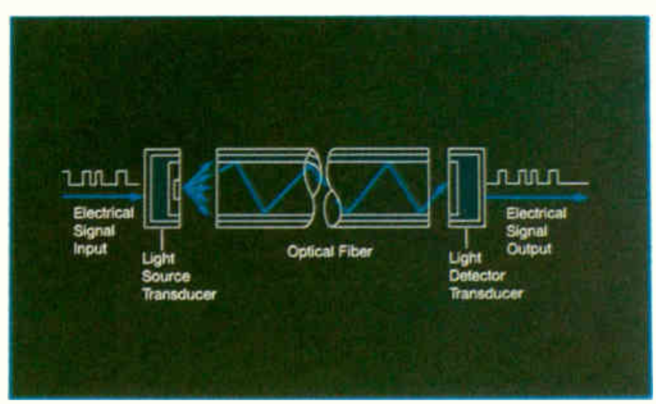
Concerns about fiber

Historically, attenuation was of most concern to companies considering fiber. It can be caused by *intrinsic* factors, which are inherent to the raw materials used to manufacture the fiber.

Extrinsic factors, such as splicing, microbending and macrobending, also may affect attenuation during system construction and over the operational lifetime. Let's look at each of these in turn.

A splice is a welding procedure or assembly that physically joins and holds two optical fibers together. Optical fiber splices are necessary for a number of reasons: to link active system devices, such as the light source and the receiver; to allow future system reconfiguration; to allow fiber installation in places where a continuous fiber cable cannot be used for environmental reasons; and to repair fiber that has been accidentally broken. Early splicing concerns led to an industry myth that you could not splice one manufacturer's fiber to another's. Today, that myth has been debunked. Different single-mode fiber and different splices all work together with acceptable attenuation and high splice strength.

Figure 4: Optical fiber link



Courtesy of Corning Inc.

Microbends are small deviations (on the order of a few microns in amplitude) that occur along the length of the fiber and cause light to leak out. Microbends may be induced at very cold temperatures, as low as −60 °C, because cable materials and fiber have different coefficients of thermal expansion. Contractions of the cable can exert enough pressure on the fiber to cause microbends.

Macrobends are large-scale bends with diameters measured in inches. Fiber macrobends typically occur in splice trays with bend diameters of two to three inches. It is important to prevent fiber bends from becoming too tight. As a beam of light goes through a bend in the fiber, part of the power can radiate out if the bend is too sharp. This macrobend-induced attenuation is more pronounced at the 1550 nm operating window than at the 1310 nm window. Small diameter bends caused by improper fiber deployment also can create stress on the fiber that may result in premature fiber failure. The industry-recommended minimum bend diameter is two inches.

Another common concern about fiber is its strength. Because optical fiber is made of glass many people assume that it is fragile. In fact, while bulk glass is fragile, optical fiber is not.

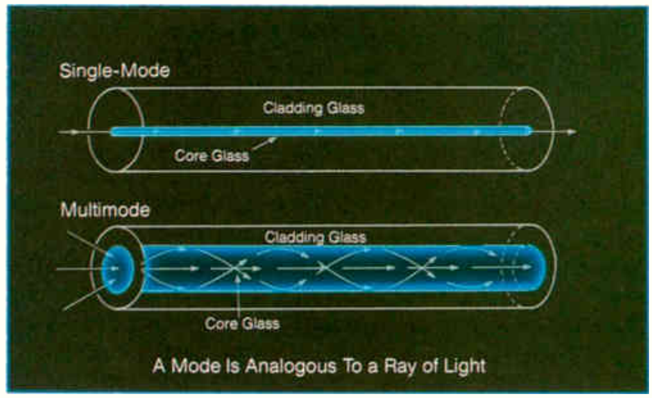
The actual strength of an individual fiber is determined by the size of inherent microscopic flaws on its surface. An optical fiber without flaws has a theoretical strength of more than 2 million pounds per square inch. To ensure that there are no microscopic flaws that would cause a fiber to break in service applications, each fiber is proof-tested. Generally, most fiber is proof-tested to a tensile strength of 50,000 pounds per square inch.

Reliability is the other concern commonly voiced about optical fiber systems. In fact, fiber offers greater reliability than coax because fiber is not affected by many of the elements that adversely affect metal like corrosion, parts that shake loose, noise, radiation interference or shorting out.

Mechanical performance

As fiber's optical performance approaches its theoretical limits, research and development has focused on improving its mechanical performance. Tougher fiber is needed to withstand the stresses of increased handling, mechanical stripping, abrasion and environmental factors. By enhancing it with even tougher coatings and more abrasion-resistant glass compositions fiber will be ideally suited to today's and tomorrow's cable TV applications. ■

Figure 5: Two basic types of optical fiber



Courtesy of Corning Inc.

Education and survival

By Jeffrey Herr
Owner, Cass Communications

● On a typical day, Somewhere, U.S.A., a systems tech goes out on a service call because of a drop torn down by a passing tractor trailer. She splices a piece of softline in the middle, goes to the end of the drop, cinches up on the messenger and calls it a day. Installation of new drops does not fall into her job description. Besides, she's due at the next service call and hasn't had her coffee break.

● It's late in the day and a contractor is hanging a drop to a subscriber's house during a plant rebuild. After surveying the property, he runs the drop into the house the fastest and most efficient way there is, and in the process, aerial trespasses onto two of the neighbors' properties and crosses the face of the pole. "Hey, they're paying me $8.50 to run this drop," he thinks, "I have kids and a mortgage to think about just like anybody else and I need to run two more drops before I get my bonus."

● The last phone call is handled for the day and the Mayor is waiting outside to meet with you regarding some minor infraction that was blown out of proportion by the Mayor's brother-in-law. Your thoughts are wandering back to when you were a service tech and why you can't find qualified people to work for you that have good attitudes and are subscriber friendly just like you were. You also are thinking about how to make more budget cuts and tighten up the operation to please the owners while, at the same time, solving the Mayor's brother-in-law's crisis. And that's just this week.

We all have our stories to tell, but in reality what is the problem in these scenarios? Is it education or attitude? Is it company policy? Where is the real fault in the system? How many times will the cable operator pay someone to return to the first two places to repair and do the job right? It's my guess that the operator will pay someone at least three times to do these jobs, whatever the causes of the problems.

The main culprit

If we have to choose one of the causes, let's assume education is the main culprit. Now, the next question would be: Who needs to be educated and where should the education start?

Education is a word that has a vast array of meanings to many people in many fields. What does it mean to the CATV operator in today's competitive field? In one word, *survival.*

In the upcoming decade and into the next century the CATV operator, whether an MSO or a "mom and pop" venture, will need education more than ever before; the reason for this is the consumer market. System operators need to take a good hard look at themselves and be honest about problems they face, whether public relations or technical, and act now, before they find themselves out of a job. The consumers operators sell their goods to are better educated and more demanding than ever before in the history of CATV. They couldn't care less whether cable is a media or a utility; all they care about is an affordable, quality

The value of a book (or class)

By Jim Heino
Instructor, CATV Systems Technology Program
Dakota County Technical College

Are you a key player in the cable television industry or are you simply a bench warmer? Consider what Mike Dietrich, technical services supervisor with Continental Cablevision in St. Paul, Minn., says with regard to his role in the cable industry, "I enjoy being a part of an ever-changing, fast-paced industry, one in which the growth potential is unlimited. Without my vocational school training in cable television technology, I would no doubt still be working some dead-end job for peanuts."

An old saying goes something like this: Do you consider education too expensive? Try ignorance. Education can take many forms but the result should theoretically be the same—a successful person. Oh, you may not get rich in terms of dollars, but the enrichment derived from a job well done can do a lot for a person. If you select a training program that will aid you in career advancement, your attitude and work habits will be enhanced and you'll be a better person for it.

How important are qualifications to the cable system operator and what is the system manager looking for when interviewing a prospective employee? Jim Schulz, technical services manager with Paragon Cable in Minneapolis, says he prefers someone with vocational training and no practical field experience to someone who has spent time in the field in a lower level job and has "picked up bad habits."

"Everyone at Paragon goes through rigorous in-house training regardless of their background," says Schulz. "It has been my experience, however, that a person with formal training has a much easier time of it and can usually advance through the testing process with a good attitude toward the experience."

Schulz also prefers to deal with trained individuals because of commitment. He says his experience has been that a person with training has more of a desire for a long term career position in the industry and through this commitment will "probably advance rapidly."

The important thing for most individuals in any endeavor is to be aware of the options available to them. If enough time and effort is spent on any one thing, success will probably result. A person can reduce the amount of head-banging on the road to success by exercising one or more of the available options. Training in CATV systems technology is certainly a viable option and one which is open to everyone.

TV picture that offers a variety of viewing options.

Operators must be sharper than ever and this will come from education, whether by formal or "seat of the pants" means. Through either one, they must learn one of the most important lessons in life—you get what you pay for. Nowhere is that more true than hiring and maintaining a competent staff. When customers come in contact with a representative from your company, what do they see? Is it someone they're afraid to let in the front door? Or is it someone that is professional-looking and can get their TV picture cleared up or installed?

Choose an option

After determining the options you have, decide which one is right for your system. Of the three or four available, Option 1 would be an in-house training program for each department on procedures and policies. After all, employees are more than a replaceable piece of equipment, they are representatives of the company. They are who the public comes face to face with every time there is a problem or a new install.

At times, the front-line people can make or break a system operator, so why not have the best in this all too critical position. We all know how difficult it is to find and hire good people, so we should train and educate the few that we do find and place them in key positions and let them handle the problem departments.

Okay, so you're sitting there and thinking, "Oh boy, another know-it-all with all the answers." Wrong! There are professionally run systems in the industry that rely on education and training, and they even show a profit at the end of the year. So how do they do it? They train and educate their people through the infinite amount of information and education programs at their disposal. (Check the trade magazines or trade organizations such as the Society of Cable Television Engineers.)

Option 2 is to contract your needs out; if you don't have the knowledge to train or educate that line tech or installer, get help! Some of the best people in the CATV field don't work for system operators, they work for vendors and contractors. Bring qualified people in to train your people on your system, that way nothing is lost in the translation between different types of electrical components and designs in different systems. Look at different industries, especially the money makers; what do they do? They don't try to do it all in-house because it's more efficient to pay someone else to do it.

Option 3 is a combination of the first two. Use your own qualified personnel to train employees. Then, for areas in-house personnel are unable to cover, go out-of-house. Vocational schools and organizations like the Society of Cable Television Engineers and the National Cable Television Institute provide numerous educational opportunities, from classes and seminars, to at-home study and correspondence courses.

While you're busy making sure your employees are educated, don't forget your education and training should be a never-ending process that sets an example. Lead by doing instead of talking and griping; this is what will filter down through your management team and provide them with direction. I once had a "young" warhorse tell me he spent more than 35 years in the industry fighting owner/operators' attitudes that education and training was like throwing money down the drain. Not so.

The most important tool you have at your disposal is education —for yourself, for your marketing team, for your operations team and even for your subscribers. So the bottom line is this: Education costs but lack of education can cost you your survival. ■

Interconnections in a MultiPort environment

By Joe Van Loan
Consultant to the Cable Television Industry

For many years the cable TV and consumer electronics industries existed, seemingly unaware of each other's existence. To the extent that each side attempted to solve interface issues, they often frustrated the other: "cable-ready" sets would not descramble and were inadequate in adjacent channel and overload performance, set-top converter/descramblers made receiver features inoperable, "channel mapping" led to subscriber confusion, etc.

In 1984, there began a cooperative effort to solve problems of concern to both industries. The effort has consisted primarily of developing standards for attaching TV receivers and VCRs directly to the cable without the necessity of active adapters such as converters and/or descramblers. The effort has taken place under the auspices of the Electronic Industries Association's (EIA) Consumer Electronics Group (CEG) Television Receiver Committee (R-4) and the National Cable Television Association's (NCTA) Engineering Committee.

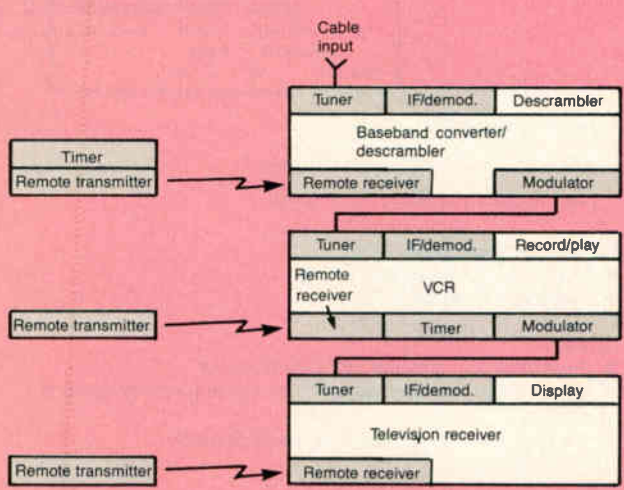
This effort resulted in the establishment of several standards. Interim Standard Number 6, defining the cable channel identification plan, was designed to ascribe uniform number assignments to all cable channels tuned by TV receivers and VCRs. Interim Standard Number 23 was developed to define the RF interface between TV receivers and VCRs and cable TV systems.

The latest standard to be developed is the keystone to permitting the direct connection of TV receivers and VCRs to cable TV systems while still allowing viewers to tune and view scrambled channels. Called EIA-563, or EIA MultiPort, it defines a connector to be included on TV receivers and VCRs with a companion connector to be included on cable TV descramblers.

These descramblers differ from current set-top units in that they contain only the essential descrambling circuitry. All tuning and control functions remain with the customer's video equipment. In operation, the MultiPort descrambler is "transparent." If the subscriber tunes to a non-scrambled signal, the unit is inactive. When a scrambled signal is tuned, the descrambler consults its authorization information and, if properly authorized, descrambles the picture. This means that such features as remote control tuning and timed multichannel recordings function in the cable environment exactly as in an antenna environment so that customers do not have to give up any features of their equipment in order to access the broader range of programming that cable offers.

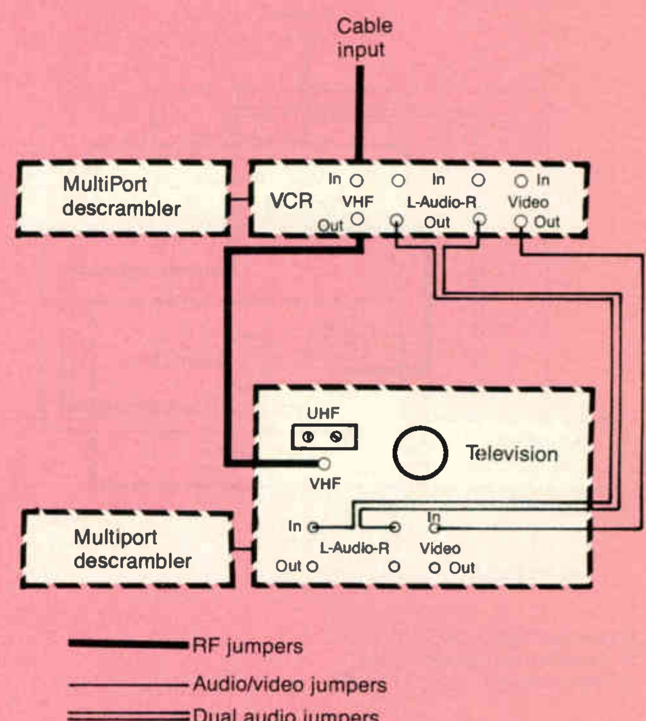
The 20-pin baseband interface, under development for nearly four years, underwent three field tests in Denver between April 1986 and October 1987. The tests involved especially modified receivers from six participating manufacturers that were mated to specially built descramblers from four converter/descrambler

Figure 1



Note: Duplicated circuitry shown shaded

Figure 2



Equipment (back panel view):
- MultiPort-equipped TV set
- MultiPort-equipped VCR

Allows:
- Totally independent selection of channels for viewing or recording, whether scrambled or not.

Note:
- Audio and video connections from VCR to television are optional for stereo tape playback

manufacturers. Four scrambling systems were tested: a Zenith baseband system, a digital audio system from Jerrold, Oak's Sigma digitally encrypted audio system and a Scientific-Atlanta RF system adapted for baseband descrambling.

Development work is now complete and the first EIA MultiPort-equipped receivers have been available in stores since May 1987. In late 1989 there were about 750,000 to 1 million MultiPort sets in homes. The first MultiPort VCRs became available in September 1989. MultiPort equipped TV sets and VCRs are available from RCA, Panasonic, Quasar, General Electric, JCPenney, Curtis-Mathes and Bang & Olufsen.

Benefits of the MultiPort jack

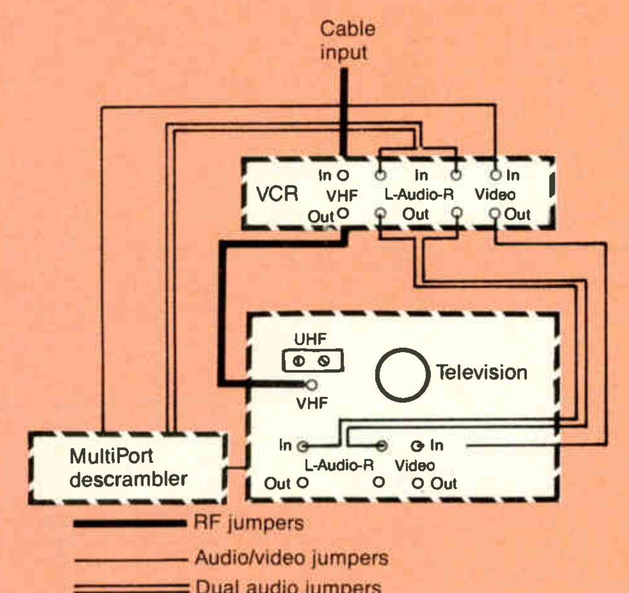
Cost reduction: Figure 1 shows the situation where a set-top descrambler, VCR and TV set are connected in a straightforward manner. Notice the duplication of functions: each includes a tuner, IF amplifier, timer, remote control and power supply; the converter and VCR each include a modulator. A MultiPort descrambler, by contrast, need only contain the descrambling circuitry. The cost of owning and maintaining conventional converters and converter/descramblers is enormous; the purchase cost can represent from one-third to one-half of an operator's annual capital outlay and service calls caused by converter related problems often account for one-fourth to one-third of an operator's total number. It has been noted that as much as one-third of a customer's monthly bill for basic service goes for owning and maintaining converters.

Simplicity of connection and use: Until the advent of the MultiPort technology, cable operators and viewers had only three choices in connecting VCR-equipped customers to addressable converters:

- The "vanilla" connection of Figure 1 which makes inoperable many customer equipment features.
- Various arrangements of A/B switches and splitters that are confusing to use and generally still involve flexibility compromises.
- Integrated switching boxes that, although better than individual switches, still involve additional cost and complexity as compared to an antenna connection situation.

In the ideal case of MultiPort-equipped VCRs and televisions, upgrading to full addressable cable television access only requires plugging in a small, low-cost module to each piece of equipment. Operation and features of the equipment will be exactly the same as before cable installation except that the subscriber can now subscribe to and access any desired combination of services.

Figure 3

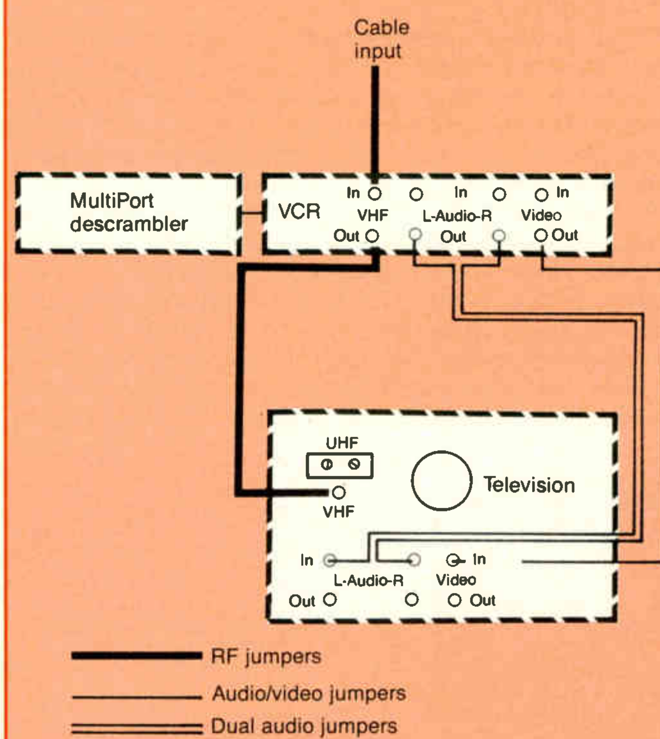


Equipment (back panel view):
- MultiPort-equipped TV set
- Non-MultiPort-equipped VCR

Allows:
- Viewing any authorized channel, scrambled or not
- Independent channel selection for recording of non-scrambled channels
- Recording of any channel while viewing same

Notes:
- Audio and video connections from VCR to television are optional for stereo tape playback
- Audio and video connections to VCR inputs may come from descrambler (if so equipped) or from TV set audio and video outputs. Some TV sets and descramblers may not have such outputs.

Figure 4



Equipment (back panel view):
- Non-MultiPort-equipped TV set
- MultiPort-equipped VCR

Allows:
- Recording any channel, scrambled or not
- Independent channel selection for viewing non-scrambled channels
- Viewing any channel selected on VCR tuner

Note:
- Audio and video connections from VCR to television are optional for stereo tape playback

Picture and sound quality: Because all processing is done at baseband, use of MultiPort descramblers eliminates remodulating the descrambled picture onto a VHF carrier and then demodulating it again in the television or VCR. Economic considerations in the design of converters and TV sets sharply limit the attainable quality of this process so that both chroma delay and luminance bandwidth shrinkage typically result when using RF interconnections from set-top units to other equipment.

Similarly, handling of BTSC stereo signals in those converters with volume control features has always been a compromise. Even those units that pass the signal with relatively little degradation may only do so at full volume.

Local video dealer relations: It should be recognized that the local television dealer's customers and a cable operator's subscribers are the same people. The feelings that dealers have toward the cable service are likely to be passed on to those who buy their products. Because connections of the type shown in Figure 1 would defeat the purpose of the features on deluxe sets, dealers are not likely to be happy with the situation and may very well point out to customers the advantages of a combination of antenna reception and rented videocassettes. By contrast, in order to take full advantage of a MultiPort environment, the customer needs to have an extended tuning range set, remote control, stereo and all of the other bells and whistles that represent good profit margins for local retailers.

Compatibility with set-top technology: Those vendors who are developing MultiPort descramblers are doing so in a way that allows coexistence of set-top and MultiPort devices in the same system. This will allow a gradual introduction of the new technology, paced by subscriber purchases of MultiPort-equipped TV sets and VCRs. Use of common scrambling schemes, addressing and service levels means that no changes need take place in addressable control hardware or software.

Equipment interconnections

Figures 2 through 4 illustrate the simplicity of equipment interconnection when MultiPort decoders are used. Figure 2 is the simplest and most flexible case in which both VCR and television are equipped with MultiPort jacks. Current predictions are that both decoders together should cost less than current model set-top units and should be more reliable as well. It should be noted, however, that there is a security issue if the decoders are physically separate in that one may "wander" to neighbor's homes. It may well be that dual units or some form of "master-slave" units may eventually be desired.

Figure 3 may be typical of early installations simply because MultiPort-equipped TV sets have been available on the market before similarly-equipped VCRs. Provided the decoder has audio and video output jacks, this connection allows recording of scrambled programs.

Figure 4 may well dominate single-decoder installations simply because VCRs, being mechanical devices, wear out and are replaced faster than TV sets.

In each case, additional audio and video connections between the VCR and TV (having nothing to do with the MultiPort devices) may be required to allow playback of stereo tapes if both VCR and television are stereophonic. ■

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Ad Index

Advances in CATV instrumentation

By Terry Bush
Vice President, Instrument Group
Trilithic Inc.

Over the past 20 years, the cable television industry has realized some notable technological advances. For instance, amplifiers, once straining to pass the standard low and high band VHF, are now replicating 86 channels of undistorted video. Little effort is now required to increase system capability as plug-in modules allow bandwidth expansion without respacing. Advances in fiber optics will soon bring a new technology and associated challenges to our industry, improving the overall performance and value of the medium.

The instrumentation used by the cable operator has also improved dramatically over this same time period. Tuning speed, accuracy, size and weight plus other user features allow the operator to perform tests quickly and confidently. Although most of the CATV equipment has realized the benefits of this technological growth, no one example has changed as much as the signal level meter (SLM). For our discussion, we'll focus on the developments that have been incorporated into today's SLM, the most basic piece of CATV instrumentation.

An SLM may be divided into four major technology segments (see accompanying figure). The attenuator is the scaling section of the instrument. This component reduces the signal to within the range of the RF front end. In the RF front end, the signal is converted, through one or more intermediate frequencies (IF), to a final IF within the response bandwidth of the detector. The detector then measures the amplitude of the IF signal and feeds the display circuitry, traditionally a meter, with information relative to the unit of measure. The tuning circuit sets the frequency of the conversion oscillator to convert the desired signal to the IF, giving the instrument the capacity to tune over a broad bandwidth. These modules, when combined, allow the operator to effectively measure the amplitudes of the channels carried by the system, assuring proper alignment and maximizing the utility's performance. Now let's consider each of these technology segments separately, examining their evolution.

Attenuator

Attenuator technology has made some significant strides over the past decades. The first commercial realizations of constant impedance attenuators using discrete leaded resistors was achieved in the early '50s and '60s by manufacturers in New York and Pennsylvania. The technology yielded the push-button, slide, rocker, toggle and turret forms of attenuation, which were used significantly in cable TV instrumentation.

In 1969, a significant advance in the reliability and performance of step attenuators was realized through the utilization of electromechanical relays. As many of the mechanical parts previously used to switch the pads in and out were eliminated, switching speed and reliability were greatly improved. The only drawbacks to this approach were the price penalties paid by the vendor for the relays (increasing the final selling price) and the undesirable power demands imposed upon portable field equipment. As a result, mechanical and rotary (turret) attenuators continued to see applications in CATV test equipment.

Recent technological developments have allowed the utilization of less expensive relays, bringing the price within the range of instrument manufacturers. These programmable attenuators are also available in a latching configuration, which consumes energy only during transition. The future may lie in solid state technology, which could yield phenomenal speed and continuous adjustment capacity.

RF front ends

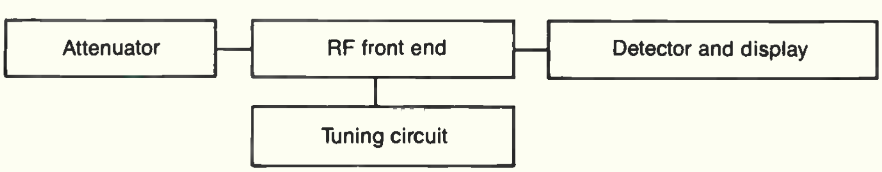
The RF front end is one of the most critical components of any radio frequency receiver. This section performs the function of converting the input signal to an IF where it can be filtered prior to detection and display. This section ultimately determines the receiver's noise floor, frequency response, and susceptibility to undesirable responses, such as images or intermodulation products. While the front ends of single frequency devices, such as leakage receivers, have remained largely unchanged, the front ends of broadband devices, like signal level meters, have evolved considerably.

In the late '60s and early '70s, when the average cable system was still 220 to 300 MHz, the front end of SLMs were single conversion tuners that converted to an IF usually located below Ch. 2. Using an IF of 50 MHz or so meant that the image response was only 100 MHz above the desired frequency. This required careful filtering of the input signal to eliminate image responses. Accomplishing good image rejection over the entire 5 to 300 MHz range required a number of band-switched filters. Because the oscillator frequencies required for single conversions covered a number of octaves, several oscillators were necessary to tune the entire frequency range. Although this approach may seem cumbersome, it was a viable and, at the time, cost-effective way to get the job done.

When cable bandwidth began to expand, the old single conversion front end, with its banks of filters and oscillators, became somewhat impractical. The growing availability of inexpensive high frequency transistors and mixers made it possible to borrow technology from more costly spectrum analyzers and begin using a dual-conversion front end scheme known as upconvert/downconvert. In a front end of this type, it is possible to place the first IF well above the highest receive frequency, (thereby eliminating the image problem) and then to convert back down to a low frequency for signal processing.

This approach had several immediate benefits. The images were now well above any signal present in the system, making input filtering unnecessary and a single oscillator could now tune the whole cable spectrum. Elimination of the input filters in combination with broadband mixer technology so greatly improved the flatness of the front end that compensation or correction factors were no longer needed. The

SLM block diagram



simplicity, high performance and ease of frequency expansion of the upconvert/downconvert tuning scheme has made it the most widely used conversion technique in broadband testing.

In the future, the RF sections of test equipment will continue to evolve. The (upconvert/downconvert) scheme will be miniaturized and improved, and will be around for a long time. Low cost MMICs (microwave miniature integrated circuits) and high frequency SAW (surface acoustic wave) filters will give renewed life to the single conversion receiver, this time with an IF above the maximum receive frequency. A whole new family of test equipment also is on the horizon, dealing not with RF but with tiny light beams and previously unimagined bandwidths.

Detector and display

Throughout the evolution of the SLM, the primary function of the detector and display circuitry was to detect and indicate the level of the signal. This posed some immediate problems, as the signal may be modulated or unmodulated. When video modulation is present, the carrier's level is only realized during the horizontal or vertical sync time frames. Detector circuits were devised that deflected properly on carriers and selectively added deflection when horizontal sync was present, correcting for the apparent level change.

This technique was incorporated into many meter designs and was used successfully until horizontal sync suppression (scrambling) became popular. This signal protection technique reduced or modulated the horizontal sync level, prohibiting peak detection. Meters with horizontal sync peak detection generally give low or unsteady readings on these carriers, rendering their readings virtually useless. Newer detector technology relies on the vertical sync component of the carrier for peak detection, relieving this problem in most cases.

Another significant technology finding its way into all detection and display circuits is normalization. Normalization allows the manufacturer to program corrections into the meter's memory, telling it how much to correct for meter response problems, temperature change and other irregularities that would normally reduce the meter's accuracy. This technology will almost solely be responsible for holding unit prices down while increasing the instrument's overall performance. As normalization relies totally on microprocessor manipulation of data, other significant features such as wide-view LCD displays and test data storage are becoming increasingly popular in new SLM designs.

Tuning circuit

To say the least, the old band selected dial tuner has probably seen the last of its involvement in new designs. Single chip integrated circuits are now available that will very reliably tune the instrument to the desired frequency, eliminating the need for manual tuning and peaking. And, as this technology is readily connected to microprocessors, keyboard tuning and remote access are just a few of the features that can be readily addressed. Tuning speed also has dramatically improved through the utilization of synthesizers. Frequency related data can now be tuned and displayed in substantially less time than ever before possible, increasing the technician's power to resolve system problems quickly and efficiently.

Constant technological advances in instrumentation should continue to provide a valuable product for the cable television technician. Greater accuracy, faster tuning, increased reliability, and expanded testing capacity are just a few of the many features the user can count on as technology enhances our working tools. ■

Basic electronics theory

This is Part XIX of a series about basic electrical and electronic principles, designed for the individual with little or no training in either electricity or electronics.

By Kenneth T. Deschler
Cable Correspondence Courses

This month we will begin a study of a device that revolutionized the electronic industry when it first appeared in 1948. This device was the transistor.

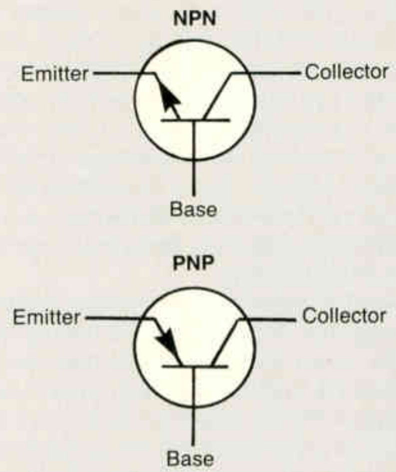
The *transistor* was developed at Bell Laboratories by John Bardeen, William Shockley and Walter Brattain, which subsequently earned them the Nobel Prize. Previously, electronic equipment used large, power consuming, inefficient devices known as *vacuum tubes* to perform the many functions associated with transmitters, receivers and computers. The transistor, on the other hand, is small, rugged, efficient and requires less power for operation.

These features, as well as mass production techniques, allowed for production of smaller electronic circuits. Electronic circuits soon became so cheap to manufacture that it was more economical to throw them away rather than repair them.

Basic transistor construction

Transistors manufactured today are made up of three sections of semiconductor material having two P-N junctions. Transistors are constructed with one P type semiconductor between two N type semiconductors or one N type between two P types. The former is known as an *NPN transistor* and the latter a *PNP transistor.* One of the outside semiconductors is called the *emitter* while the other is known as the *collector.* The thinner portion between the emitter and the collector is called the *base.* Figure 1 shows the schematic symbols for both types of transistors.

Figure 1: Transistor types



When properly biased, the emitter section supplies the majority carriers that flow into the base and collector regions. The base region provides control over the carriers that flow between the emitter and the collector of a transistor.

Figure 2 shows the proper biasing of both NPN and PNP transistors. The emitter-base junction is forward biased while the base-collector junction is reverse biased.

Basic transistor operation

Because most transistors are of the NPN configuration, we will use it to explain how a transistor operates. Looking at Figure 2A, electrons enter the emitter from the base-emitter battery and flow into the base region. Because the base is so thin, they are attracted to the higher potential of the base-collector battery. In practice, about 95 percent of the electrons leaving the emitter travel to the collector with the remainder going to the base supply.

"The most common test for transistors is a simple ohmmeter check."

Figure 2: Proper biasing

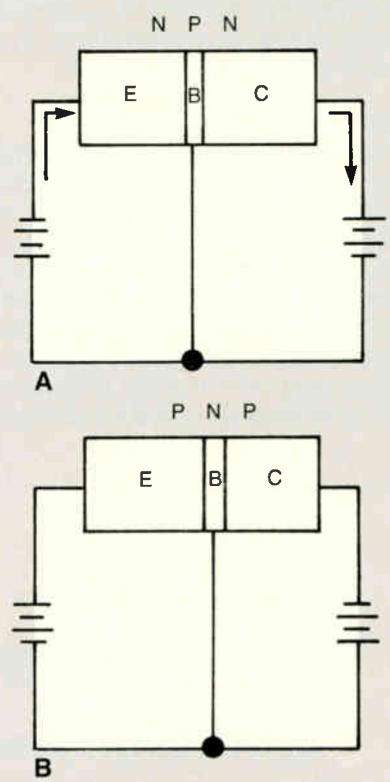


Figure 3: Typical transistor circuit

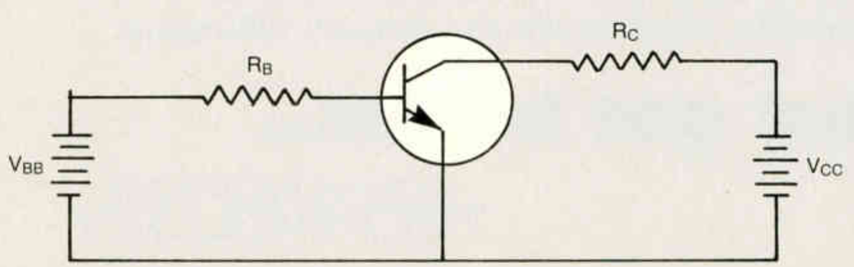


Figure 3 shows a typical transistor circuit. This circuit is referred to as a common emitter circuit because the emitter is common to both the base and the collector bias batteries. The abbreviations used in the transistor circuit in Figure 3 are:

V_{BB} = base-emitter voltage source
V_{CC} = base-collector voltage source
β = current gain of the transistor
R_B = base resistance
R_C = collector resistance

In transistor circuits the following relationships exist:

1) $I_E = I_C + I_B$
2) $I_C = \beta \times I_B$
3) $\beta = I_C \div I_B$
4) $I_B = I_C \div \beta$ or $V_{BB} - 0.7 \div R_B$

By assigning values and using the configuration of Figure 3, let us determine the characteristics of a 2N162 NPN silicon transistor.

Given:
V_{CC} = 10 volts R_C = 10 kΩ
V_{BB} = 10 volts R_B = 500 kΩ
β = 60
Find:
I_B, I_C, I_E

$$\begin{aligned} I_B &= V_{BB} - 0.7 \div R_B \\ &= 10 - 0.7 \div 500{,}000 \\ &= 9.3 \div 500{,}000 \\ &= 18.6\ \mu A \end{aligned}$$

$$\begin{aligned} I_C &= \beta \times I_B \\ &= 60 \times 18\ \mu A \\ &= 1.116\ mA \end{aligned}$$

$$\begin{aligned} I_E &= I_C + I_B \\ &= 1.116\ mA + 18.6\ \mu A \\ &= 1.1346\ mA \end{aligned}$$

Transistor testing

When it becomes necessary to test a transistor, the technician has a choice of many fine instruments such as curve tracers, dynamic testers and simple ohmmeters. A curve tracer enables the technician to view the characteristics of a transistor under test using an instrument called an oscilloscope. A scope is a piece of test equipment with a screen similar to a TV set that allows signal waveforms to be viewed. A dynamic transistor tester is an instrument into which the suspect transistor is inserted, causing it to be subjected to a large variety of voltages and signals. By far, the most common test for transistors is a simple ohmmeter check.

Because the transistor is made up of three semiconductor regions with two junctions, it resembles two diodes, back to back, in series with each other (Figure 4). By placing an ohmmeter across the emitter and base leads, both forward and reverse resistance may be measured. The same can be done to the base and collector leads, resulting in the measurement of its forward and reverse resistance values. (Refer to testing procedures for diodes in last month's "Basic electronics".)

Figure 4

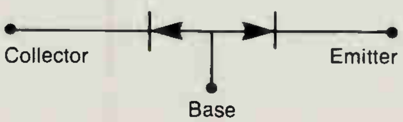


Figure 5: Transistor housings

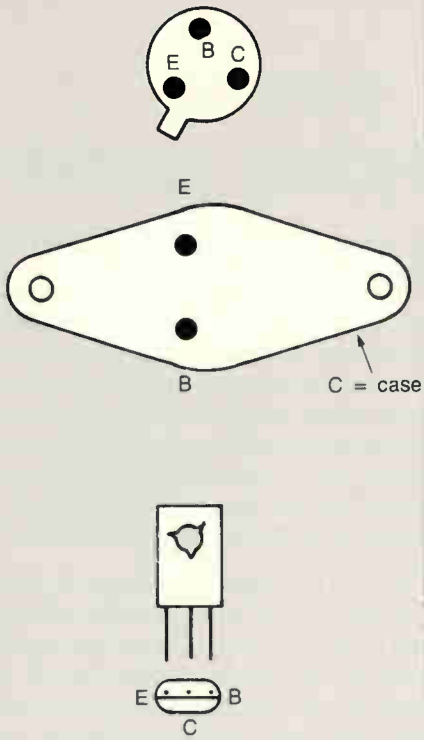


Figure 5 shows three common shapes of cases used to house transistors. The lead identifications shown are only representative. Please consult a manual or specification sheet for exact lead identification for specific transistors.

Test your knowledge

1) When did the transistor first appear?
2) What device did the transistor replace?
3) Name the two types of transistors constructed from semiconductor materials.
4) What do the symbols V_{CC}, β and R_B stand for?
5) Name the most common test instrument used to test transistors. ■

Answers
1) 1948
2) The vacuum tube
3) NPN and PNP
4) The base collector voltage source, the current gain figure of the transistor and the base resistor
5) The ohmmeter

Keeping your power supplies supplying power

By Jud Williams
Owner, Performance Cable TV Products

The power supply can be a very evasive part of a cable TV system to work on mainly due to a misunderstanding about power converting devices. There are two basic types of power supplies to be considered in cable, each with its own particular set of weaknesses.

The simple "ferro"

The primary power for a cable system is the ferroresonant power supply, often called an AC supply or more often a "ferro." This is by far the simplest in design and has the fewest parts to consider. The purpose of this power supply is to convert the 120 volt AC utility power to 60 VAC for use in the cable system. In the case of older systems, the voltage might still be 30 VAC. In the process of dropping the voltage, it stabilizes the variations that are taking place in the power provided by the utility. Also transients and other irregularities from the utility are cleaned up.

The component most likely to fail is the ferroresonant transformer. The second most likely candidate is the circuit breaker. The least likely component to fail is the AC capacitor. Heat is the most destructive thing affecting the longevity of these supplies. The ferroresonant transformer operates at several hundred degrees and if it is enclosed in a cabinet with poor ventilation it reaches an even higher temperature. The net effect is that the power supply may fail prematurely because the insulation on the windings of the transformer deteriorates to the point that they short out and burn up. A transient may cause the final breakdown of the insulation but it is not the primary cause.

The addition of a fan to any ferro power supply adds to the life of the unit immeasurably. Preventive maintenance by the proper cooling of these power supplies is the key to reliability. Since the transformer is the most costly portion of a ferro once it has burned out, it is often more economical to replace the entire power supply.

Troubleshooting the rest of the power supply becomes mostly a process of observation. Burned wires or faulty quick disconnects are easily found and repaired. Often if the AC capacitor has failed it will puff up or else show a short on an ohmmeter. If the circuit breaker is at fault it will continuously trip when a load is applied to the power supply. On the test bench a bank of ordinary 300 watt light bulbs can act as a load for test purposes. Six bulbs in parallel will load the supply down approximately 10 amperes while eight bulbs will load it to about 14 amperes.

While a *true* RMS (root mean square) voltmeter is most desirable when working with power supplies, an ordinary digital meter will suffice as long as the user is aware that the readings may be as much as 3.5 volts high. A clamp-on ammeter can also be a valuable asset.

If the power supply location is not metered by the power company and you need to estimate its operating cost, an accurate measurement of the current going into the input side of the ferro under normal load can be the basis of what the power company would charge for the electricity used at that location. Make sure that the clamp-on ammeter attaches to only one conductor at a time in order to make a measurement.

The use of gloves is most important when handling ferroresonant power supplies due to their elevated operating temperature. The most dangerous voltage encountered in the ferroresonant power supply is across the AC capacitor and can be lethal. When dealing with terminal screws in barrier strips the most important thing to remember is to make sure that they are tight, since any looseness may cause arcing and ultimately a burned terminal.

The standby supply

The second type of power supply used in cable systems is the standby power supply. This may be a stand-alone unit or an integral part of the ferroresonant supply; each presents a unique set of problems.

A standby power supply is designed to take over if the utility power is no longer available due to an outage. It derives its power from a bank of batteries and delivers the required 30 or 60 VAC in order for the cable system to stay on. Typically the standby or "inverter" is comprised of several different sections. The section that is the source of most controversy is of course the battery charger.

It is estimated that more than 80 percent of standby failures can be traced to the batteries. Battery voltage is not constant over time, nor is battery capacity constant over rated discharge range. It is noteworthy that for each 10°C increase in temperature, the maximum storage time of a battery is cut in half.

The proper setting of a battery charge may have the most affect on the life of the batteries. Also, whether the power supply system is designed to use two batteries in series vs. three batteries in series is also a consideration. The fact is, a lead acid battery is at full charge at 12.65 V. What the effect is of charging the battery to a higher voltage has not been fully established. The so-called surface charge does not add any capacity to the battery discharge time because it bleeds off during the first few seconds of standby operation.

Since the batteries are an integral part of the battery charger we will consider them as interacting with each other. When troubleshooting this area we are trying to determine several things. First, we wish to know if the charger is putting out current into the batteries. Second, we wish to know if the batteries are able to retain a charge.

Our first inclination is to measure the voltage across the battery charger output, then to measure the voltage across each individual battery. These measurements are inconclusive and often inaccurate. If no other test is available the ideal would be to test the "open circuit voltage" of a battery. This is done by fully charging the battery and then disconnecting the battery from its charger and allowing it to rest for a period of time (several hours) and then checking it with a *very* accurate digital voltmeter. If the battery measures between 12.65 and 12.70 V it is holding a full charge and the battery is excellent. If the open circuit voltage has dropped as low as 11.89 V, it is completely discharged and is in need of recharging. If the battery reading is lower than 9.6 V, it is doubtful that it can be recharged.

In the real world an open circuit test is impractical at best so the alternative is to use a battery load tester so that testing can be conducted while the batteries are in circuit and being charged. In this way the technician is able to ascertain which standby battery is at fault without disconnecting them from service. By attaching a voltmeter to the load tester the voltage of each battery can be logged and tracked so you'll know when to replace a failing battery before it has gone completely bad.

It is wise to set up a maintenance schedule for checking power supply performance in the field at least three times a year. As the trend to go back to flooded types of batteries increases, due to the problems with recombination types, make sure to check the fluid level particularly if the charging voltage of the standby is set excessively high. Charging a battery at too high a voltage will of course cause the fluid to boil away at an accelerated rate and often cause buckling of the plates—thus shortening the life of the battery.

There are special problems with power supplies using three batteries in series. These 36 V input inverters occasionally have the batteries go out of balance after a period of time. The battery most affected is the middle one. Some systems report that they rotate the batteries on a regular basis while others report they remove all the batteries on a regular basis and replace them with a matched set. A matched set can only be implemented by fully charging them and matching them based on their open circuit voltage as previously described. A 24 V system using two batteries in series seems to have fewer of these problems, particularly if the charge voltage is correct.

When troubleshooting the output voltage of the battery charger section of a standby power supply it is best to make two checks. The first test is made with a digital voltmeter prior to load testing the batteries. Note that your reading is 38 to 39 volts for a three-battery system and 25.5 to 26.5 volts for a two-battery one. Some power supplies have an equalize voltage and you should be familiar with the procedure that is given by the manufacturer for checking it properly. After the load test the charge voltage may be measured again. The voltage will have dropped slightly but by observing the meter for several minutes you will become aware that the voltage is increasing, which is an indication that the charger is in fact delivering current to the batteries.

As an alternative to using a load tester to check the batteries the inverter may be

"It is wise to set up a maintenance schedule for checking power supply performance in the field at least three times a year."

kicked in by disconnecting the power supply from the utility. Of course you are running the risk of shutting down the system if the inverter does not come on. If this is your only alternative for load testing the batteries, leave the inverter on for several minutes and make sure to use the same length of time for each test so your results will be consistent.

A word of caution

When working around batteries *always* wear a face shield to protect against the possibility of a battery exploding. Explosions apparently occur when the battery has been over charging, causing it to gas. This gas can accumulate around the vent holes of the battery and if a spark occurs the top of the battery may blow off, splashing sulfuric acid everywhere. One precaution to take is to fan the battery to ventilate it, then wipe the top of the battery with a rag prior to carrying out any tests.

There have been reports of gel cells being dropped from poles and having their contents splashed onto bystanders. The gel is highly concentrated acid and when it gets onto the skin, it is very difficult to remove and severe burns can result.

If a battery is to be disconnected from the power supply it is best to remove the jumper wire connecting the batteries together and taping the loose end of the jumper so it does not short onto anything. If the batteries must be disconnected from the power supply terminal strip, always disconnect the negative (black) wire first and tape the end. When reconnecting, make sure the negative goes on last.

Many power supplies were designed to be field-serviceable by the use of plug-in modules. Implementing this depends a great deal on one's competence. Many of the problems that occur in power supplies are interrelated to such an extent that replacing a module in the field may in some cases compound the problem or cause a replacement to fail. Another problem, which can be easily avoided, is having both good and bad modules mixed together due to the fact that they were not properly tagged when they were previously changed out.

There are some obvious things that it may be expedient to do in the field, such as the resetting of circuit breakers or the replacement of fuses. Some power supplies have incandescent indicator lamps on their front panel. If one of the lamps has failed, the technician will get a false indication that there is something more serious with the power supply. If a lamp does not illuminate, it is worth the time to replace the bulb prior to proceeding with any further tests.

Oxidation and corrosion increasingly become a problem as the power supply ages. This is caused by the corrosive action of the batteries, the emissions from automobiles and salt air near the shoreline. The things that are most affected are fuse holders, edge connectors of printed circuit boards and crimp-on connectors. Special attention must be paid to clean these surfaces with a good electrical cleaner.

Sometimes scraping has to be resorted to in order to clean a corroded surface. When dealing with printed circuit card edge connectors, buffing the surface with a soft eraser improves the contact surface. Often the action of unplugging and replugging a board will clean it to the point that it will function properly. If the power supply is in a particularly corrosive area it may be wise to solder the crimp-on connectors so that moisture does not get into the junction.

Contactors and relays are problem areas, particularly those used to switch the DC current coming from the batteries. Over time the contacts will erode due to the arcing that takes place when they function. Contact resistance is such a particularly difficult measurement to make, you may wish to deal with these devices by visually inspecting them; the bad contacts will look burned.

Know your power supply

Since each manufacturer has unique features in their products it is beyond the scope of this article to describe them. I strongly urge that you *read* the instructional manual and, most of all, understand what you have read. Sometimes it is helpful to read and discuss the contents of these manuals with another person in your group. Also, two people studying together can liven up the subject matter, making it more comprehensive and interesting.

If you find some section or function of your power supplies that continue to give problems, contact the manufacturer; a design change may have been made that affects the units in your system. ■

Safe work practices in CATV

Management and employees need to be reminded that an effective safety program is not only an integral part of the management of a cable system but ultimately can have a positive impact on the business's bottom line. This article will address the issue of safety, describing a specific safety training process and the importance of compliance with OSHA regulations.

By Leo Garcia

The Occupational Safety and Health Act of 1970 requires employers to provide for a safe and healthful work environment. The Code of Federal Regulations (CFR) 1910.268 specifically addresses the training, equipment inspection and safe work practices that employers in the telecommunications industry must provide.

In addition to being mandated by law, safety measures also play an important role in employee morale. Morale often will suffer when an employee is hurt on the job. Fellow employees may worry about the financial impact the accident will have on the injured employee, the overtime they must work to cover the workload of the injured employee, or they may place blame for the accident on the company or the supervisor. Institution of appropriate safety measures can serve to mitigate these problems by reducing the number, frequency and severity of accidents.

Lastly, cable television employees have a great deal of community contact, e.g., direct customer contact, driving high visibility vehicles, community programming, etc. The manner in which they conduct their business determines how they are perceived by the community. If employees are perceived to be efficient and safety conscious, the resultant positive perception by the community may increase subscriber base and/or may help in recruiting employees who value positive customer relations.

Accidents: cost, causes, frequency

When managers look at the direct costs of an accident (such as the medical bills), they are looking at the tip of an iceberg. The indirect costs of accidents are considerably greater than the direct costs. Indirect accident costs include increased overtime, damaged or lost equipment, lost productivity, retraining and accident investigation. Indirect costs of accidents are often four to 10 times higher than the direct cost.

Two of the most common types of accidents in the cable industry involve pole climbing and ladder handling. These accidents do not just happen—they are caused by either unsafe acts or unsafe conditions. Some examples of unsafe acts include: lack of systematic employee training, horseplay, failing to inspect tools and equipment, improper lifting techniques, improper body mechanics, failing to use personal protective equipment, etc. Unsafe conditions arise from defective equipment such as dull and misshaped gaffs; ladders with cracked rails, broken rungs or other defects; clearance violations between power company plant and cable plant; improper clothing; adverse weather; physical fatigue to name a few.

Pole climbing and ladder handling accidents rank second and third respectively in accident frequency; only vehicle accidents occur more often. Pole climbing accidents include falls, gaff puncture wounds and splinters. Most pole climbing accidents (50.4 percent in a random 12-month sample) occur to employees with less than six months experience and could be eliminated with systematic training in pole climbing techniques, equipment inspection and maintenance, and appropriate clothing while climbing.

Some of the more common accidents include ladder slippage (42 percent), carrying material (10 percent), ladder handling (8 percent), and ladder breakage (6 percent). These accidents can be eliminated or greatly reduced by educating employees in proper ladder handling and ladder inspection methods.

Dealing with the problem

The first step in a six-step process for dealing with accidents is to *identify the targets*, for example, pole climbing and ladder handling through analysis of accident reports. The next step is to *identify the components* of the job. List them in proper sequence; examine the job components to determine how to reduce accident possibilities. Employees are an excellent source of information in this step. *Writing corrective procedures* and reviewing them with knowledgeable employees follows in the process of accident reduction. Corrective procedures may reiterate safe practices from present methods as well as present new techniques. These procedures should be reviewed by personnel experienced in that job function.

After the review process, the next step is *implementation of new procedures* which includes training, periodic retraining, certification and documentation. This step is easily accomplished if employees are allowed to participate in steps two and three. *Monitoring* and *evaluating* the effect of the new procedures are the last steps in the process. They should not, however, be considered final steps since periodic monitoring and re-evaluation are necessary in an effective safety program.

Examples of corrective procedures for targeted accident sources could include:

Ladder slippage

- All ladders will be equipped with non-slip feet.
- All ladder feet will be equipped with ice pick plates.
- Bottom rung of ladder will be tied to pole as necessary.
- Employees will use safety strap to secure themselves and ladder to cable strand.

Carrying material

- Employees will use both hands on ladder while climbing.
- Employees will use handline and bucket to raise tools, materials and equipment.

Handling ladder

- Employees will lift ladder by using leg

(Continued on page 42)

Installer's Tech Book

Converting dBmV to µV/m

By Ron Hranac
Senior Staff Engineer, Jones Intercable Inc.

Channel 27 or N (241.2625 MHz)

dBmV	µV/m	dBmV	µV/m	dBmV	µV/m	dBmV	µV/m
−60	5.07	−36	80.30	−10	1602.17	16	31967.53
−59	5.68	−35	90.10	− 9	1797.67	17	35868.16
−58	6.38	−34	101.09	− 8	2017.01	18	40244.74
−57	7.16	−33	113.43	− 7	2263.13	19	45155.34
−56	8.03	−32	127.27	− 6	2539.27	20	50665.13
−55	9.01	−31	142.79	− 5	2849.11	21	56847.21
−54	10.11	−30	160.22	− 4	3196.75	22	63783.61
−53	11.34	−29	179.77	− 3	3586.82	23	71566.39
−52	12.73	−28	201.70	− 2	4024.47	24	80298.81
−51	14.28	−27	226.31	− 1	4515.53	25	90096.75
−50.57	**15**	−26	253.93	0	5066.51	26	101090.21
−50	16.02	−25	284.91	1	5684.72	27	113425.09
−49	17.98	−24	319.68	2	6378.36	28	127265.04
−48	20.17	−23	358.68	3	7156.64	29	142793.72
−47	22.63	−22	402.45	4	8029.88	30	160217.19
−46	25.39	−21	451.55	5	9009.67	31	179766.65
−45	28.49	−20	506.65	6	10109.02	32	201701.50
−44	31.97	−19	568.47	7	11342.51	33	226312.80
−43	35.87	−18	637.84	8	12726.50	34	253927.14
−42	40.24	−17	715.66	9	14279.37	35	284910.94
−41	45.16	−16	802.99	10	16021.72	36	319675.33
−40.11	**50**	−15	900.97	11	17976.66	37	358681.62
−40	50.17	−14	1010.90	12	20170.15	38	402447.39
−39	56.85	−13	1134.25	13	22631.28	39	451553.40
−38	63.78	−12	1272.65	14	25392.71	40	506651.25
−37	71.57	−11	1427.94	15	28491.09		

Channel 28 or O (247.2625 MHz)

dBmV	µV/m	dBmV	µV/m	dBmV	µV/m	dBmV	µV/m
−60	5.19	−36	82.30	−10	1642.02	16	32762.54
−59	5.83	−35	92.34	− 9	1842.37	17	36760.17
−58	6.54	−34	103.60	− 8	2067.18	18	41245.59
−57	7.33	−33	116.25	− 7	2319.41	19	46278.32
−56	8.23	−32	130.43	− 6	2602.42	20	51925.13
−55	9.23	−31	146.34	− 5	2919.96	21	58260.95
−54	10.36	−30	164.20	− 4	3276.25	22	65369.86
−53	11.62	−29	184.24	− 3	3676.02	23	73346.19
−52	13.04	−28	206.72	− 2	4124.56	24	82295.78
−51	14.63	−27	231.94	− 1	4627.83	25	92337.38
−50.79	**15**	−26	260.24	0	5192.51	26	103604.25
−50	16.42	−25	292.00	1	5826.09	27	116245.88
−49	18.42	−24	327.63	2	6536.99	28	130430.02
−48	20.67	−23	367.60	3	7334.62	29	146344.89
−47	23.19	−22	412.46	4	8229.58	30	164201.66
−46	26.02	−21	462.78	5	9233.74	31	184237.30
−45	29.20	−20	519.25	6	10360.42	32	206717.65
−44	32.76	−19	582.61	7	11624.59	33	231941.01
−43	36.76	−18	653.70	8	13043.00	34	260242.10
−42	41.25	−17	733.46	9	14634.49	35	291996.44
−41	46.28	−16	822.96	10	16420.17	36	327625.39
−40.33	**50**	−15	923.37	11	18423.73	37	367601.73
−40	51.93	−14	1036.04	12	20671.76	38	412455.93
−39	58.26	−13	1162.46	13	23194.10	39	462783.16
−38	65.37	−12	1304.30	14	26024.21	40	519251.25
−37	73.35	−11	1463.45	15	29199.64		

Channel 29 or P (253.2625 MHz)

dBmV	µV/m	dBmV	µV/m	dBmV	µV/m	dBmV	µV/m
-60	5.32	-36	84.29	-10	1681.86	16	33557.55
-59	5.97	-35	94.58	-9	1887.08	17	37652.19
-58	6.70	-34	106.12	-8	2117.34	18	42246.45
-57	7.51	-33	119.07	-7	2375.69	19	47401.29
-56	8.43	-32	133.59	-6	2665.57	20	53185.13
-55	9.46	-31	149.90	-5	2990.82	21	59674.69
-54	10.61	-30	168.19	-4	3355.75	22	66956.11
-53	11.91	-29	188.71	-3	3765.22	23	75125.99
-52	13.36	-28	211.73	-2	4224.64	24	84292.74
-51	14.99	-27	237.57	-1	4740.13	25	94578.01
-50.99	**15**	-26	266.56	0	5318.51	26	106118.28
-50	16.82	-25	299.08	1	5967.47	27	119066.66
-49	18.87	-24	335.58	2	6695.61	28	133594.99
-48	21.17	-23	376.52	3	7512.60	29	149896.05
-47	23.76	-22	422.46	4	8429.27	30	168186.13
-46	26.66	-21	474.01	5	9457.80	31	188707.94
-45	29.91	-20	531.85	6	10611.83	32	211733.80
-44	33.56	-19	596.75	7	11906.67	33	237569.23
-43	37.65	-18	669.56	8	13359.50	34	266557.06
-42	42.25	-17	751.26	9	14989.60	35	299081.94
-41	47.40	-16	842.93	10	16818.61	36	335575.45
-40.54	**50**	-15	945.78	11	18870.79	37	376521.85
-40	53.19	-14	1061.18	12	21173.38	38	422464.46
-39	59.67	-13	1190.67	13	23756.92	39	474012.93
-38	66.96	-12	1335.95	14	26655.71	40	531851.25
-37	75.13	-11	1498.96	15	29908.19		

Channel 30 or Q (259.2625 MHz)

dBmV	µV/m	dBmV	µV/m	dBmV	µV/m	dBmV	µV/m
-60	5.44	-36	86.29	-10	1721.71	16	34352.55
-59	6.11	-35	96.82	-9	1931.79	17	38544.20
-58	6.85	-34	108.63	-8	2167.50	18	43247.30
-57	7.69	-33	121.89	-7	2431.97	19	48524.27
-56	8.63	-32	136.76	-6	2728.72	20	54445.13
-55	9.68	-31	153.45	-5	3061.67	21	61088.43
-54	10.86	-30	172.17	-4	3435.26	22	68542.35
-53	12.19	-29	193.18	-3	3854.42	23	76905.78
-52	13.68	-28	216.75	-2	4324.73	24	86289.71
-51.20	**15**	-27	243.20	-1	4852.43	25	96818.64
-51	15.34	-26	272.87	0	5444.51	26	108632.31
-50	17.22	-25	306.17	1	6108.84	27	121887.45
-49	19.32	-24	343.53	2	6854.24	28	136759.97
-48	21.67	-23	385.44	3	7690.58	29	153447.21
-47	24.32	-22	432.47	4	8628.97	30	172170.60
-46	27.29	-21	485.24	5	9681.86	31	193178.59
-45	30.62	-20	544.45	6	10863.23	32	216749.95
-44	34.35	-19	610.88	7	12188.75	33	243197.44
-43	38.54	-18	685.42	8	13676.00	34	272872.02
-42	43.25	-17	796.06	9	15344.72	35	306167.44
-41	48.52	-16	862.90	10	17217.06	36	343525.51
-40.74	**50**	-15	968.19	11	19317.86	37	385441.97
-40	54.45	-14	1086.32	12	21674.99	38	432473.00
-39	61.09	-13	1218.87	13	24319.74	39	485242.69
-38	68.54	-12	1367.60	14	27287.20	40	544451.25
-37	76.91	-11	1534.47	15	30616.74		

(For the formula used to derive the conversion data in these charts, see May 1989's "Installer's Tech Book.")

Classifieds /Directory

Help Wanted

Palmer CableVision

Maintenance/Sweep Technician
Lead Converter Control Clerk

Fast growing Palm Springs area Cable Company has full time openings. Challenging position, advancements, and good benefits. Must have a valid drivers license and good driving record.

Send resume to or call:

Palmer CableVision
Personnel
41-725 Cook Street
Palm Desert, CA 92260
(619) 340-1312

Service Technicians

Friendship Cable, a subsidiary of Buford Television, Inc. has openings for Service Technicians in Texas, Arkansas, Georgia, North and South Carolina, Missouri and Florida. Applicants must have previous cable television experience, a valid driver's license, and a good driving record. Company will assist with relocation costs if necessary.

We offer a competitive salary and a generous benefits package. Please send resume or call for an application to:

Buford Television, Inc.
P.O. Box 9090
Tyler, Texas 75711
214-561-4411
EOE/M/F

WANTED:

INSTRUCTOR's *for Cable Installer & CSR training*
• CLI TECH's *for monitoring signal leakage*
(must be willing to travel)

Minimum Requirements:

3 yrs. cable exp. • valid driver's license • good driving record

Send resume or call Leslie Grauer at: **1-800-627-4123**
1003 K St., NW, Suite 825, Washington, D.C. 20001

ORION BUSINESS SERVICES, INC.

MAINTENANCE TECHNICIAN

Needed for large central New Jersey cable system. Experienced for 450 MHz S-A system. Applicant must have 3-5 years experience in a CATV technical position. A thorough knowledge of system sweep, signal leakage. Preventive maintenance and outage control is a must. We offer an excellent compensation and benefit package.

Please send resume to:

TKR Cable Company
268 Cliffwood Avenue
Cliffwood, New Jersey 07721

Attention: James Capone
EOE

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TECH MANAGEMENT	TECHNICIANS	TECHNICIANS
DIR TCH OPS, NE, 60K	HDEND/MICRO, NE, 35K	LN TCH, E, 12/HR
ENGR MGR, W, 70K	HDEND/MICRO, W, 30K	LN TCH, SE, 10/HR
CH ENG, NE, 45K	HDEND/MICRO, MW, 30K	AREA TCH, N, 10/HR
CH ENG, SW, 45K	MGR/TCH, MW, 27K	LN TCH, W, 13/HR
PL MGR, ATL, 40K	MGR/TCH, ATLC, 28K	LN TCH, SW, 10/HR
TCH MGR, SE, 35K	LD TCH, N, 12/HR	LN TCH, MW, 25K
CONST MGR, E, 40K	SW TCH, S, 26K	CLI TCH, SE, 10/HR
CH TCH, NE, 30K	SW TCH, E, 13/HR	SERV TCH, MW, 9/HR
CH TCH, S, 30K	LD TCH, MW, 25K	SERV TCH, W, 8/HR
PL MGR, E, 30K	SW TCH, SE, 11/HR	SERV TCH, SE, 8/HR

JIM YOUNG & ASSOCIATES
One Young Plaza 1235 Ranger Highway Weatherford, TX 76086
Call for information about these and many other opportunities nationwide.

SERVICE TECHNICIAN II

Warner Cable Communications, Inc. has openings for service technicians in the Cincinnati system. We seek experienced individuals with electronics background. We offer a comprehensive benefit package. Send resume to: **Warner Cable Communications, Inc.**, 11252 Cornell Park Drive, Cincinnati, Ohio 45252.

Equal Opportunity Employer M/F

Summit Cable Contractors, Inc.
a national contractor needs experienced linemen, splicers and technicians in addition to fully equipped residential and MDU subcontractors.
817-277-6995
EOE

ATREX INC.

A national installation contracting company has standing need for experienced installers. Call 1-800-874-4505 for details and locations!

Maintenance Technicians

Immediate opening for maintenance sweep technicians. Must have headend and sweep experience, BCT/E Certification a plus. Competitive wages. Send resume to:

TeleScripps Cable Company
614 N. Central
Knoxville, TN 37917
Attention: Personnel
EOE

Installer/Technician

Permanent, full-time positions in Northwest Ohio and Northeastern Indiana for Installer/Technicians with a minimum of 2 years experience in routine plant operation. Duties include installation, troubleshooting, plant maintenance, signal leakage monitoring and repair.

Qualified applicants will be self-motivated, customer-service oriented, willing to work as a team and open to advancement. Self-improvement is encouraged through participation in NCTI courses as well as group training situations. We offer a competitive compensation package.

Individuals interested in joining our team should send resume to:

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Which course should I take?

By Tom Brooksher
Marketing Director, National Cable Television Institute

So you've decided it's time to learn a little bit more about your chosen profession. You've decided you would like some formal training to go along with what you've learned on the job, or through your system's training program. And, after looking around a little, you've decided the way to go is an NCTI self-study course.

First of all, you're in good company. You're making the same decision that over 30,000 of your cable colleagues have made over the last 21 years. Second, while you've made one important decision, a second one must now be made: "Which course should I take?"

That and its companion question "I've got an employee I want to enroll in one of your courses. Which one should I put him in?" are questions we field on a daily basis. Sometimes the answer is pretty straightforward, sometimes not. But to begin to answer the question requires an understanding of two things—NCTI's career path concept and the content of our courses.

NCTI's five basic courses are indeed built to form a career path. They are designed in such a way that if you progress through them in sequence you will learn virtually all aspects of the technical operation of a cable system, from the customer's TV set to the headend. The courses are cable television specific. They were developed by cable television veterans for the cable television industry. They stress cable applications first, but also teach electricity and electronic theory when they are relevant to cable application. In addition, the courses teach you the non-electronic or non-technical aspects of the business as they relate to technical personnel, including safety, first aid, customer relations, supervision, etc.

Building blocks

The five basic career path courses also are designed on a building block concept. Each lesson assumes you have a thorough understanding of the material presented in the previous lesson. And each course assumes you have mastered the information in the previous course. For example, the Installer Technician course presents the concept of decibels in two lessons. From that point on, the material in the Service Technician, System Technician and Advanced Technician courses assume that the student has mastered the concept of decibels. If students don't understand decibels, they will have a very difficult time with these courses. This building of one concept on the previous reinforces the need to take the courses in sequence, from beginning to end.

"NCTI's five basic courses...are designed in such a way that if you progress through them in sequence you will learn virtually all aspects of the technical operation of a cable system."

If you have had extensive electronic training in other courses, you may have the background to skip a course. We see this most often with people who have had a great deal of military electronic training, or who have graduated from an electronics program at a vocational school, junior college or four-year college.

In evaluating which course to enroll in, probably the best advice we can give you is to ignore the name of the course and look instead at the content of the course. Our career path courses closely mirror the various areas of a typical cable system. The Installer and Installer Technician courses cover the drop portion of the system. The Service Technician course covers the components and operations of the feeder. The System Technician course covers the trunk system. And the Advanced Technician course covers the headend. Because the courses parallel the system, we've named the courses to represent the employee most likely to be responsible for working on that area of the system.

However, the content is most important. For example, in the Installer course, in addition to installation procedures, you'll learn safety, first aid and customer relations practices applicable in all areas of the system. In the Installer Technician course, in addition to learning installation troubleshooting and MDU installation procedures, you'll learn Ohm's law, series and parallel circuits, decibels, signal leakage detection, etc. Our experience has shown that even seasoned cable veterans who decide to take NCTI courses well into their careers find the first career path courses valuable.

So, if the content is so important, just what's in each course? Following is a listing of each lesson in each career path course:

Installer—Introduction to CATV, Signal Sources, Signal Processing I, Signal Processing II, Signal Distribution, Subscriber Services, General Tools I, General Tools II, Safety, Emergency First Aid, Pole Climbing, Customer Relations I, Installation Preparation, Aerial Installation, Underground Installation, Interior Installation, Converters and Decoders, Tuning TV Sets, Signal Level Testing, Work Records, TV System Fundamentals, TV Picture Analysis.

Installer Technician—Understanding Electricity, Electrons and Electricity, Electricity: Production and Effects I, Electricity: Production and Effects II, Magnetism and Electromagnetism, Mathematics Refresher I, Mathematics Refresher II, Mathematics Refresher III, Electrical Circuits, Resistance and Resistors, Ohm's Law and Power, Series Circuits, Parallel Circuits, Series-Parallel Circuits, Introduction to Decibels, Decibels in CATV, Planning Multiple Installations, Making Multiple Installations, Signal Level Meters, Signal Leakage Detectors I, Signal Leakage Detectors II, Signal Leakage Detection, Troubleshooting TV Problems, Troubleshooting Drop Cable.

Service Technician—Alternating Current, AC Characteristics, Inductance, Transformers, Capacitance and the Capacitor, Capacitors in AC Circuits, Vectors, RL Circuits, RC Circuits, Series LCR Circuits, Series Resonance, Parallel LCR Circuits, Parallel Resonance, Meter Movements, Meter Characteristics, Ammeters, Using Meters, Ohmmeters and Multimeters, Coaxial Cable, Types of Transmission Line, Passive Devices, Cable Powering.

System Technician—Electronic Signals, Amplitude Modulation, FM and Pulse Modulation, TV and FM Multiplexing, Navigation Signals, Heterodyning and Harmonics, Electronic Circuits I, Electronic Circuits II, Transmitters, Receivers, Concepts of Distribution, CATV Test Equipment I, CATV Test Equipment II, System Measurements, Semiconductor Theory, Diodes and Transistors, Transistor Circuit Design I, Transistor Circuit Design II, FETs and Integrated Circuits, Television Signal Analysis.

Advanced Technician—Rectifiers and Filters, Power Supplies, AF Amplifiers, Broadband Amplifiers, RF Amplifiers, IF Amplifiers, Amplifier Operation, Amplifier Application, LC and Crystal Oscillators, Other Oscillators/Modulators, Mixers and Demodulators, Detectors, Principles of Supervision, Supervisor/Employee Relations, AVC, AGC and Limiter Circuits, AFC and Computer Circuits, Transmitting Antennas, Antenna Characteristics, Receiving Antenna Design, Transmission Lines and Antennas, Radio Wave Propagation, Television Antennas, Interference Elimination, Antenna Installation, Preamplifiers and Filters, Heterodyne Converter, Demodulator-Modulator, Signal Combining, Headend Testing.

If you have sufficient previous training and elect to start with one of the career path courses other than the Installer course, it will include the first six lessons listed under the Installer course mentioned previously. These six lessons are required of all new NCTI career path students, regardless of which course they start in. These lessons ensure that all students, regardless of their backgrounds, have a basic understanding of the operation of the system and the background of cable television.

If the career path courses don't quite meet your needs, we also have three special topic courses to offer. In a recent column I told you about the newest of these, CATV Fiber Optics. As the name implies, it teaches you about fiber optics and its increasingly important application in cable television. Our CATV System Overview is an introduction to the cable plant and how signals are processed and distributed through it. This course is frequently taken by non-technical cable personnel who want an understanding of the technical side of the operation. Our Broadband RF Technician is designed for cable personnel who have had extensive formal training in electronics, but who may be new to cable television. It is a compilation of all of our cable application lessons from the five career path courses.

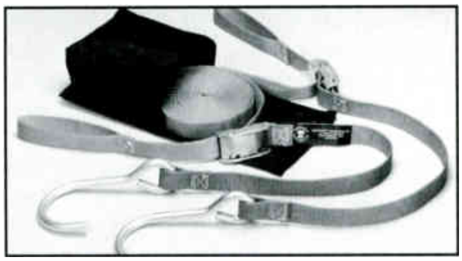
If you would like more help in answering the question "Which course should I take?" or would like a training kit with complete information on NCTI courses, just call Ray Charest or me at (303) 761-8554. Or you can write to us at NCTI, P.O. Box 27277, Denver, Colo. 80227. ■

Out of Focus

Deb Morrow

It's a sticky situation when spiders go condo and try to get cable. (Submitted by Deborah Morrow, Cable Prep.)

Products



Ladder securer

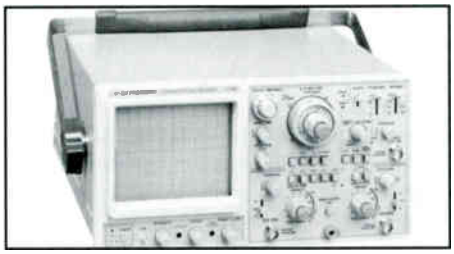
The ITC-6003 Safe-Tie ladder safety product from Independent Technologies is said to be faster and more convenient than rope or canvas straps and meets OSHA requirements. The product can be used to secure ladders to utility poles or other secure structures like conduits, beams, pipes, etc. Put-up and take-down takes just minutes, according to the company, and a carrying case is included with the product.

For more details, contact Independent Industries, 11414 W. Center Rd., Omaha, Neb. 68144, (402) 330-3045; or circle #130 on the reader service card.

CLI software

Trilithic introduced its CLICS cumulative leakage index computing software that allows multiple entry modes for μV/m, dBmV and dB referenced to 20 and 50 μV/m. Real-time, on-screen displays are updated with each entry for leaks per mile, CLI of infinity, CLI 3000, leak level and leak fix categories. A report generator provides Federal Communications Commission logs, repair worksheets and other summaries.

For more details, contact Trilithic, 3169 N. Shadeland Ave., Indianapolis, Ind. 46226, (317) 545-4196; or circle #132 on the reader service card.



Oscilloscope

B&K-Precision's Model 2190 100 MHz oscilloscope features triple input, six trace operation, allowing three different signals to be observed at two timebase settings. According to the company, this instrument triggers on signals well beyond its rated bandwidth, ensuring stable performance over the full rated bandwidth.

Other features include 1 mV per division vertical sensitivity, V-mode for viewing two signals unrelated in frequency, dual time base, alternate sweep function, 20 MHz bandwidth limiter and video-sync separators. The user can select from 23 calibrated sweep time ranges from 2 ns to 50 ns/division on the main time base and 20 calibrated ranges on the delayed-sweep time base. An X10 magnifier allows closer examination of waveforms while maintaining display calibration.

For further information, contact B&K-Precision, Maxtec International Corp., 6470 W. Cortland St., Chicago, Ill. 60635, (312) 889-1448; or circle #114 on the reader service card.

Lineman boots

Dayton Shoe Co. is offering its lineman boots manufactured with oil tan leather and hard oak tanned insoles and midsoles. They have a steel shank in the arch for added support and feature niche sewn-down laceable scuff pads.

The boots are available in D and EE widths and from 10 to 16 inches in height. They can be manufactured with Neocord or Vibram soles and with or without the safety steel toe.

For more information, contact Dayton Shoe Co., 866 E. Douglas Ave., Dept. IT, Bellingham, Wash. 98226, (604) 253-6671; or circle #136 on the reader service card.

Battery

Bat/Pak introduced its Model 12/30 hour sealed lead acid battery mounted in a custom flight case. According to the company, the battery can power equipment for days, weeks or months. Features include flush-mount meter and XLR connection. Dimensions are 6.75 inches wide, 9.5 inches deep and 9.5 inches high. It weighs 25 pounds.

For additional details, contact Bat/Pak, 7102 Grand Blvd., Houston, Texas 77054, (713) 747-6433; or circle #121 on the reader service card.

Catalog

Leader Instruments announced the release of its Catalog No. 21, which contains information and application instructions on its expanded line of test equipment including digital and analog oscilloscopes, audio and video products, signal generators, frequency counters and power supplies.

For more information, contact Leader Instruments, 380 Oser Ave., Hauppauge, N.Y. 11788, (516) 231-6900; or circle #125 on the reader service card. ■

Safety on the Job

(Continued from page 30)

muscles, not back muscles.

- Employees should not twist upper body while carrying ladder.

Ladder breakage

- Employees will inspect ladders prior to each use.
- Employees will report, in writing, all ladder defects.

Training material

Training materials can be generated within a company which addresses its specific needs by analyzing accident records.

General training materials can be borrowed from OSHA regional offices, equipment manufacturers and equipment distributors. OSHA will provide copies of their audio visual catalog at no cost along with films, videotapes, and slide programs encompassing a broad range of subjects.

Manufacturers and suppliers who provide high quality training aid, supplies and information include: W.M. Bashlin, Grove City, Pa.; Gilbert Engineering, Phoenix, Ariz.; General Cable Telsta Division, Westminster, Colo.; Lynn Ladder and Scaffolding, Lynn, Mass.; and Sachs Communications, Chaplain, N.Y. Many manufacturers and suppliers will provide safety training information or will assist in finding the information. The Society of Cable Television Engineers and the National Safety Council are also excellent sources.

Increased productivity

If management expects employees to perform their jobs safely, they must work together to design and implement effective safety training programs. Safety training will not only reduce accidents, but also increase productivity, improve community image, and assure compliance with OSHA requirements.

Use of the six step accident reduction method will assist cable companies in implementing an effective program, one that employees will adhere to because they participated in the creation process. ■

Authors note: Statistics and percentages used in this article were generated from cable TV industry loss source analyses or were obtained from insurance industry compilation.

Reprinted from "Communications Technology," December 1985. At the time of this writing, Leo Garcia was the Corporate Safety Officer at American Television & Communications Corp.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NEW PRODUCTS
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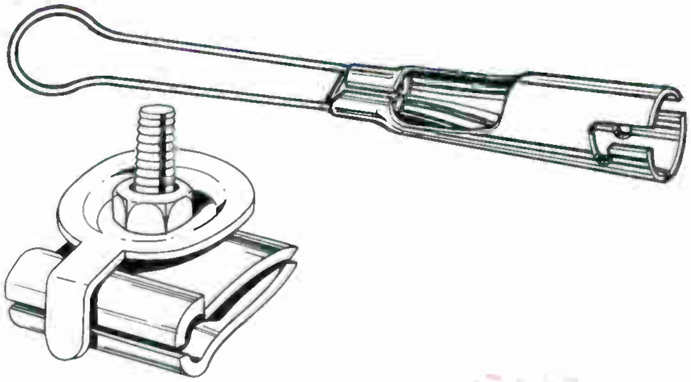
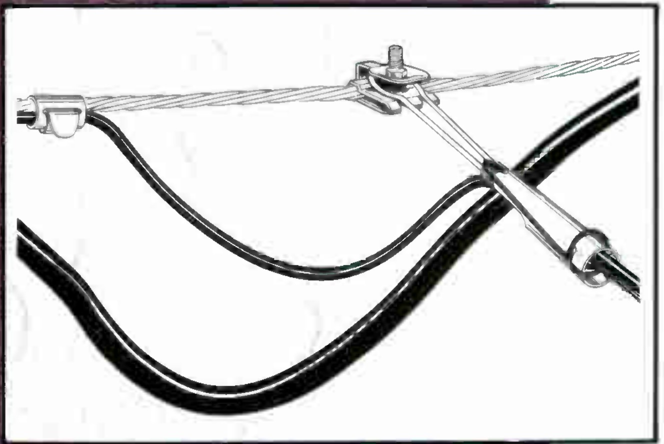
The stage is set. See CaLan at the Western Show, Booth 608

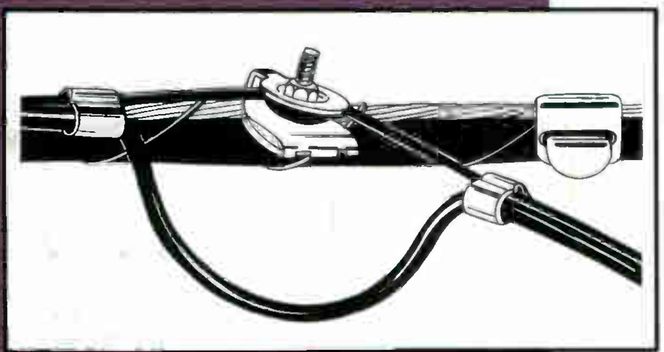
PROBLEM

SOLUTION

Eliminate
radiation
C.L.I.







1. PROBLEM the old industry practice of wrapping steel messenger wire around the drop cable is time consuming and non-consistant. It increases sheath breakdown caused by drop movement resulting in ingress/egress within 6 months.
SOLUTION the SC02M supports the cable freely and secures the messenger wire. This method allows a gradual drip loop, which prevents sheath breakdown caused by drop movement, climinating cable distortion and ingress/egress. The SC02M offers a quick and uniform installation.

2. PROBLEM the old industry practice of using a knife or a side cutter to separate the messenger wire from the drop cable at mid-span, in most cases will result in damaging the drop cable, causing cable distortion and ingress/egress. This method is time consuming and non-consistant.
SOLUTION the SC03E clamp has a unique retainer tab to separate the messenger wire from the drop cable, without the use of a knife or a side cutter, eliminating any chances of damaging the cable. This method offers easy installation and time savings.

3. PROBLEM the old industry practice of using plastic tie wraps to secure cable tightly along the strand and/or to prevent cable separation from the messenger, in most cases results in depressing or kinking the drop cable, damaging the sheath and generating ingress/egress.
SOLUTION the SC10 will prevent cable separation from the messenger wire without crushing the cable and it can be installed without a tool. The SC052 strap allows to bundle multiple drops without causing any damage to the cable, eliminating potential cable distortion and ingress/egress. Both products offer easy installation and time savings.

The time savings using the Sachs methods allows the installer/technician to be less pressured and more attentive in producing a quality drop installation.

See us at the Western Show, Booth 1428.
Reader Service Number 25.

SACHS®

Sachs Communications Inc.
1885 West Dartmouth
Unit 1
Englewood, Colorado 80110
Tel: 303-761-8339
Fax: 303-761-4482

Sachs Canada Inc.
745 Avoca Avenue
Dorval, Quebec
H9P 1G4
Tel: 514-636-6560
Fax: 514-636-0794

Sachs Communications Inc.
30 West Service Road
Champlain, New York 12919-9703
Tel: 1-800-361-3685
Fax: 514-636-0794