

June 1989

Learning the system

IT INSTALLER TECHNICIAN

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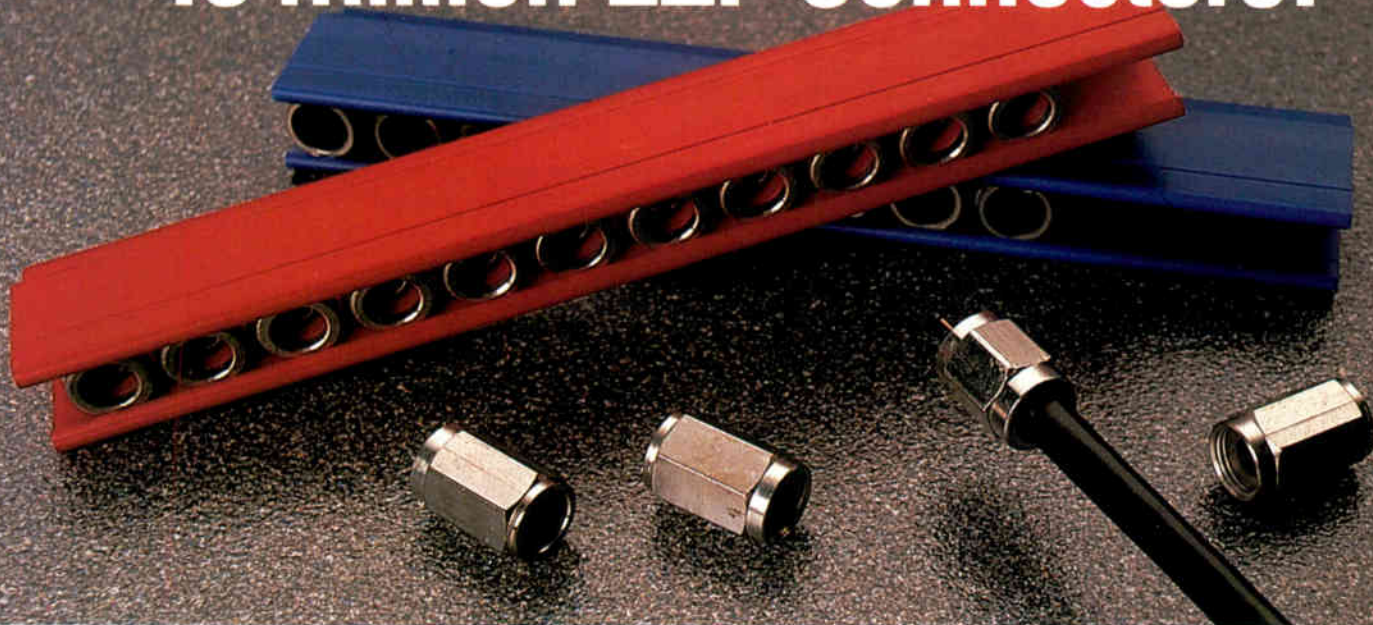


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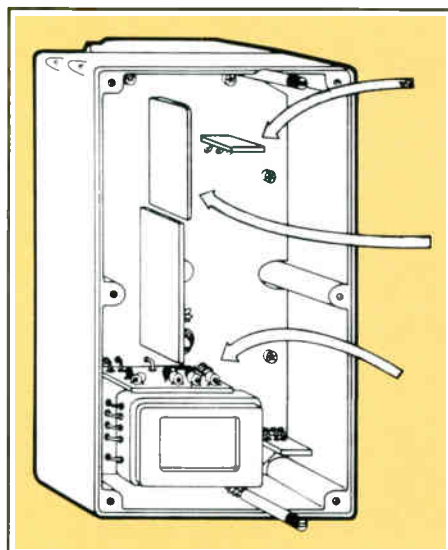
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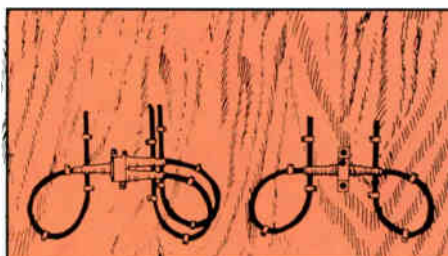
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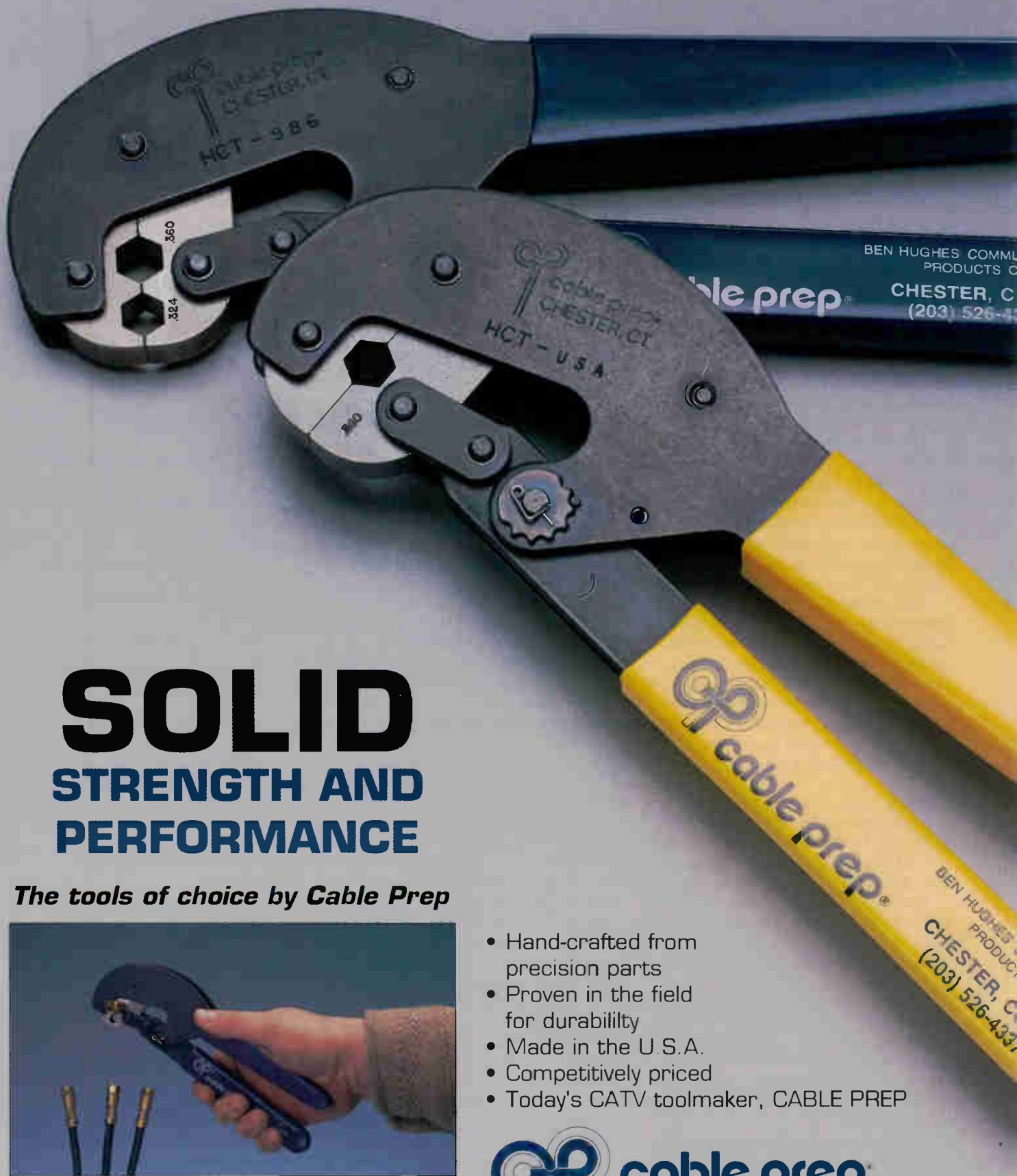
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Reader Service Number 3.

From the Editor

That's the way it goes

Remember that song, I think it was called "Dem Bones"? You probably learned it as a small child. It was the one that taught you "the head bone's connected to the neck bone, the neck bone's connected to the shoulder bone," and so on. It finished, "and that's the way it goes." Remember?

Of course as you grew older you learned that there really wasn't such a thing as a "head bone" and that the human body was a little more complex than that. You learned that there were many more bones in the body than in the song, and these bones supported muscles and organs that made the whole body function.

As an installer or technician, you may have some rudimentary idea as to how a cable system works. The headend's connected to the trunk line system, the trunk line system's connected to the feeder line system, and the feeder line system's connected to the drop line system, and that's the way it goes. Right? But, of course, like the human body, it is a bit more complex than that.

I'm sure you know the drop line system very well as you work with that portion every day. This month we want to give you an idea of what each part of the cable system does and how it all ties in together. "Overview of the cable system" (page 14) will lead you through the 10 basic functions of the distribution system from reception of the signal all the way to billing of the subscriber.

As in the human body, a CATV system needs sources of energy to keep it going. Tim Mooney's article (page 24) explains the various components that provide power to the system, a crucial function. After all, what good is all the equipment with no juice?

Although you may not work with all the parts of the cable system, a good overall knowledge of it doesn't hurt. As Jack Crites says in his article (page 52), "If one factor could be pinpointed that would ensure advancement of your career in cable, it would be education." And that's the way it goes.



Wendell Woody, Anixter Cable TV

Showdown

As you may have heard (if you weren't able to witness it firsthand), the National Show in Dallas last month was a great success. Professionals from all segments of our industry met to share ideas and introduce new technologies that were of great interest to cable. They also managed to have a little fun on the side. Anixter Cable TV graciously offered to let me ride a real live bull, complete with horns, at one of the after hours parties and rodeo. No bull! Hopefully, Anixter made out better than I did. But I do owe them a great amount of gratitude.

Now, this month we have the SCTE's Cable-Tec Expo in Orlando to attend. Unlike the National Show, this one will be dedicated entirely to the technical aspects of cable. The agenda is chock full of sessions and workshops to attend when you're not cruising the floor to examine all the new equipment and services. (See "News" on page 8.)

The workshops will cover such topics as fiber-optic test measurements, signal level meter basics, data transmission techniques, supervisory and management fundamentals, and signal leakage, CLI and the FCC. Other subjects include remote automated system testing, basic spectrum analyzer theory and operation, local origination equipment and its use, AM fiber-optic transmission, installing fiber-optic cable and installer certification.

Although the Expo Evening will be held at Sea World, be assured that no one here will be riding Shamu the Killer Whale (that I know of). Hope to see you there!

Toni I. Barnett

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SCTE announces Expo '89 agenda

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

Wednesday, June 14 (Stouffer Orlando Resort)

5-8 p.m.—Interface Practices Committee meeting

5-8 p.m.—Conference registration (Crystal Ballroom Foyer)

6-8 p.m.—Hospitality by Wavetek (Wedgewood Room)

Thursday, June 15 (Annual Engineering Conference, Stouffer Orlando Resort)

7:30-8:30 a.m.—Registration

8:30-9 a.m.—Opening remarks by William Riker (SCTE)

9-10:30 a.m.—Session A: "High definition television," with Walt Ciciora, American Television and Communications Corp. (discussion leader); Wayne Luplow, Zenith Electronics; and Norman Hurst, David Sarnoff Research Center

10:45 a.m.-noon—Session B: "Digital

video: A future alternative," with Steffen Rasmussen, ABL Engineering

Noon-2 p.m.—Membership luncheon with awards and keynote speaker Paul Weitz, Johnson Space Center (Atrium)

2-3:15 p.m.—Session C: "Cable vs. the Telcos," with Gary Kim, Focus Communications (discussion leader); Steve Wilkerson, Florida Cable Television Association; Gary Moore, Southern Energy Consultants Ltd.; and Mark Balmes, BellSouth

3-5 p.m.—Expo registration

3:30-5 p.m.—Session D: "Fiber-optic technology," with Scott Esty, Corning Glass; and Jim Chiddix, ATC

5-7 p.m.—CLI Committee meeting

6-8:30 p.m.—Welcome reception sponsored by Anixter, AT&T, Raychem, SCTE Florida Chapter and the Florida Cable Television Association

8-11:30 p.m.—Jerold Night at Church Street Station

Friday, June 16 (Cable-Tec Expo, Orange County Convention Center)

8 a.m.-1 p.m.—Expo registration (Civic Center South Lobby)

8-9:15 a.m.—Workshop Period A

9:30-10:45 a.m.—Workshop Period B

11 a.m.-12:15 p.m.—Workshop Period C

Noon-5 p.m.—Exhibit hall open (Hall D)

Noon-2:30 p.m.—Lunch in exhibit hall

6-10 p.m.—Expo Evening at Sea World

Saturday, June 17

8 a.m.-1 p.m.—Expo registration (Civic Center South Lobby)

8-9:15 a.m.—Workshop Period D

9:30-10:45 a.m.—Workshop Period E

11 a.m.-12:15 p.m.—Workshop Period F

Noon-5 p.m.—Exhibit hall open

4-5 p.m.—Exhibitors' reception

5:30-7 p.m.—Amateur radio operators reception (Yellowtail Room, Stouffer Orlando Resort)

7-10 p.m.—Scientific-Atlanta party (Crystal Ballroom, Stouffer Orlando Resort)

Sunday, June 18

8:30 a.m.-noon—BCT/E and Installer Certification Program exams (Crystal Ballroom). (You must register and pay for exams before 1 p.m. on June 17.)

9-10:30 a.m.—Chapter Development meeting (Japanero Room)

9 a.m.-noon—Cablevision of Central Florida Tour (Palani Room)

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You and the SCTE

Promotional rock video to premiere at '89 Expo Evening

The Society of Cable Television Engineers' new promotional rock video will have its world premiere at the Society's 1989 Expo Evening, to be held June 16 at Sea World, Orlando, Fla., in conjunction with Cable-Tec Expo '89. The video is based on "The SCTE Theme," a song written by Society Manager of Editorial and Promotion Howard Whitman. It was first performed at Cable-Tec Expo '88 by the SCTE Band, which featured Executive Vice President Bill Riker on drums and Whitman on guitar. During this performance, the band was joined onstage by the Society's board of directors.

The popularity of the song led to the production of a promotional video in a style similar to current music videos. In the October 1988 edition of the Society's newsletter, *The Interval*, SCTE solicited

video footage from its chapters and meeting groups. A storyboard, based on the lyrics of the song, was created to map out the various segments to be included in the video.

Upon their completion of a studio recording of "The SCTE Theme," Riker and Whitman journeyed to New Jersey for location shooting April 18-19. Shooting was conducted at the Orange, N.J., offices of Suburban Cablevision April 18. Footage of the company's converter repair center, as well as the company's fleet of repair trucks leaving for calls, was shot.

The production team also went on location at a nearby home for shots of a service technician visiting a subscriber. This material closely relates to the song's lyrics that detail the story of a customer whose reception problems are solved by a tech-

nician who has been trained through the Society's programs.

The Ritz Theater in Elizabeth, N.J., which is currently owned by former SCTE President Bob Bilodeau, was the site of the April 19 shoot. The SCTE Band, joined by guest musician Warren Heimall of Suburban Cablevision, performed in sync with the recording. The production was capped by the shooting of a sequence involving actual technicians from New Jersey systems, who came to the theater dressed in authentic cable gear to participate in the video. The enthusiastic performances of these volunteers is sure to be a highlight of the finished video.

Following the premiere at Expo Evening, plans call for the screening of the video with future editions of the Society's monthly Satellite Tele-Seminar Programs.

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Jones Intercable provides dictionaries for members

Jones Intercable, an MSO based in Englewood, Colo., recently sent one free copy of its new publication, the *Jones Dictionary of Cable Television Terminology (Third Edition)*, to each of the over 5,000 members of the Society. The book, written by company founder and industry veteran Glenn Jones, includes definitions for more than 1,600 cable television technical words, phrases and acronyms. It also includes related terms for satellite and computer communications. The book covers cable operations, marketing and sales, finance, regulatory issues, management, programming, systems and industry associations, agencies and services. This 108-page 6-by-9 inch hard-bound edition normally sells for \$14.95 a copy.

Jones encourages the Society's members to use the book as "...a tool to tackle the daily challenges of new information, and consider it a token of my appreciation for the contributions each of you make toward the advancement of cable television." SCTE wishes to express its gratitude to Glenn Jones and Jones Intercable for this generous and useful gift.

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.

Appalachian Mid-Atlantic Chapter
Contact: Richard Ginter, (814) 672-5393

Cactus Chapter
Contact: Harold Mackey, (602) 866-0072

Caribbean Area Chapter
Contact: Jerry Fitz, (809) 766-0909

Cascade Range Chapter
Contact: Norrie Bush, (206) 254-3228

Central Illinois Chapter
Contact: Tony Lasher, (217) 784-5518

Central Indiana Chapter
Contact: Joe Shanks, (317) 649-0407

Chattahoochee Chapter
Contact: Jack Connolly, (912) 741-5068

Chesapeake Chapter
Contact: Thomas Gorman, (301) 252-1012

Delaware Valley Chapter
Contact: Diana Riley, (717) 764-1436

Florida Chapter
Contact: Denise Turner, (800) 282-9164

Gateway Chapter
Contact: Darrell Diel, (314) 576-4446

Golden Gate Chapter

Contact: John Parker, (408) 437-7600

Great Lakes Chapter
Contact: Daniel Leith, (313) 549-8288

Greater Chicago Chapter
Contact: Joe Thomas, (312) 362-6110

Heart of America Chapter
Contact: Wendell Woody, (816) 454-3495

Hudson Valley Chapter
Contact: Wayne Davis, (518) 587-7993; or Bob Price, (518) 382-8000

Iowa Heartland Chapter
Contact: Dan Passick, (515) 266-2979

Miss/Lou Chapter
Contact: Rick Jubeck, (601) 992-3377

New England Chapter
Contact: Bill Riley, (617) 472-1231

North Central Texas Chapter
Contact: Vern Kahler, (817) 265-7766

North Country Chapter
Contact: Doug Ceballos, (612) 522-5200

North Jersey Chapter
Contact: Art Muschler, (201) 672-1397

Ohio Valley Chapter
Contact: Robert Heim, (419) 627-0800

Oklahoma Chapter
Contact: Gary Beikman, (405) 842-2405

Old Dominion Chapter
Contact: Margaret Harvey, (703) 238-3400

Piedmont Chapter
Contact: Rick Hollowell, (919) 968-4661

Razorbuck Chapter
Contact: Jim Dickerson, (501) 777-4684

Rocky Mountain Chapter
Contact: Rikki Lee, (303) 792-0023

Tip-O-Tex Chapter
Contact: Arnold Cisneros, (512) 425-7880

Big Sky Meeting Group
Contact: Marla DeShaw, (406) 632-4200

Bonneville Meeting Group
Contact: Roger Peterson, (801) 486-3036

Central California Meeting Group
Contact: Andrew Valles, (209) 453-7791

Chaparral Meeting Group
Contact: Bill Simons, (505) 988-9841

Dairyland Meeting Group
Contact: Jeff Spence, (414) 738-3180

Dakota Territories Meeting Group
Contact: A.J. VandeKamp, (605) 339-3339

Dixie Meeting Group
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Great Plains Meeting Group
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Hawaiian Island Meeting Group
Contact: Howard Feig, (808) 242-7257

Inland Empire Meeting Group
Contact: Michael Lajko, (208) 263-4070

Michiana Meeting Group
Contact: Thomas White, (219) 259-8015

Midlands Cable Training Association
Contact: John Page, (712) 323-0420

Mt. Rainier Meeting Group
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Palmetto Meeting Group
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Snake River Meeting Group
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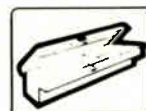
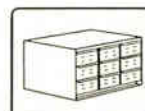
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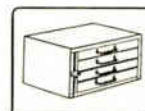
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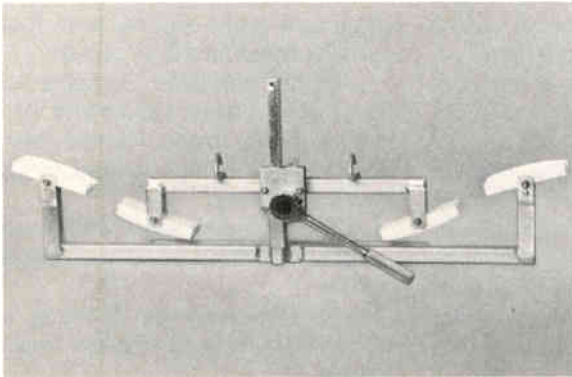
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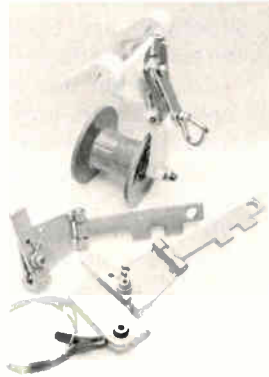
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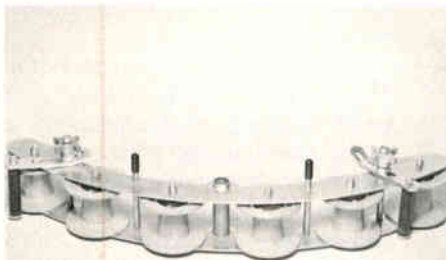
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Overview of the cable system

By Magnavox CATV Systems Inc.

What is the purpose of a subscriber cable TV distribution system? The answer: To carry multiple TV signals from a central source (the headend) to subscribers and, if necessary, to carry data signals from outlying locations in the distribution system back to the headend. To reach this general goal, the distribution system must perform 10 basic functions. In the ensuing explanation of each function, we list and describe the types of equipment needed to fulfill that function in a CATV system.

This list of equipment is not exhaustive. To fulfill these 10 basic functions, other incidental and less obvious types of equipment are used in support of and in conjunction with the types of equipment discussed here. Furthermore, the circumstances under which any particular cable system must operate may call for additional types of equipment, and any special services or features of the system may require additional equipment. Nevertheless, the following ten functions and the equipment types associated with them are essential to the operation of cable systems in general.

Reception

You must receive the multiple TV signals to be sent out. In some cases, a cable system will be equipped to produce one or more signals locally. Also, many programs will be recorded on videotape or film and played back through equipment at the headend.

• Equipment needed:

- Satellite antennas
- Microwave antennas
- Antennas for off-air TV and FM radio signals
- Low-noise amplifiers for weak signals from satellite, microwave, or off-air sources
- Videotape and cinescope equipment for recorded programs
- Studio for locally made programs (optional)

• Constraints:

Satellite antennas should be located slightly below the lay of the surrounding land to shield the antenna from microwave interference. Also, in general, microwave and off-air antennas should be located on high ground.

Terrestrial microwave antennas come in many shapes and sizes. The most common type for CATV use is the solid-reflector parabolic antenna. Because of their excellent directivity, horn-shaped antennas are used in areas where terrestrial interference is a problem.

The length and spacing of the elements in the log-periodic antenna determines the frequency and bandwidth of off-air signals that the antenna will receive, and the antenna's directivity. When off-air signals are especially weak, sets of antennas (usually two or four) can be arranged in specially spaced configurations (arrays) to increase the received signal level.

FDM modulation

You must modulate the multiple signals onto the coaxial cable using

frequency-division multiplexing (FDM). In FDM, all signals are present on the cable at all times. However, each baseband TV signal (video, audio and color) is modulated onto its own set of carrier signals. Each set of carrier signals occupies its own unique frequency band or channel. The combination of these modulated carriers makes up a composite signal often called an "RF broadband signal."

• Equipment needed:

—Modulator: Introduces a baseband signal onto an RF carrier for cablecasting.

—Combiner: Combines multiple signals onto the coaxial cable.

In practice, several other types of equipment are needed to manipulate received signals into the form they must have in order to be modulated onto the cable, including:

—Demodulator: Extracts baseband video and audio signals from their RF carriers. Used for off-air signal.

—Signal processor: Accepts an off-air signal. Allows adjustment of individual carrier levels. Remodulates the off-air signal at the desired frequency for cablecasting.

—Microwave receiver: Extracts baseband signal from a microwave frequency carrier.

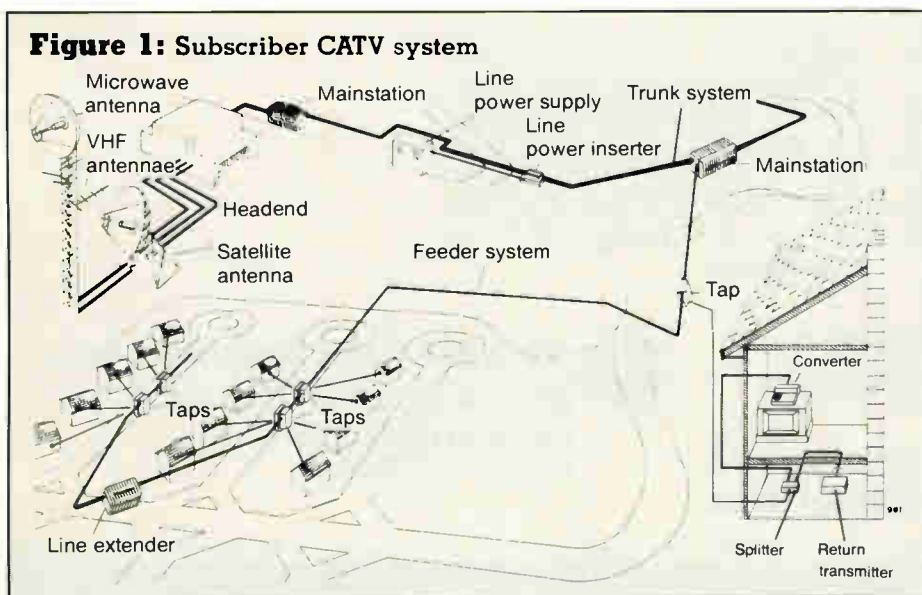
—Satellite receiver: Extracts baseband signal from a satellite frequency carrier.

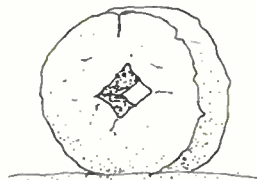
—Satellite descrambler: Decodes a scrambled signal received via satellite.

• Constraints:

Using the NTSC video standard, each TV channel requires 6 MHz of bandwidth. Modern cable equipment allows use of the 50 to 550 MHz bandwidth for signals that are sent to subscribers. The bandwidth used to carry signals to subscribers is called the "forward" bandwidth. In the United States, the lowest frequency in the forward bandwidth is usually either 50 MHz or 54 MHz; the highest frequency in the forward bandwidth might commonly be anywhere from 220 MHz to 550 MHz, depending upon how many channels are needed.

The frequency band of 5 to 30 MHz is used for return data signals and/or TV signals generated by certain subscribers like schools. The 30 to 50 MHz band must remain empty. It serves as a "guard band" to prevent destructive





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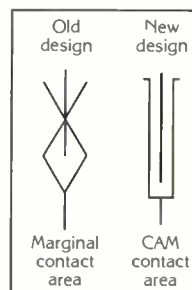
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interaction (unintentional feedback or "back-talk") between the outgoing and incoming signals on the same coaxial cable.

Conduction

You must conduct signals from the headend to each subscriber.

- Equipment needed:
 - coaxial cable of several different sizes

- Characteristics of coaxial cable

Technical facts:

- 1) The center conductor carries the RF signal and, in some cases, AC power.
- 2) The outer conductor (sheath) is the electrical "ground."
- 3) Coaxial cable has a characteristic impedance (75 ohms), which is determined by the ratio of the inner conductor's diameter to the outer conductor's diameter, and also is affected by the dielectric between the two conductors.
- 4) For any given length, the larger the diameter of the cable, the less it attenuates (reduces) signal power.
- 5) Coaxial cable attenuates (reduces) high-frequency signals more than low-frequency signals.

- 6) The higher the temperature, the more it attenuates (reduces) signal power.

Product notes for coaxial cable:

- 1) For trunk and feeder cables, the center conductor is usually copper-clad aluminum and the outer conductor is made of aluminum.
- 2) Trunk and feeder cables also are available in plastic-coated and metal-armored versions. Some types of cable also have a built-in messenger wire that helps support the weight of the cable when it is hung on the utility poles.
- 3) Drop cable, the cable used for the last link between the distribution system and the subscriber, has a stranded or woven outer conductor. Some drop cable has two outer conductors: an aluminum foil bonded to plastic lies between the dielectric and the woven outermost conductor. For greater ruggedness, the center conductor is usually copper-clad steel rather than copper-clad aluminum.

The cable industry uses a "tree" metaphor to describe the coaxial distribution network. Trunk lines, feeder lines and drops in a cable system

correspond to tree trunks, tree branches and twigs respectively.

Trunk lines are main lines or "super-highways" along which signals are sent. Cable of large diameter is used to make trunk lines, usually .750-inch, .875-inch, 1.00-inch, or 1.25-inch. Trunk lines usually carry AC power.

Feeder lines are subordinate highways for signals. Feeder lines receive their signals from a trunk line. In general, one trunk line will supply signal to many feeder lines. Feeder cables are generally .412-inch, .500-inch, or .625-inch in diameter. Feeder lines sometimes carry AC power.

Drop cables carry signals from the feederline to the subscriber. They never carry AC power.

Amplification

You must amplify the RF broadband signal at regular length intervals along the trunk and feeder lines. This amplification is necessary not only because signal power is used to serve each subscriber, but also because the coaxial cable dissipates signal power significantly.

- Equipment needed:
 - Mainstation; also called trunk station, trunk line station and trunk line amplifier station: A combination of equipment mounted in a housing attached to a trunk line. Although the mainstation's primary function is amplification, it also is equipped with a device that monitors and adjusts signal levels, a device to convert AC power to DC, a device to divert signal from the trunk into the feeder lines and a device to route and connect signals as they pass through the mainstation.

—Line extender: A combination of three devices (forward amplifier, return amplifier and DC power supply) all mounted in a housing on a feeder line.

- Amplifying devices in the mainstation
 - Trunk amplifier module: Most important part of mainstation. Amplifies forward trunk signal. Its main components are two low-noise, low-distortion amplifier hybrids. It also contains three plug-in devices that allow for precise adjustment: an equalizer, an attenuator and a response equalizer (de-bumper).

—Bridger amplifier module: Receives signal from the trunk amplifier module, amplifies the signal and sends it into the feeder lines. Contains two low-noise, low-distortion amplifier hybrids.

—Return amplifier module: Amplifies return signals from the trunk line and

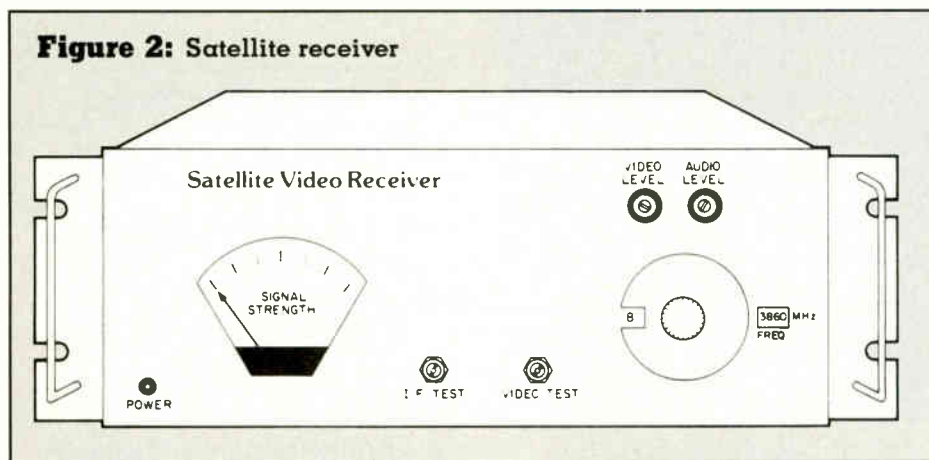


Figure 2: Satellite receiver

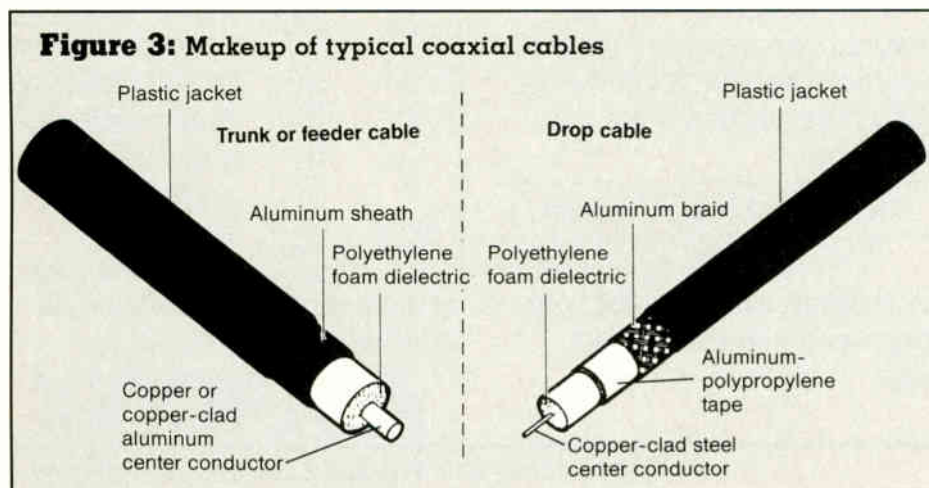


Figure 3: Makeup of typical coaxial cables

from the feeder lines. Sends the amplified signal toward the headend. Contains one or two low-noise, low-distortion amplifying hybrids or discrete transistors.

- Other basic mainstation equipment:
 - Housing: Protects electronic devices from the weather. Prevents leakage of RF signals (ingress and egress). Contains "seizure mechanisms" that make a secure connection between the coaxial cable and the mainstation's electronic components.

- Interconnection chassis: Contains connectors for amplifier modules and other devices. Amplifier modules mount onto this chassis. It directs the forward signal to its amplifier (the trunk amplifier module) and the return signal to its amplifier (the return amplifier module). Contains test points. The chassis also separates the combined AC and RF input.

- Feeder maker: Connects the output of the bridger amplifier module to the feeder lines. One, two, three, or four feeder lines can be served from a single mainstation.

- DC power supply: Converts AC power received on the coaxial cable into the DC power needed to operate the mainstation's electronic devices.

- Amplifying devices in the line extender:

- Forward amplifier: Amplifies forward feeder signal. Its main components are two low-noise, low-distortion amplifier hybrids. It contains two plug-in devices that allow for precise adjustment, an equalizer and an attenuator.

- Return amplifier: Amplifies return feeder signal. Its main component is a low-noise, low-distortion amplifier (either a hybrid or a discrete transistor).

- Other basic line extender equipment:

- Housing: Protects electronic devices from the weather. Prevents leakage of RF signals (ingress and egress). Contains "seizure mechanisms" that make a secure connection between the coaxial cable and the mainstation's electronic components.

- DC power supply: Converts AC power received on the coaxial cable into the DC power needed to operate the line extender's electronic devices. Manufacturers build this device into the line extender in different ways. It may be entirely separable from the housing and the amplifier chassis or it may be built into the forward amplifier chassis.

- Constraints on amplification:

How far from the headend can you carry the signal? To carry signals to all

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subscribers, you use a series of mainstations located, for example, every 1,800 feet (on the average) along the trunk cable. We call this series of mainstations a "cascade." The number of mainstations you can put in series (the

"depth" of the cascade), is limited by the noise and distortion performance of the trunk amplifier module within the mainstation. Cascades of 20 mainstations are common. However, if the cascade gets too deep, noise and

Figure 4: Trunkline amplifier station

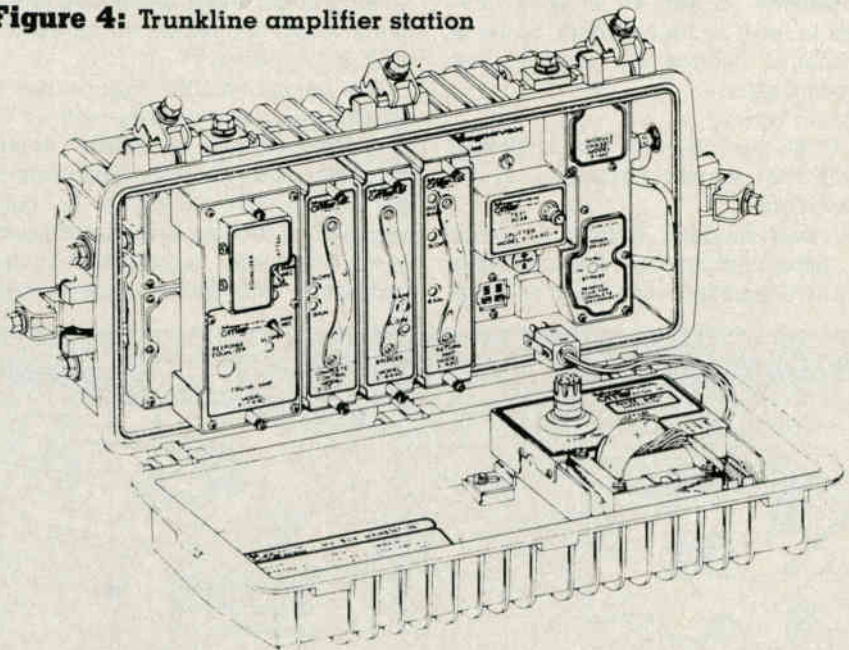
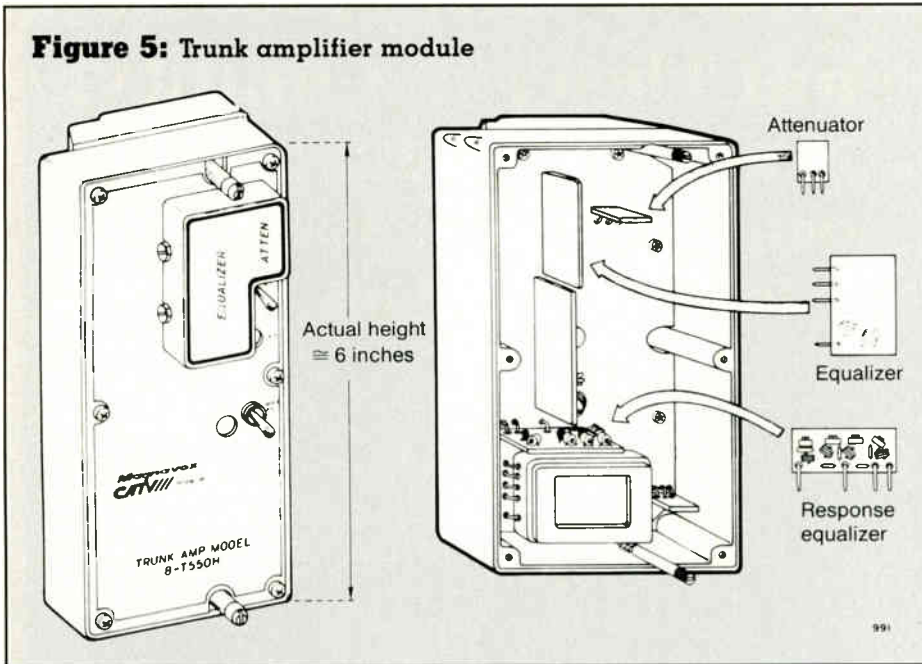


Figure 5: Trunk amplifier module



distortion will get so bad that the picture quality will become unacceptable.

High signal levels make it possible to carry signals a long distance. But even a high signal level has its problems. If the signal power level is too high, distortion becomes too high; if the signal level is too low, you get too much noise as a result.

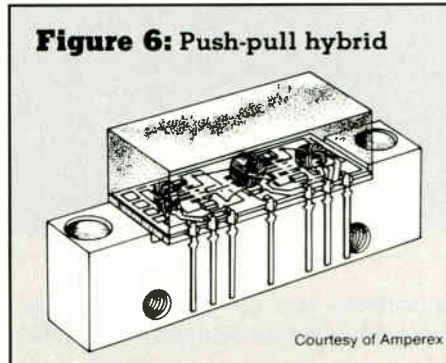
How then can you carry signals a longer distance (longer than, say, 20 mainstations) without having problems with noise and distortion? The answer is to use special amplifier hybrids in the trunk amplifier module of each mainstation. These special hybrids allow you to have a greater distance between mainstations as well as allowing cascades to have a greater depth. Some of the special hybrids are used in line extenders also.

• Hybrid types:

—Push-pull hybrid: An ordinary hybrid that allows cascades of 20 mainstations.

—Power-doubling hybrid: A hybrid with better performance; it causes less noise and distortion, allows higher signal

Figure 6: Push-pull hybrid

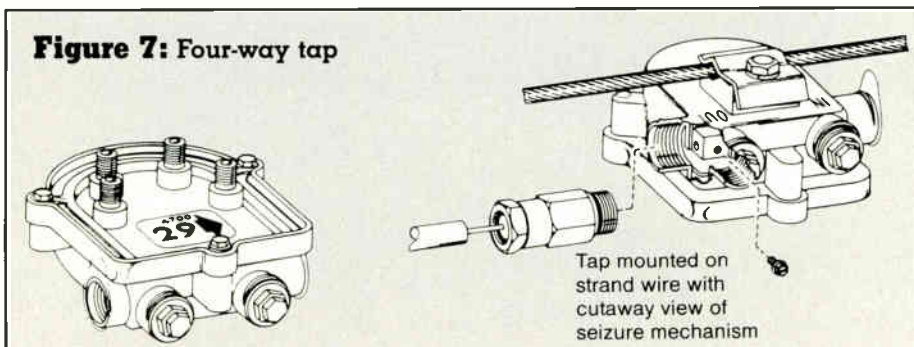


levels and allows cascades of 25 to 30 mainstations.

—Feedforward hybrid: A hybrid with the best performance; it causes the least noise and distortion, allows the highest signal levels and allows cascades of 25 to 35 mainstations.

The semiconductor hybrids are the amplifying components within any amplifying module, or "active" module. (In some cases discrete transistors are still used.) The hybrid is so called because its circuitry is a combination of semiconductor substrate devices (transistors and other circuit elements)

Figure 7: Four-way tap



and discrete electronic components, like transformer coils, all in one package. A heat sink is also typically part of the package.

A further constraint on amplification is impedance matching. Coaxial cable has a characteristic impedance of 75 ohms. (This is a complex impedance that describes the cable's capacitive and inductive characteristics and is not a simple resistance.) To send signals through the cable efficiently, all parts of the distribution system must have the same characteristic impedance. If impedances in the amplifiers do not match this 75-ohm standard, part of the signal power will be reflected within the distribution system, and therefore wasted. The degree to which a device within a cable system maintains this matched impedance is called its "return loss."

The fact that you must amplify and re-amplify the RF broadband signal makes one other function, powering, absolutely necessary, and suggests the need for two other optional functions, automatic gain and slope control, and status monitoring.

Powering: You must supply the amplifying devices with AC power, which they must convert to DC power.

• Equipment needed:

—Line power supply: Converts 120 VAC (sine waveform) into a 60 VAC (quasi-square waveform), which is then introduced onto the coaxial cable. Receives its power from the electrical utility company. The line power supply is often mounted on a telephone pole near a cable trunk line. On the average, one line power supply can supply about three mainstations and all of the line extenders that receive signals from those mainstations.

—Standby power supply: Same as an ordinary line power supply, except that it has batteries and a DC-to-AC inverter circuit so it can operate during a utility power failure.

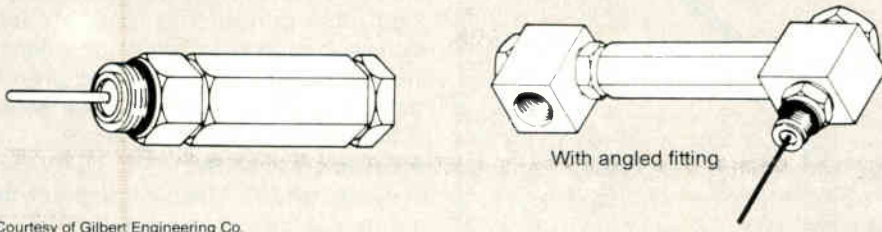
—Line power inserter: A special connecting device that introduces the 60 VAC from the line power supply onto the coaxial cable. Line power inserters are usually installed in trunk lines. You need one for each line power supply.

—DC power supply: Located within each mainstation or line extender. Converts the AC power from the line power supply into the 24 VDC that is used to power the amplifying modules in the mainstation or line extender.

• Constraints on powering:

Because of the series-parallel method of powering and the large amount of

Figure 8: Pin-type connectors



In subscriber cable systems, the return bandwidth is considered too small to require AGC/ASC devices. However, these devices are considered necessary equipment for the forward bandwidth of most subscriber cable systems.

Status monitoring: You may monitor AC and DC power supplies and amplifiers to observe their condition and to detect faults and failures.

- Equipment needed:
 - Status monitoring headend equipment
 - Special AGC/ASC devices (in mainstations)
 - Special return amplifiers (in mainstations)

(In general, status monitoring does not apply to line extenders.)

A status-monitoring system consists of three groups of devices: (1) sensing devices located in mainstations, at the ends of trunk lines or feeder lines, and/or located in line power supplies; (2) data receivers and transmitters located both in the field and at the headend; and (3) a central computer at the headend that allows you to see the status of the cable system.

Status monitoring systems typically monitor such parameters as forward

power needed, many line power supplies must be used in a cable system. A single line power supply can only supply a few mainstations because the AC voltage decreases in every span of cable, and the DC power supply in the mainstation requires a certain minimum voltage to operate. Line extenders are powered in the same way. AC power comes to each line extender via the mainstation from which it receives its signal.

Automatic gain and slope control (AGC/ASC): You must maintain the same output signal level throughout the trunk system.

- Equipment needed:
 - AGC/ASC device: Located in every mainstation or every other mainstation, but not generally used in line extenders. This device "watches" the forward trunk

output signal level. If the level goes up or down (usually due to temperature changes), the device automatically adjusts the amplification (or gain) of the trunk amplifier module so that the signal level returns to its original standard value.

The AGC/ASC unit watches two signals, one at the high end of the forward bandwidth, the other at the low end. By controlling these, it controls the signal level for the entire forward bandwidth. The signals it watches are called "pilot" carriers. One of these pilot carriers is often called the "slope" pilot and the other the "gain" pilot. However, manufacturers disagree about what to call what, so for greatest clarity, it is best to refer to them simply as the high pilot and the low pilot.

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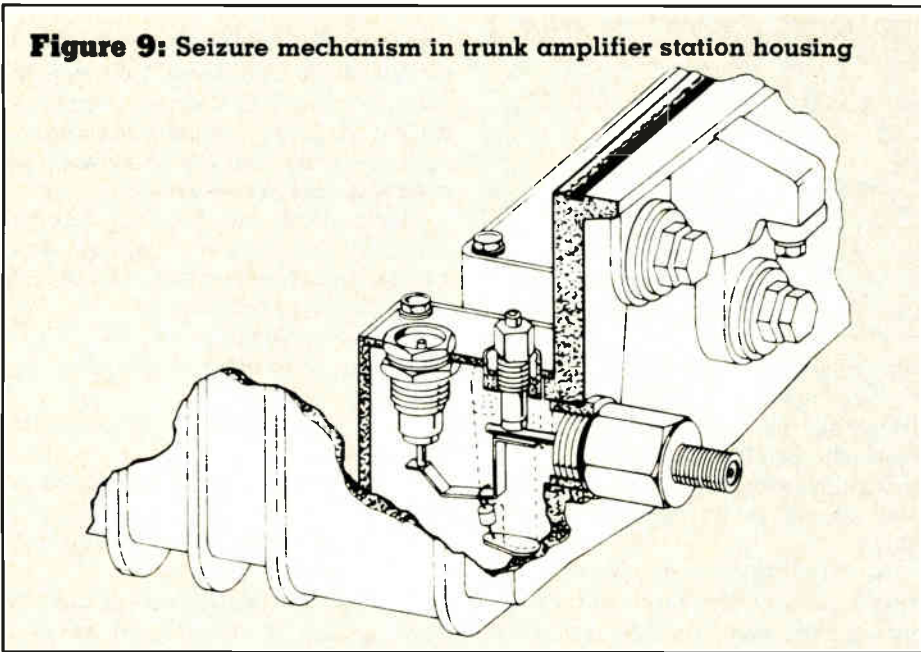
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Figure 9: Seizure mechanism in trunk amplifier station housing



trunk signal levels, return trunk signal levels, status of DC power supplies (inside mainstations), AGC and ASC pilot signal levels, temperature inside the mainstation, the functioning of the special feedforward hybrid with which some trunk amplifier modules are equipped, and status of standby line power supplies. The features of status monitoring systems differ from manufacturer to manufacturer.

Division

You must divide the signal power so it can reach all subscribers.

- Equipment needed:

- Line directional coupler: Installed in trunk line or feeder line. Divides RF signal power into two unequal parts and allows AC to pass through.

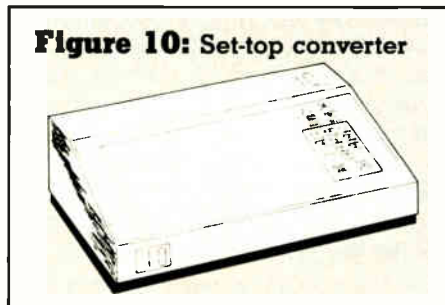
- Line splitter: Installed in trunk line or feeder line. Divides RF signal power into two equal parts and allows AC to pass through.

- Tap: Installed in feeder line. A combination of splitters and a directional coupler. The directional coupler diverts part of the signal from the feeder line and sends it to internal signal-splitting circuitry. The remaining signal passes downstream on the feeder line. The signal-splitting circuitry divides the RF signal power into two, four, or eight equal parts for subscribers. It prevents AC power from going to subscribers, but allows AC power to pass through on the feeder line.

- Subscriber splitter: Installed in drop cable. Divides RF signal power into two, four, or eight equal parts for use by subscribers. Receives no AC power.

All of these signal-splitting devices

Figure 10: Set-top converter



split the RF signal power for the entire RF bandwidth. They do not split or separate the signal by frequency. For example, if a forward broadband signal of 50 to 450 MHz enters a two-way splitter, each of the two output signals will still carry the entire 50 to 450 MHz bandwidth; but each of these two output signals will have about one-half of the signal power. (Whenever you split a signal, you waste some signal power.)

- Constraints on signal-splitting devices:

Signal-splitting devices must be made to accommodate the highest frequency used in the cable system. The higher the top frequency, the more difficult it is to make the tap perform correctly. Therefore, a 550 MHz signal-splitting device requires a more sophisticated design than a 220 MHz signal-splitting device, and the 550 MHz device will be the more expensive to make.

All signal-splitting devices must have a characteristic impedance of 75 ohms. If not, signal power will be wasted by being reflected in the cable system. Furthermore, the reflected signal interferes with the original signal. Such a problem is called a "mismatch" or a "return loss" problem.

Connection

You must connect all parts of the distribution system to allow good electrical conduction and prevent signals from leaking out of or entering into the cable. You also must prevent water (or vapor) from entering any device in the cable distribution system.

- Equipment needed:

- Connectors: Used throughout the cable system. Common "male" to "female" connections (also called "pin" to "jack" connections) are used. Pin-type connectors are used to connect trunk or feeder cables to amplifier stations or passive devices. Angled fittings are often needed when devices are mounted in pedestals or other confined spaces, or when passive devices are mounted adjacent to amplifier stations. All connectors maintain the continuity of both the center and outer conductors of the coaxial cable. Connectors have flat edges to allow tightening with wrenches and other hand tools. Most connectors also have rubber gaskets to prevent water leakage.

- Seizure mechanisms: Used in mainstation housings, line extender housings, and in the housings of the signal-splitting devices installed in the trunk and feeder lines. A seizure mechanism is a device that seizes or "grabs" the center conductor. A tight connection is necessary for good conduction. Also, tight connections prevent corrosion.

- Constraints regarding connectors:

- All connectors and seizure mechanisms must have the proper physical dimensions so they will conduct signals at the 75-ohm characteristic impedance. Poor connectors and seizure mechanisms cause mismatch problems (return-loss problems). Poor connections in seizure mechanisms and connectors can cause severe attenuation of the signal in very narrow bandwidths; such abnormal attenuation patterns are often referred to as "suck-outs."

FDM demodulation

You must make each TV channel available to the subscriber's receiver at a frequency that it can receive.

- Equipment needed:

- Converter: Located in each subscriber's home. Accepts RF broadband input from drop cable. This RF broadband signal contains all cable-casted TV channels. The converter sends a single channel to the receiver. This single channel could contain any of the video signals sent from the headend, but it will

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always go to the receiver on Ch. 2, 3 or 4. A converter is needed because ordinary TV receivers cannot tune in all of the channels sent out on the cable distribution system.

—Cable-ready television: A television that can tune in all or most of the channels of the composite broadband signal. The subscriber who has a cable-ready television can tune in cable television signals without a converter.

Guarding premium signals

You may provide a way to prevent unauthorized subscribers from receiving certain signals. If you want to make some special channels (for example, Home Box Office and Showtime) available only to those who will pay an extra charge, you must have a method of preventing non-payers from receiving them. "Scrambling" and "trapping" are the two most common methods. Channels for which subscribers must pay extra are often called "premium" channels.

• Equipment needed:

—Signal-scrambling device: Used at headend. Encodes or changes the video signal so that the subscriber's television cannot understand it. Suppression of the horizontal sync pulse is the most common method. (It is possible for "pirates" to defeat sync-suppression scrambling, but it is not easy.)

—Positive trap: A jamming carrier is superimposed on the premium channel at the headend. A positive trap is installed only at the location of those customers who pay for the premium service. The

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positive trap eliminates the jamming carrier, thus making the premium channel available to the paying subscriber.

—Negative trap: Installed in the coaxial cable near the subscriber's house. If the subscriber does not pay for the premium channel, you must install a trap to keep him from receiving it. A negative trap is a tuned circuit that severely attenuates the premium channel signal and thus makes it unavailable to the subscriber who does not pay for the premium channel.

Descrambling

If you use a signal-scrambling device to guard premium signals, you must have a descrambling (unscrambling) method

to make premium signals available to authorized subscribers.

• Equipment needed:

—Descrambling converter: A descrambling converter decodes scrambled signals and performs the FDM demodulation. Many descrambling converters simply restore the horizontal sync pulse to the video signal. A more complex descrambling converter may be addressable. Addressability means that each converter has a special identifying code which the cable operator can use to send premium and/or pay-per-view services to one subscriber while withholding them from another subscriber. This kind of addressability, called "one-way" addressability does not require the use of the return bandwidth. "Two-way" addressability allows signals to pass from the subscriber to the headend, also. Features like burglar alarms and "panic buttons" can be offered in a two-way addressable system. Two-way addressability, however, does require the use of the return bandwidth.

When the horizontal sync pulse is lost, the TV picture goes into jagged disarray. Horizontal sync suppression is by far the most common form of scrambling. The other common method is video inversion wherein light areas of the screen become dark and dark areas light. In the signal inversion process, synchronization is also lost, but the resulting picture is generally less jagged than that produced by horizontal sync suppression.

Billing

To bill subscribers properly, you must keep track of the services that each one buys.

• Equipment needed:

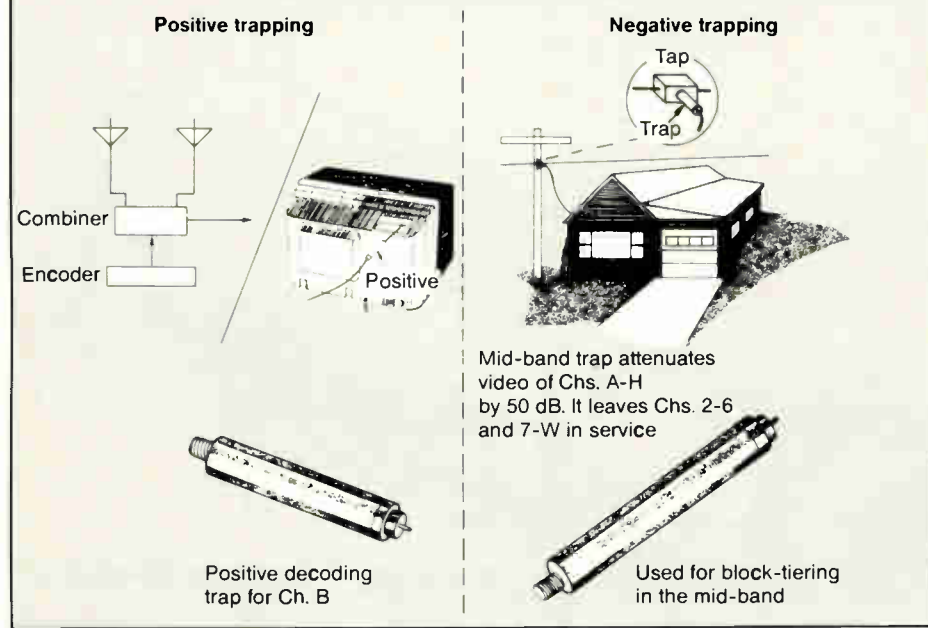
- ordinary office record-keeping equipment or
- a billing computer or
- both

A billing computer for a cable system can be set up to work in a way similar to billing machines used to do billing in a telephone system. Computerized billing is common today, especially in large cable franchises. In some cases, the cable operator keeps records by computer but hires an outside company to send out the bills. However, ordinary paper-based record-keeping methods are very common in small cable systems and are completely adequate. ■

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Figure 11: Methods and devices for trapping



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Components of system powering

By Tim Mooney

Sales Engineer, C-COR Electronics Inc.

This article will explain the various components that make up the powering of a CATV system. Such items as ferroresonant power supplies, standby power supplies, power insertion, power direction, amplifiers and coaxial cable will be discussed.

Before we cover the various components of the CATV powering system, I would like to discuss the system power maps. The system power maps are designed after the electronics have been placed on the maps. By this I mean trunk, feeder routings and amplifier placement. The power design is fitted into the system as it exists.

Ferroresonant

Ferroresonant power supplies are used to power CATV systems. They exhibit good regulation of output voltage over wide changes at the input to the ferro's primary. Because of this feature, they are a prime choice for CATV applications. The ferroresonant transformer also satisfies the National Electrical Code requirement as a current limiting source. This characteristic allows the unit to protect itself from system short-circuiting. In addition, this simplifies power supply design for active components like trunks and line extenders.

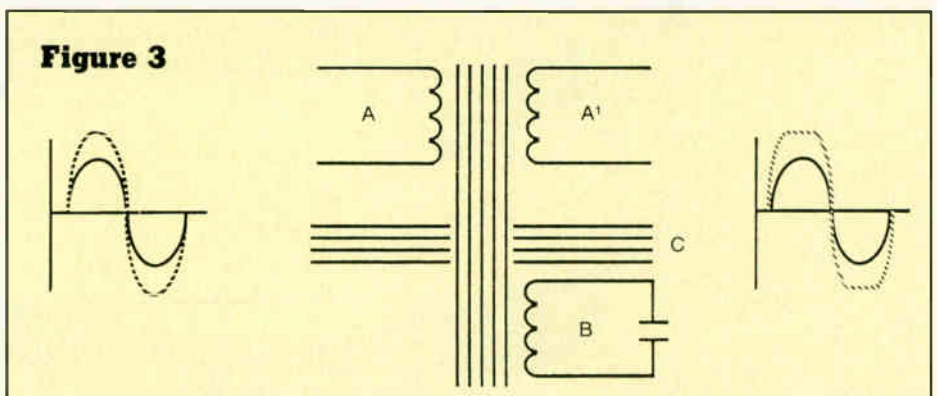
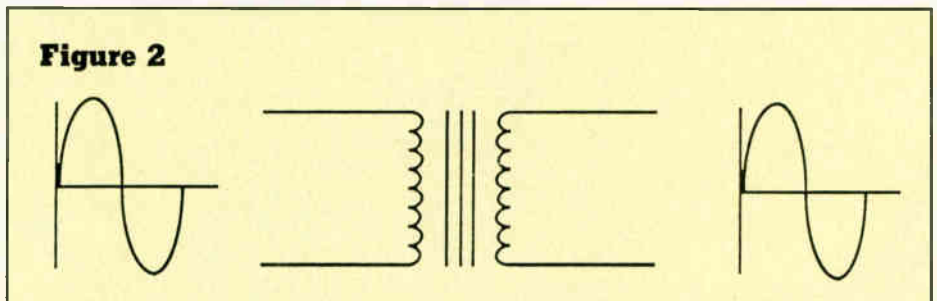
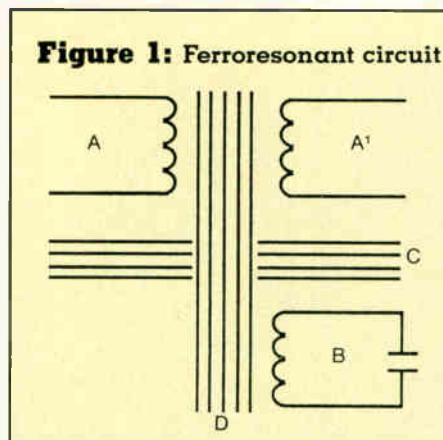
Transformers are devices that change an AC (alternating current) signal (relative to amplitude) or isolate the output signal from the input signal. They also can step the AC signal up or down in amplitude. This is accomplished by changing the turns ratio (primary to secondary or secondary to primary) of the transformer. For example, if 120 volts is applied to a transformer's input with a 2-to-1 (primary to secondary) turns ratio, the output voltage is 60 volts. Conversely, if the direction of this transformer is reversed to now make it a 1-to-2 (primary to secondary) turns ratio, and the same 120 volts is applied, 240 volts appears at its output.

Now let's take an isolation transformer

with a 1-to-1 turns ratio. In this example the same 120 volts are applied to the input. Due to the turns ratio, the same voltage appears at its output. In addition, any change to the input voltage results in a change at its output. Because of this, a circuit was developed that would maintain constant output voltages over a wide range of input voltage change; this circuit was the ferroresonant transformer.

The ferroresonant circuit is pictured in Figure 1. The ferro is a transformer (A, A') as described previously. The difference comes in the third winding of the transformer. In this part of the circuit, a tank circuit (B), which is an inductor and capacitor combination, is added. This circuit is designed to be resonant at 60 Hz. Heavy currents flow in this part of the circuit and help to supply current to the secondary, which keeps it regulating properly. This secondary winding is where the load is placed. The third part of the circuit is the magnetic shunt (C) that passes through the core. This serves to control and limit the current in the secondary winding. The circuit also is made up of many laminated sheets of metal (D) that are tightly bolted together. The more lamination there is in a transformer, the more concentrated the magnetic lines of force will be.

The ferro's regulation is due to the magnetic design of the core and the tank circuit. Figure 2 shows a signal at the input of a transformer and the cor-



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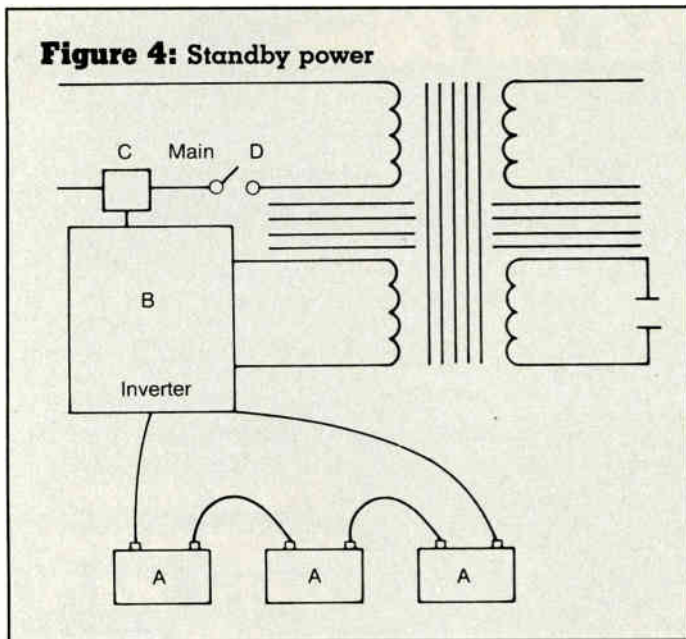
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Figure 4: Standby power



responding output. This is an oversimplification, but for the purpose of explanation it will suffice. Note that as the input is increased, the output also will increase. If this were a 1-to-1 turns ratio transformer, a 1 volt increase at the input would yield a 1 volt output increase. For Figure 3, the resonant tank circuit has been added and the transformer core modified with more laminations and a magnetic shunt. Again, at a 1 volt input there would be a corresponding output of 1 volt. Now the input is raised by 10 times to 10 volts.

The output no longer looks like the input but rather like a "clipped" sine wave or a square wave. This occurs because of the magnetic saturation of the transformer core, by the circulating currents in the tank circuit, added to the currents flowing in the primary. It cannot supply any more magnetic lines of force (to induce more current in the secondary) to raise the voltage level at the output. This is the reason ferros have such good regulation. As the input varies, the output, as long as it is still saturated, will remain relatively constant.

Standby power

Standby power supplies (SBPS) work as described before with a few differences. In those cases in which a system has to ensure that the main trunk is always functioning, an alternative power source must be used. If a power interruption occurs with a non-standby unit, the actives that the power supply is feeding will no longer be able to function and therefore an outage will occur.

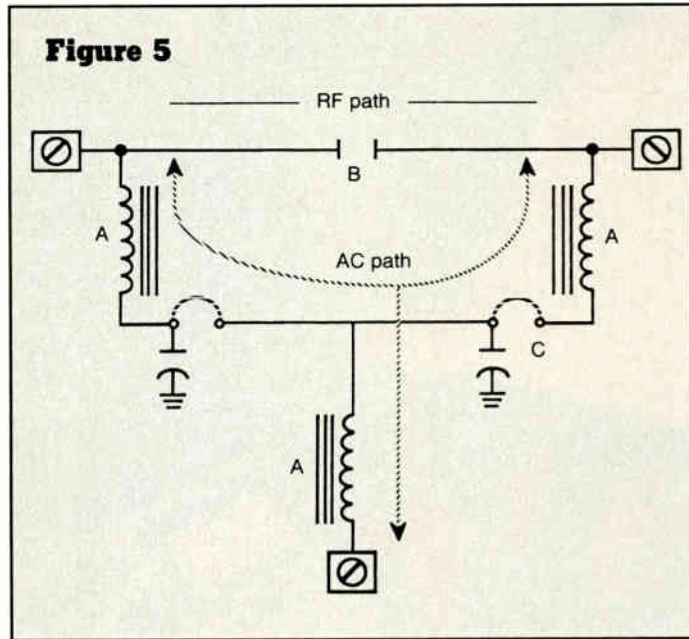
Certain applications may warrant

standby power. In an SBPS, batteries are used as the source for the line voltage in the event of a power outage. The batteries (Figure 4, A) supply power to a circuit that converts a DC current to an AC current. This circuit is called an inverter (B). The control section of the SBPS monitors (C) the supply voltage at the primary side. If the supply voltage falls below a preset level, the inverter will turn on and disconnect (D) the main transformer from the load line. Additional circuitry is built into the supply for charging the batteries and deep discharge cutoff; a delay circuit keeps mains and inverters from switching back and forth during brown-outs or unstable voltage conditions.

The devices used to combine RF and AC signals are called power inserters. They also can be used to separate an AC and RF signal. They exhibit high isolation (typically 58 dB from the power to RF port) and low loss to the RF signal (0.25 dB). Isolation is the loss that the circuit induces between two outputs or, in this case, the AC insertion point to RF output. Power inserters should be transparent to the transmission line when correctly installed. In those trunks that offer a built-in power inserter, the advantage of not cutting the trunk line is realized. This reduces maintenance costs because there are two less connectors and one less passive housing in the system.

There are several different types of power inserters that are used in the CATV system. Some are fused and others are not, but in all cases, power can be blocked by the removal of a fuse or the cutting of a jumper. A power inserter

Figure 5



consists of basically two components. In Figure 5 there are three radio frequency chokes (A) that block the RF signal and pass the 60 Hz signal, a capacitor (B) that blocks the 60 Hz signal and passes the RF signal, and power directors (C) that will stop power if removed.

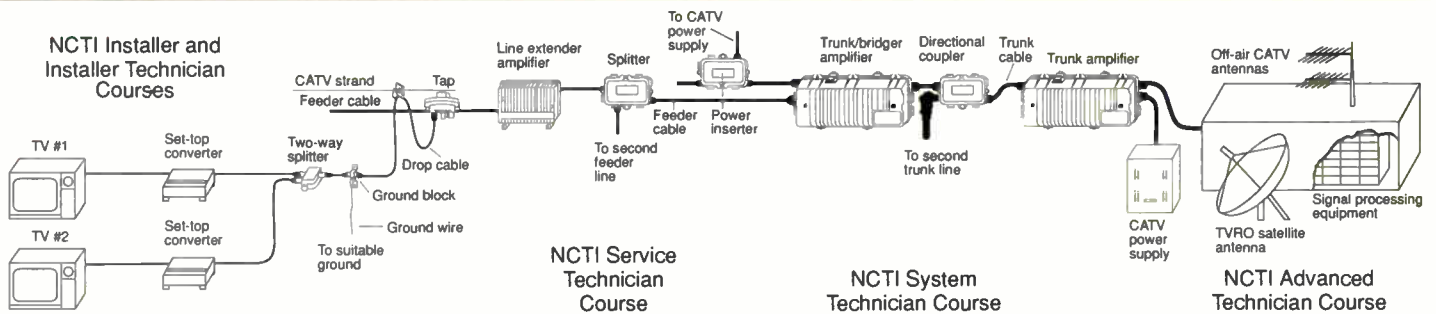
Amplifiers

Amplifiers are the load on the system. They require a proper level of voltage to operate correctly. They also draw current from the ferro that is fairly constant across their operational voltage range. Powering of the actives in the system is as important as the process of choosing equalizers, pads and spacing of the amplifier. If the supply voltage is out of specification, the actives' power supply will not be able to function correctly. This will lead to increased service calls from subscribers due to increased levels of hum modulation of the RF signals, and in the most severe case, amplifier gains beginning to change with associated picture degradation.

Amplifiers can feed power or accept power in many different configurations. Some manufacturers fuse their amplifiers, others use power directors. In any case, these are used to send power to the appropriate port where another amplifier will be supplied voltage. If there are no actives off of a port, power is not directed to that port of the amplifier.

Power is separated at the baseplates or similar location in the housing. Consider the analogy that a power inserter is built into each port. The power is routed by cables to the appropriate areas of the housing, with the RF signal

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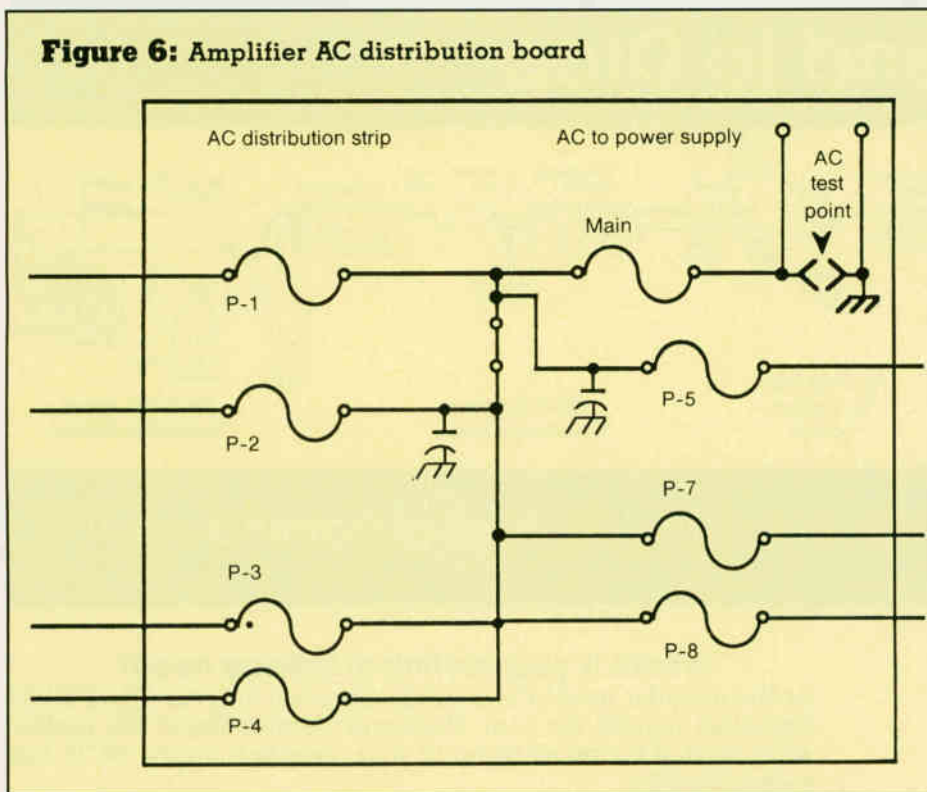
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Figure 6: Amplifier AC distribution board



routed to the amplification section of the amplifier. At this point, power is sent to the areas of the housing that may require it. Figure 6 is a drawing of an amplifier's

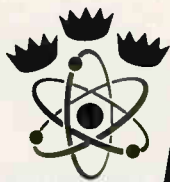
AC distribution board. In this product, fuses are placed in fuse clips to route power to the appropriate port. This setup allows the technician to visit only one

location to repair fuse blowings rather than having to hunt down a blown fuse in a passive.

Coaxial cable is the component that limits reach relative to powering. The simple fact that as cable size increases, the resistance (DC loop resistance) decreases, tells us something. This relates to voltage drop ($E=IR$), which means at a given current, if the resistance of the cable is twice as much, the voltage drop increases by a proportional amount. In addition, the greater the drop, the more power is wasted on heating the cable.

Each item of the powering system warrants equal consideration. Each has a special important function that must not be overlooked during the system design planning stages. An efficient power design will reduce system maintenance and save money. A preventive maintenance program, including current carrying paths, tight connections, battery fluid levels and SBPS testing, should be instituted and followed to help locate potential trouble spots before a catastrophic failure occurs. ■

Special thanks to Bill McVay for his technical input and assistance in writing this article.



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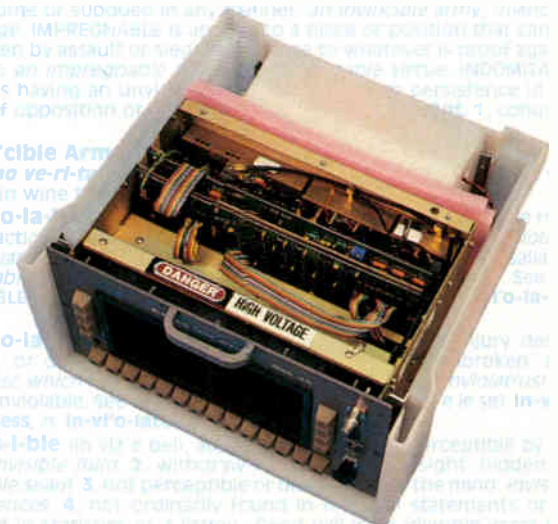
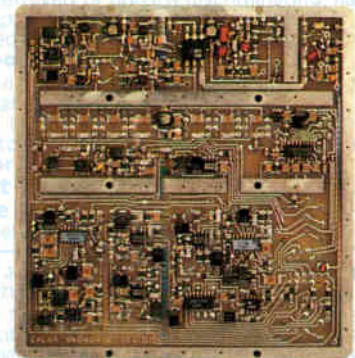


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in-vest-ment (in vest' mən't), *n.*

1. a devoting, using, or giving of time, talent, emotional energy, etc., as for a purpose or to achieve something. 2. a particular instance or mode of investing money. 3.



Don't take 'de feet' lightly

By Leslie W. Read

Field Service Engineer, Sammons Communications

Climbing boots are essential for comfort and safety when climbing utility poles. Although one can work on a pole using less sturdy footwear, it soon becomes painfully obvious that the question is not, "Shall I buy some climbing boots?" but "Which kind shall I buy?" This article is intended to provide some guidelines for the prospective purchaser but is not intended to be a *Consumer's Report*-style brand name comparison.

The prospective purchaser has an array of choices, ranging from a department or surplus/camping equipment store pair that might cost \$75 and would be available immediately, to a custom-made pair for \$400 with a four month delivery time.

What is the difference between the less and more expensive boots? What options are available to the purchaser and what are the advantages and disadvantages of these options? And who are the major suppliers of premium boots?

To spend or not to spend

The following are some of the differences between the less and more expensive boots you may want to consider:

1) Most of the boots, even some of the cheaper ones, have an extra layer of outside leather where the boot uppers might contact the pole.

2) Most premium boots have metal "pole guards" for further wear protection where the side of the boot sole contacts the pole.

3) Almost all boots have a steel shank (a metal plate between the outer and middle sole) designed to spread body weight over a wider area of the sole. Two exceptions are boots manufactured by White's, a well regarded firm in Spokane; and Kulien's, a custom manufacturer in Centraila, Wash. They choose to use a solid leather shank because they feel that properly treated leather will give ample support on the pole and, of course, the threat of rusting is eliminated.

4) The tongue in a premium boot will be stitched all the way to the top of the boot and will be wide enough to properly fold over when the boot is laced up.

5) There will be an additional piece of leather, sometimes called a "false tongue," between the laces and the tongue on the lower part of the boot. This reduces wear on the tongue

and improves the fit.

6) The eyelets and hooks will be solid brass, not plated.

7) In addition to these specific differences, most premium boots have thicker upper leather and soles than lower priced boots. If you have a chance for side-by-side comparison of premium and cheaper boots, the differences in leather, sole thickness and weight are often obvious.

The soles consist of an inner sole (what you feel when you put your hand inside), a middle sole for stiffness and an outer sole (the part that touches the ground). In premium boots all except the outer sole are leather. The cheapest boots have no middle sole. Incidentally, any footwear used to climb should have a definite heel to help hold the hooks in place; flat soles (as found in sneakers) have no place on poles.

The uppers can be loosely defined as everything above the sole. The thickness of the leather uppers is rated in ounces; a good quality boot will have 6- to 8-ounce leather uppers. Various terms such as "quarter," "vamp" and "counter" refer to the particular parts of the uppers.

8) The cheapest boots typically last about a year, although this varies with the wear and care that they receive. Premium boots last several years under the same conditions and can be rebuilt. Rebuilding is not cheap (you won't get much change from a \$100 bill) but the boots are nearly new and will give good service for several more years.

This "rebuildability" is one of the major differences between premium and cheaper boots. As you shop, ask the salesman if the manufacturer will rebuild the boots when they are worn. If the answer is "no" (or the salesman does not know what you are talking about) you are probably looking at non-premium footwear. Figure 1 shows a typical premium boot illustrating the side flap, pole guard and false tongue.

Options

There are a variety of options often available to the purchaser. They are usually boot height, sole type, regular or lace-to-toe style, roughout leather, color and type of laces.

The height will depend on a person's size, where hooks are worn and personal preference. Many climbers choose boots high enough so that the top strap of the hooks is completely on the boot. As shown in Figure 2, the right boot is comfortably higher than the top strap of the hooks; on the left boot the top strap is partly on the boot and partly above it, which is usually uncomfortable. (Alternatively, some purchasers choose boots low enough so they are completely below the straps.)

Another advantage of the higher boots can be a reduced tendency for the hooks to "kick back" when standing a pole. If the pants are either inside the boots or rolled above, the top strap will be completely on the boot and leather-to-leather contact can exist between the boot and strap. If the pants are turned up once before placing inside the boots, the user has two layers of cloth plus leather between himself and the hooks—a little additional padding.

Most premium manufacturers will, on request, supply any height; however the purchaser should be sure to find out whether the manufacturer is specifying height from the ground or from the sole of the foot. For example, an 18-inch boot measured from the ground is only 16 inches from the sole if the 2-inch heel is included. When trying on boots it is a good idea to bring in your hooks to see where they will fit on the boot.

Figure 1: Typical premium climbing boot



Some manufacturers do not install pole guards on boots with the heavy Vibram #100 sole because of its extra thickness. However, a competent shoe repair service can grind a small area of the sole down to the right thickness so it will accept pole guards. Figure 3 illustrates the difference between the two sole types; the upper is Vibram #100 and the lower is Vibram #430.

Many climbing boots are lace-to-toe style; as the name implies, the laces are closer to the toes than in more conventional boots. Some manufacturers feel this gives an improved fit in the lower part of the foot. About the only disadvantage is that the steel toe is not always available with this style; however, steel toes are not considered necessary when climbing poles, and foot comfort is critical. Steel toes also have been reported to feel colder in extremely cold weather than non-steel toes. Figure 4 shows a regular style (upper left) and lace-to-toe (lower right).

Roughout leather on the lower part of the uppers also is presented as an option by some manufacturers. It resists nicks and scratches better than smooth leather. I have had no input on this from users.

Color is a matter of personal preference but black is standard. Wesco offers a tan color they call "redwood." There is no difference in wearability.

Laces are either nylon or leather. I feel nylon is preferable because presently available leather laces stretch and break without warning. Whether nylon or leather laces are chosen, it is a good idea to get a spare pair long before you will need them if your boots are 16 or 18 inches high. Finding a replacement may be difficult at the local shoe shop.

Choosing your boots

There are three choices the prospective purchaser may have. He may choose off-the-shelf boots (whether they are inexpensive or premium), order boots from a premium manufacturer in a size that fits best or have his boots custom made.

The person choosing boots off-the-shelf generally is limited to one or two heights and one sole style. The heights are often 8-inch and 16-inch, and the sole is a Vibram #430 or something similar. The advantage is, of course, that the purchaser can try on the boots before purchase and walk away carrying (or wearing) them.

The person ordering sized boots from a premium manufacturer can choose from a variety of heights and sole styles. If he lives in an area where a stock is maintained by a distributor he can try on pairs to find the best size. Orders for the exact options he chooses are then taken through that distributor. It would be good to check the purchasing department of your company too, to see if they can arrange a better price through the distributor. This is even more likely if several people are buying boots at the same time.

It is extremely important that the manufacturer's instructions regarding measurement be read carefully and followed explicitly (e.g., should you be sitting or standing when measured; what socks should you be wearing; how tightly should the tape measure be pulled; etc.?). If there is some question you may wish to telephone the manufacturer; the cost of a telephone call is cheap compared to the aggravation you and the manufacturer both experience if the boots you receive are not what you want. At least two manufacturers provide toll free numbers for customers.

Delivery can be several days if the boots are in stock and several weeks if the size or options chosen are not in stock. It is prudent for you to check on this, as well as checking

Figure 2: A 2-inch difference in height



Figure 3: Sole types



on the return policy if the fit is not adequate.

Custom boots are the ultimate in fit and options. The boots you receive are made to measure using the measurements taken on your foot. Some of the suppliers listed make only custom boots; they do not make sized boots. Some others make primarily sized but offer a custom service at additional cost. Custom boots are expensive and take a long time. Plan on spending about \$300 (or more) and on waiting one to four months. However, custom boots are a good choice if you have very hard-to-fit feet, special requirements not

Figure 4: Regular vs. lace-to-toe style



available in standard footwear or if you spend many hours each day on hooks and just want to be certain you have the best possible foot support.

No matter which route you choose it is important when you are trying boots on, or are being measured for them, that you wear the socks you will have on when working in the boots. By the way, if you are contemplating buying a pair of used premium boots (as many of us have), try not to choose a pair that is obviously too tight. The leather will not stretch, and you will be stuck with an ill-fitting pair of boots. Slightly oversized boots, on the other hand, often will be satisfactory if worn with thicker socks.

Maintenance

Moisture is the enemy of leather because it removes the natural oils, causing the boots to dry out and then crack. This moisture comes from two sources—perspiration, and water or mud. You can't avoid either of these because your feet are going to sweat at times and you certainly can't be choosy about the terrain on which you walk.

Perspiration damage can be minimized by wearing two pairs of socks, ideally a light cotton pair next to the skin and wool socks next to the boot. The cotton pair will wick away the moisture from the skin and the wool will retain it.

Maintaining your boots by replenishing the natural oils will greatly lengthen their life. They should be treated with a preservative periodically to keep the leather from drying out and cracking but don't treat them too often if they haven't gotten wet or muddy. Every two weeks or once a month may be a good time for putting on preservative. Ideally, they should be treated just before they become dry; you will be the best judge of that.

There are a variety of preservatives on the market; mink oil is readily available and is good to replenish natural oils. Bee Seal Plus (Wesco) and Nor-V-Gen (Norweigan Leather Waterproofing Co.) enhance water resistance in addition to replenishing natural oils. There is some question about the use of mink oil: one manufacturer of motorcycling apparel considers it damaging to the cotton/polyester threads of his garments. The boot manufacturers consulted use nylon threads and felt it did not degrade the threads any faster than the natural leather oils. They did not discourage its use. When in doubt, check with the manufacturer of your boots.

If the boots get muddy, take immediate action. As much of the mud as possible should be removed as soon as possible

as mud can do more damage than plain water. After it has dried the remainder should be thoroughly brushed off. If the boots are just soaked with water they should be stuffed with newspaper and allowed to dry at room temperature or slightly above; some manufacturers sell dryers specifically for this purpose. Do not put them in front of a fire. Do not put them in a microwave oven either—they will be useless as footwear; edibility has not been tested. After the boots have been thoroughly cleaned and gently dried they should be treated with a preservative.

Suppliers

A partial list of suppliers of premium and custom boots is listed. A mail or telephone request should produce a catalog and/or measurement instructions. There are probably others of which I am unaware; readers are encouraged to write to *IT* with the name of any good supplier that may have been overlooked.

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This article is intended to provide guidelines for a prospective purchaser of climbing boots. The author has gathered information from technical and construction personnel, his own experience and conversations with some manufacturers. Special thanks are given to Bob Shoemaker of West Coast Shoe Co. for his information.

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Basic electronics theory

This is Part XIV 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 look at circuit Q, the bandwidth of a resonant circuit and circuits that separate or filter bands of frequencies.

The quality or figure of merit of a resonant circuit is measured in a quantity known as Q. The higher the Q of a resonant circuit, the more responsive that circuit is to specific frequencies. An example would be the ability of a radio receiver to select one station from all of the others available. The formula for finding circuit Q is as follows:

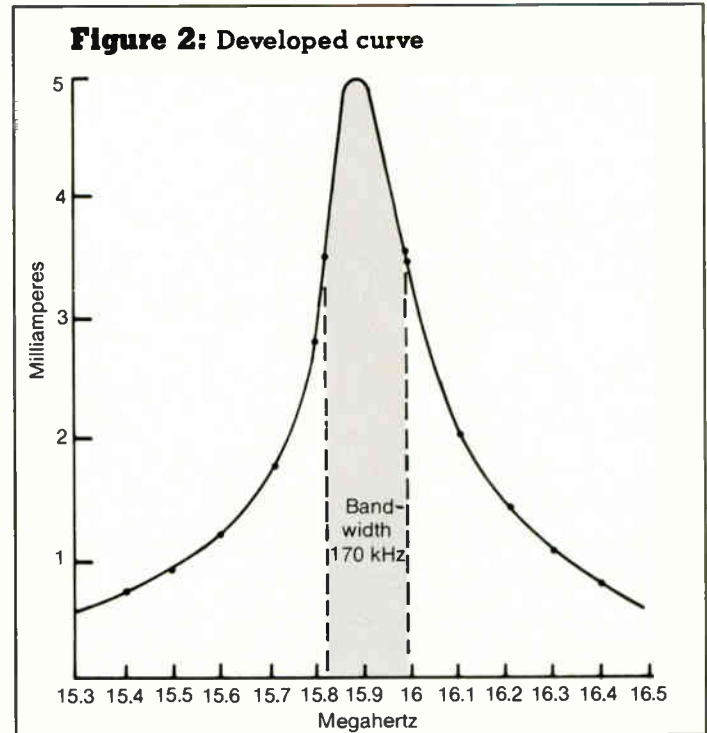
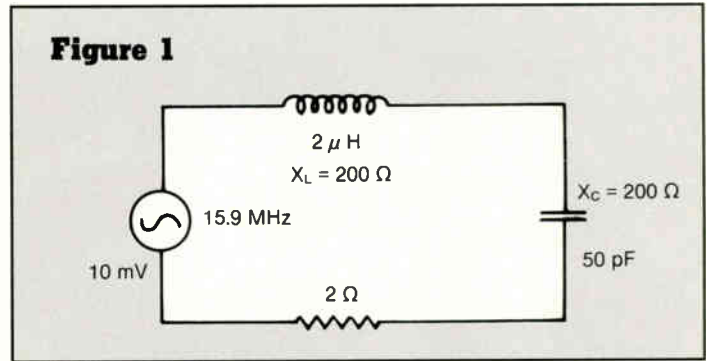
$$Q = \frac{X_L}{R_{series}}$$

Using Figure 1 we see that the inductive reactance (X_L) equals 200 ohms and that the resistor in series (R_{series}) with it is equal to 2 ohms. By placing these values into our formula we find that the Q of this circuit is equal to a value of 100.

Bandwidth

Bandwidth is the range of frequencies that can be passed by a resonant circuit without appreciable attenuation. The accompanying table has been constructed to find the values of the different variables associated with the circuit of Figure 1 and are used to determine the shape of its resonant curve.

Figure 2 is the developed curve. Note that frequency is plotted against the current flowing in the circuit at that frequency. The bandwidth of the circuit also is shown and



Resonant circuit values

Frequency	X_L	X_C	$X_L - X_C$	Z	I
15.4 MHz	193.5 ohms	207.0 ohms	13.5 ohms	13.65 ohms	0.732 mA
15.5	194.7	205.3	10.6	10.78	0.927
15.6	196.0	204.0	8.0	8.25	1.200
15.7	197.3	202.7	5.4	5.76	1.740
15.8	198.5	201.4	2.9	3.52	2.840
15.9	200.0	200.0	0.0	2.00	5.000
16.0	201.0	198.9	2.1	2.90	3.450
16.1	202.3	197.7	4.6	5.00	2.000
16.2	203.5	196.5	7.0	7.28	1.370
16.3	204.8	195.3	9.5	9.70	1.030
16.4	206.0	194.0	12.0	12.16	0.794

RENCE

Fitting

IES FIBER

ided Foil Tape, PVC "CATVD" Jacket
May require special cable prep dimensions.

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

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

for installation tools.

RILOGY

ided Foil Tape, PVC "CATVD" Jacket
May require special cable prep dimensions.

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

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

for installation tools.

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COMMUNICATIONS INC.



Hex Crimp Tools

Ben Hughes/Cable Prep

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

Gilbert

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

LRC

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

PPC

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

Ripley/Cablematic

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

Sargent/Rostra

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

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

SCTE

Interface Practices Committee

Antronix Brings You The Greatest Cable Invention Since Cable Itself.

The New Antronix® CAM-Port™

The "Connector Activated Mechanism" (CAM)

Introducing a revolution in cable port design: the Antronix® CAM-Port™. The new CAM-Port delivers the most reliable, intermittent-free connections since the dawn of the cable era.

New CAM Action. The new CAM mechanism will automatically grip any size center conductor with the exact contact pressure to insure a reliable, intermittent-free connection.

New Contact Design. The key to a proper mechanical and electrical connection is the contact area. Present design, by its own nature has to have a marginal contact area. In the CAM-Port, the whole contact is the contact area.

Normally Open Contact. This normally open contact design allows perfect plating over the entire contact area.

The Incredible Result: Exact contact pressure. No insertion wear on the contact. Perfect contact plating. No more loose connections. No more port failures. The new CAM-Port is rapidly setting a new industry standard. Soon, it will be standard equipment on all Antronix cable products.

Antronix is now connecting the world of communications better than ever. And suddenly, every other cable port is obsolete.

Make your perfect connection by calling Antronix at 201-446-2626.

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 Outside FL 800 433-3765

Southwestern Region
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 Outside TX 800 421-4334

Western Region
 Denver, CO 303 773-2205
 Outside CO 800 232-9378

REFERENCE

Fitting

RIES FIBER

ided Foil Tape, PVC "CATVD" Jacket
May require special cable prep dimensions.

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

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

for installation tools.

RILOGY

ided Foil Tape, PVC "CATVD" Jacket
May require special cable prep dimensions.

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

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

for installation tools.

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G-CRT-660	.324		.384
G-CRT-804	.262	.324	.384
G-CRT-986	.324		.360
G-CRT-USA			.360

LRC

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

PPC

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

Ripley/Cablematic

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

Sargent/Rostra

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

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The Incredible Result: Exact contact pressure. No insertion wear on the contact. Perfect contact plating. No more loose connections. No more port failures. The new CAM-Port is rapidly setting a new industry standard. Soon, it will be standard equipment on all Antronix cable products.

Antronix is now connecting the world of communications better than ever. And suddenly, every other cable port is obsolete.

Make your perfect connection by calling Antronix at 201-446-2626.

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 Outside CO 800 232-9378

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BELDEN

Foam Dielectric, APA Bonded Foil Tape, PVC "CATVD" Jacket
May require special cable prep dimensions.

Part Number	GILBERT		LRC*	PPC		RAYCHEM*
	Fitting	Crimp	Fitting	Fitting	Crimp	Fitting
9102 9103 9067	GFWL59-AHS-USA	.360	SNS-59-NS	CFSS-59-4HS	.324	EZF-59
9104 9105	GFWL59-AHS-USA	.360	SNS-59-NS	CFSS-59-4HS	.324	EZF-59
9108 9109	GFWL59-AHS-USA	.360	SNS-59-NS	CFSS-59-2HS	.324	EZF-59
9110 9111	GFWL59-AHS-USA	.360	SNS-59-NS	CFSS-59-4HS	.324	EZF-59
9052 9053 9063	GFWL59-AHS-USA	.360	SNS-59-NS	CFSS-59-4HS	.324	EZF-59
9054 9055	GFWL59-AHS-USA	.360	SNS-59-NS	CFSS-59-2HS	.324	EZF-59

Part Number	GILBERT		LRC	PPC		RAYCHEM
	Fitting	Crimp	Fitting	Fitting	Crimp	Fitting
9116 9117 9066	GFWL6-AHS-USA	.360	SNS-6-NS	CFSS-56-5HS	.384	EZF-6
9118 9119 9056 9057	GFWL6-AHS-USA	.360	SNS-6-NS	CFSS-56-5HS	.384	EZF-6
9058 9059 9062 9074	GFWL6-AHS-USA	.360	SNS-6-NS	CFSS-56-5HS	.384	EZF-6
9060 9061	GFWL6-AHS-USA	.360	SNS-6-NS	CFSS-56-3HS	.384	EZF-6

manufacturer's prep and/or installation tools.

COMM/SCOPE

Foam Dielectric, APA Bonded Foil Tape, PVC "CATVD" Jacket
May require special cable prep dimensions.

Part Number	GILBERT		LRC*	PPC		RAYCHEM*
	Fitting	Crimp	Fitting	Fitting	Crimp	Fitting
F5953BV F5953BVM F5953BEF	GFWL59-AHS-USA	.360	SNS-59-NS	CFSS-59-4HS	.324	EZF-59
F5967BV F5967BVM F5967BEF	GFWL59-AHS-USA	.360	SNS-59-NS	CFSS-59-4HS	.324	EZF-59
F5995BV F5995BVM F5995BEF	GFWL59-AHS-USA	.360	SNS-59-NS	CFSS-59-2HS	.324	EZF-59
F59TSV F59TSVM	GFWL59-AHS-USA	.360	SNS-59-NS	CFSS-59-2HS	.324	EZF-59
F59SSV F59SSVM F59SSEF	GFWL59-AHS-USA	.360	SNS-59QS-NS	CFSS-59-2HS	.324	EZF-59

Part Number	GILBERT		LRC	PPC		RAYCHEM
	Fitting	Crimp	Fitting	Fitting	Crimp	Fitting
F660BV F660BVM F660BEF	GFWL6-AHS-USA	.360	SNS-6-NS	CFSS-56-5HS	.384	EZF-6
F690BV F690BVM F690BEF	GFWL6-AHS-USA	.360	SNS-6-NS	CFSS-56-3HS	.384	EZF-6
F6TSV F6TSVM	GFWL6-AHS-USA	.360	SNS-6-NS	CFSS-56-5HS	.384	EZF-6
F6SSV F6SSVM F6SSEF	GFWL6-AHS-USA	.360	SNS-6QS-NS	CFSS-56-3HS	.384	EZF-6

manufacturer's prep and/or installation tools.

TIM

Foam Dielectric, APA Bor.

59 Series

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

6 Series

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

* Requires manufacturer's prep and

Foam Dielectric, APA Bor

59 Series

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

6 Series

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

* Requires manufacturer's prep and

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Some suppliers could care less about your
Next time, try MIDWEST CATV. The su



Pull-out
Wall Chart

COMMUNICATIONS TECHNOLOGY'S

F-FITTING CROSS-REFERENCE CHART

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

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

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

- | | |
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| BELDEN ELECTRONIC WIRE AND CABLE | (800) 235-3362 |
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| GILBERT ENGINEERING | (800) 528-0199 |
| LRC ELECTRONICS INC. | (800) 332-8428 |
| PRODUCTION PRODUCTS CO. | (800) 468-2288 |
| PYRAMID INDUSTRIES INC. | (800) 528-4529 |
| RAYCHEM | (415) 361-2288 |
| SARGENT/ROSTRA TOOL CO. | (203) 488-8665 |
| TIMES FIBER COMMUNICATIONS INC. | (800) 832-2288 |
| TRILOGY COMMUNICATIONS INC. | (800) 874-5649 |

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The Society of Cable Television Engineers

Fitting & Crimp

TIMES FIBER

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

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

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

TRILOGY

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

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

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

59 Series

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

6 Series

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

* Requires

59 Series

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

6 Series

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

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BELDEN

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

59 Series

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

6 Series

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

COMM/SCOPE

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

59 Series

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

6 Series

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

Compiled by Barry Smith, SCTE Interface Practices Committee

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Drop Cable

Figure 3: Low-pass and high-pass circuit shapes

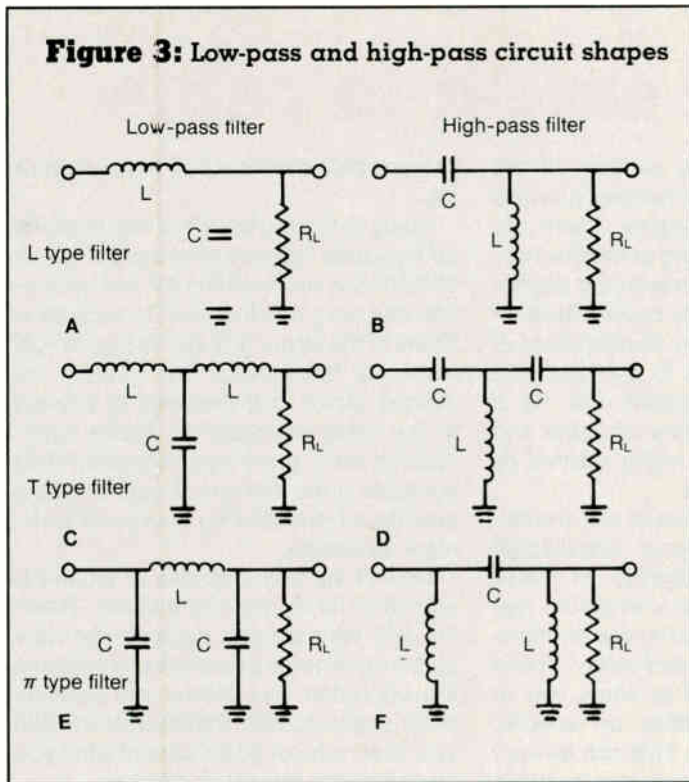
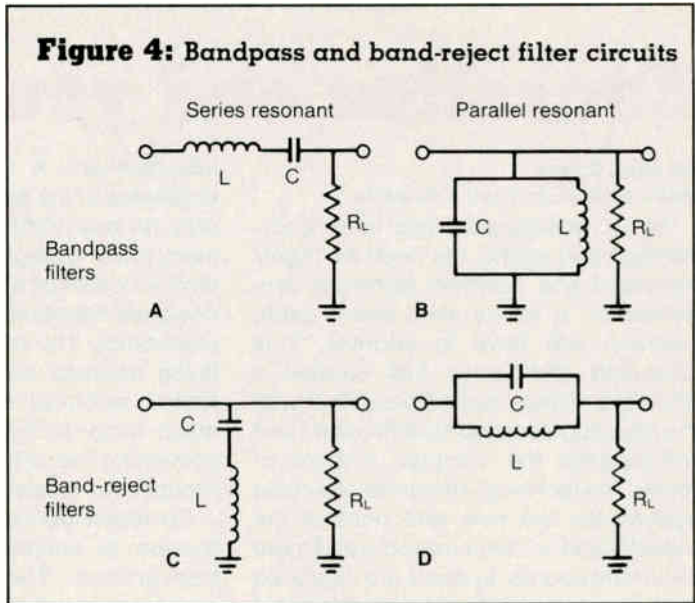


Figure 4: Bandpass and band-reject filter circuits



is defined as being 0.707 of the maximum current value both above and below the resonant frequency. In this example, the bandwidth is 170 kHz wide (16 MHz to 15.83 MHz).

Filter circuits

Filter circuits are used to separate frequencies in many applications including cable TV. Filter circuits are classified as either being low-pass, high-pass, band-pass or band-reject. As we found out in previous lessons, inductors offer very little opposition at lower frequencies while capacitors offer less opposition as frequency increases. With this in mind it is possible to design a network of inductors and capacitors that can be used to either accept or reject any band of frequencies that we wish.

The basic shapes of filter circuits are the L, T and π types. The load resistor (R_L) is not considered as part of the filter. Figure 3 shows both low-pass and high-pass filters in these configurations.

A *low-pass* filter circuit is one that allows the low frequency component of the input voltage to be developed across the load resistor without appreciable loss, while the higher frequency component is attenuated. Figures 3A, 3C and 3E are examples of low-pass filters. Notice that in all three cases, inductors are placed in the through line while capacitors are in parallel with the load resistor. When a voltage containing both high and low frequencies enters the filter, the higher frequencies find less opposition by the capacitors and go to ground. At the same time, the lower frequencies see the inductors as providing less opposition and pass on to the load resistor.

A *high-pass* filter circuit is one that allows the high frequency component of the input voltage to be developed across the load resistor without appreciable loss, while the lower frequency component is attenuated. Figures 3B, 3D and 3F are examples of high-pass filters. Notice that in all three cases, capacitors are placed in the through line while inductors are in parallel with the load resistor. When a voltage containing

both high and low frequencies enters the filter, the lower frequencies find less opposition by the inductors and go directly to ground. The high frequencies see the capacitors as providing lower opposition and pass on to the load resistor. By carefully choosing the values of L and C; either low-pass or high-pass filters can be designed to fit most applications.

A *bandpass* filter is used to pass a band of frequencies and contains either a series resonant circuit in its through line or a parallel resonant circuit across the load resistor. Remember that series resonant circuits have maximum current and minimum impedance, and parallel resonant circuits have minimum current and maximum impedance at resonance. Examples of both bandpass and band-reject filter circuits are shown in Figure 4. In Figure 4A, the series resonant circuit allows maximum signal to pass to the load resistor. In Figure 4B, the band of frequencies we wish to pass experiences maximum impedance and therefore passes on to the load resistor while all other frequencies are passed to ground.

A *band-reject* filter operates opposite to that of the bandpass filter in that we wish to eliminate a band of frequencies. In Figure 4C the band of frequencies at which the circuit is resonant is passed to ground while all others pass to the load resistor. In Figure 4D all frequencies pass to the load resistor except those at which the circuit is resonant.

Next month we will cover electronic power supplies.

Test your knowledge

- 1) What is circuit Q?
- 2) Define bandwidth.
- 3) Describe a π type filter.
- 4) Name three kinds of filters covered in this chapter.
- 5) What is a band-reject filter used for?

Answers

- 1) The quality or figure of merit of a resonant circuit.
- 2) The range of frequencies passed by a resonant circuit.
- 3) It contains a series component and two components on each side resembling the symbol π .
- 4) Bandpass, band-reject, low-pass and high-pass.
- 5) To eliminate a band of frequencies.

Education and your career in cable

By Jack Crites

Head Consultant, Jim Young & Associates

As technology becomes more complicated and exotic, the need for highly educated and qualified technical personnel is a factor that every cable operator will have to address. This changing technology has created a shortage of experienced personnel with the education needed to understand and troubleshoot the complex systems of today. The technical personnel of a cable system are the nuts and bolts of the industry and will become more and more important as older systems are upgraded to current technology. If one factor could be pinpointed that would ensure advancement of your career in cable, it would be education.

In demand

Technicians with formal education in electronics are being sought after more and more by employers in cable television. A two year associate's degree in electronics can be one of the most advantageous tools you can use for career

advancement. A large majority of the engineers in the cable industry possess only an associate's degree. There are many junior colleges and accredited v-tech schools that offer a two year degree designed specifically for cable television electronics. The recent development of these degrees points to the fact that formal technical education will be a major factor in the future of cable and something that will be highly desired by prospective employers.

Correspondence courses are another avenue to enhance your educational background. The majority of these courses are self-paced curriculum that allow you to proceed at a rate comfortable to your schedule and ability. These courses are designed to allow you to concentrate your studies on specific areas that interest you. This can be very beneficial in that it allows you to focus your studies on items that you are able to immediately use in your occupation.

There are several schools that offer cable-specific courses for entry level installers to advanced engineering topics for chief technicians and engineers. Many of the MSOs we deal with will ask specifically for candidates that have completed these types of courses. Most of these courses are not eligible for college credit at this time, but a trend is developing to certify the courses with major universities and colleges to allow credit.

Manufacturer seminars are great for broadening your knowledge of cable-specific technology. Most manufacturers offer some type of technical seminar or literature on the use, maintenance and troubleshooting of their equipment and are more than happy to pass this knowledge on to you. It is to your advantage to attend these seminars whenever possible. Your skills become more valuable and marketable as the types of equipment you are familiar with increase.

Trade publications are a very good source for learning more about the industry and the latest developments in technology. These magazines offer a wide range of items from how-to articles for entry level personnel to highly technical papers for engineers. The majority of these articles are written by industry veterans who have "been there," so the knowledge gained can be

of immediate practical use to you in your job.

Many of the professional associations for the cable industry offer a wide variety of technical publications for self education at a very nominal cost to members. Some of the larger groups hold technical seminars throughout the country on various topics and methods of interest to the cable professional. These associations are a great way to expand your contacts in the industry. These contacts provide an outstanding source of technical expertise.

One of the best avenues of technical education is on-the-job training. Training will very quickly become the cornerstone of cable operations as systems are upgraded and consumers become more sophisticated. Statistics show that you retain almost 80 percent of what you learn through hands-on training.

Most cable operators offer some type of training program for their employees, and many are developing a career program for their technical employees. This is beneficial to both you and the operator. The operator gets a loyal, higher quality employee and you are able to further your skills and knowledge of the industry. Another resource at this level is your fellow employees. That engineer you are working with is a great source to teach you the tricks of the trade. Don't be afraid to ask questions.

The bottom line is the more knowledge you have of the technical aspect of cable television, the more valuable your skills become to a prospective employer. Many of the hiring authorities we deal with will request that the candidates we submit for openings possess either a certain level of formal education in electronics or courses from correspondence schools. Correspondingly, the higher the education level, the higher the salary.

The education portion of your resume is just as important as the technical responsibility and skills section. As the systems become more exotic and new technology is integrated, the need for the highly educated and experienced technician to run and maintain the system will grow. This critical shortage will translate to better training and pay for the technical personnel who keep on the leading edge of their education and technical skills. ■



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Learning
the system

**Ben Hughes/
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Maintaining your hex crimp tool

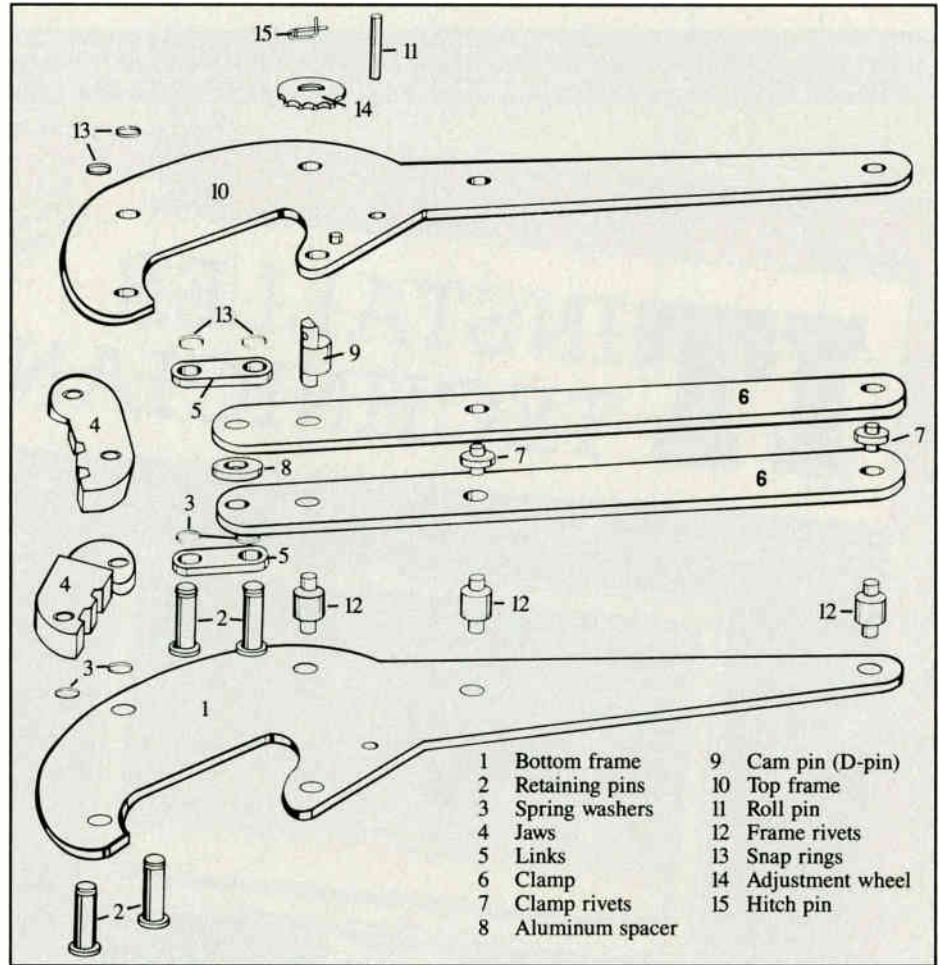
By Ben Hughes/Cable Prep

A major area of concern in cable systems is the cable/connector interface. Proper training in the use of hex crimp tools (HCT) is recommended. Connector manufacturers specify the proper hex size for their connectors and this should be adhered to in order to avoid "double-crimping" by installers or use of the wrong hex size. We manufacture a wide range of tools with various hex sizes specified by manufacturers of connectors. We have endeavored to cross-reference as much information as possible. The bottom line indicates that the cable, connector and hex size must be in accord with each other.

To extend the life of the Cable Prep hex crimp tool, it has a built-in adjustment feature. Determining when the tool needs to be adjusted is as important as which hex size to use. When a connector can be pulled off using a force of less than 50 pounds or the "toggle" action is no longer felt in the tool, rotating the adjustment wheel in a *counterclockwise* direction restores the toggle.

The uniqueness of the Cable Prep adjustment feature is such that field maintenance is fast and easy. One simply slides the hitch pin out of the hole in the camshaft (eccentric pin), adjusts the notched wheel (turn counterclockwise, in the direction of the available notches) and slides the hitch pin back through the hole. Small needle-nosed pliers are all that are needed. Should the hitch pin be lost, a simple cotter-pin is all that is needed.

Cable Prep offers its MK-1050 field maintenance kit to extend the life of the crimp tool. The primary wear points of an HCT have been designed into the pins, which are easily replaceable. The kit consists of four pins with rings, two links, the adjustment wheel and hitch pin. Our service department will restore worn crimp tools as well. For a nominal fee, each tool is examined by our experienced staff who installs the maintenance kit, readjusts the tool, applies new handle grips and returns it to the customer. The Cable Prep address and telephone number are on each tool for a reason—our obligation



to our customers does not end with the sale of the tool. The following are details on how to adjust the crimp tool and install a field maintenance kit.

Adjusting the compression wheel

Normal wear results in loss of toggle action in the tool. What does toggle mean? Pull the handles of your crimp tool together and if the jaws are completely closed together and there is almost one inch of space between the tips of the handles, you can pull about 3/4 inch further and you will meet slight resistance. Loosen your grip and the handles spring apart. That is the toggle.

Improper toggle means improper adjustment. Improper adjustment is indicated when the handles lock together

when compressed or you feel complete resistance to fully compress further.

If the tool is adjusted *too many notches clockwise*, the result is no toggle; too few notches results in handles sticking together. This can be restored by changing the compression adjustment.

Readjusting your hex crimp tool

You will need a small pick or needle-nosed pliers for this procedure.

- 1) Remove the silver hitch pin.
- 2) Lift the cogged wheel until it just clears the compression bump but is not removed from the D-pin.
- 3) Rotate the D-pin and cogged wheel together in a counterclockwise direction one notch.
- 4) Reset the cogged wheel down onto the

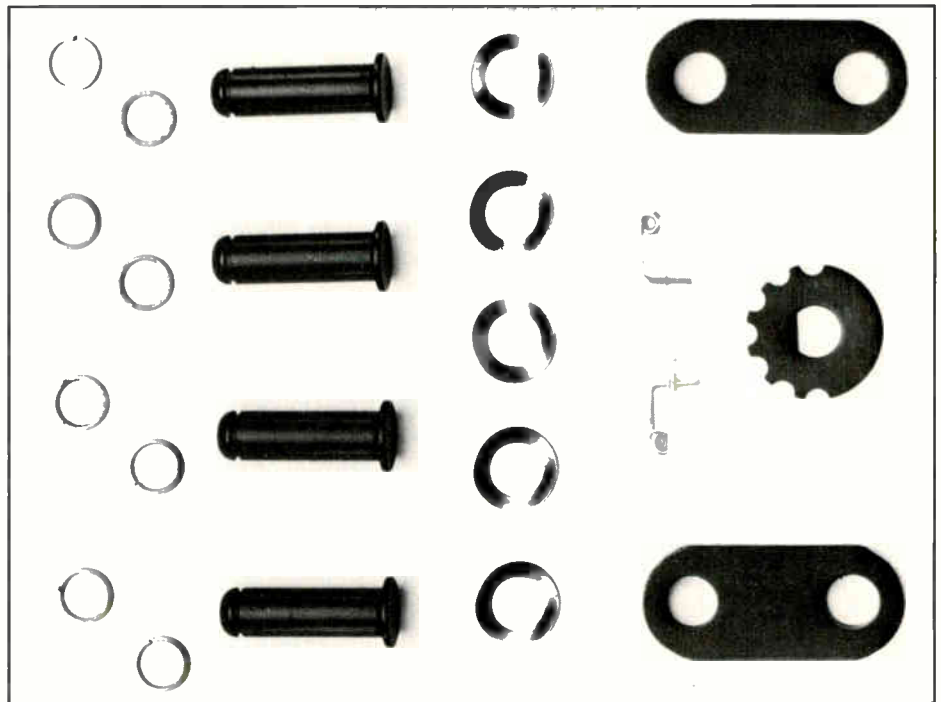
D-pin and against the compression bump. Fully compress the handles and the restored toggle should be evident. If no toggle is felt, lift the cogged wheel and rotate it one more notch counter-clockwise.

- 5) When toggle action has been restored, slide the silver hitch pin back into the D-pin to hold the cogged wheel in its readjusted position. Make sure that the L-shape on the hitch pin is on the flat of the D-shape by bending the straight edge of the pin slightly upward.

Installing the field maintenance kit

You will need needle-nosed pliers, a soft-faced hammer, pick-like object, punch and knife for this procedure.

- 1) Use a small pick or needle-nosed pliers to remove the hitch pin and cogged wheel.
- 2) Retaining pins hold the jaws in the frame of the tool. Since the tool is riveted together, remove and replace these pins *one at a time* or it becomes difficult to line up the jaws to place them back into the frame.
- 3) Replace the pins in the frame first and then the pins in the links. Each pin has a ring on one end and flat head on the other end. Pry the ring off the pin, inserting the pick into the split on each ring.
- 4) Push the pin out of the tool with a punch and hammer. At each pin location there is a U-shaped spring washer between the jaws, frame and links. Replacement washers are in the maintenance kit.
- 5) Once the pin is removed, use a thin knife blade to push out the old washer. Then insert a new washer and slide it between the jaw and frame until you can see it through the pinhole. At that point, use a small tapered punch to align the spring washer and jaw. Then install a new pin in same direction as the old pin (the flat side shows on the unmarked side of tool).
- 6) Rings that hold the pins in the tool are supplied by the MK-1050. These are put on the end of the pins by using a soft-faced hammer. Make sure the ring is seated in the pin groove and closed.



The MK-1050 field maintenance kit

- 7) Now that the pins in the frame are replaced, you can install the two pins holding the links. This time remove both pins. Each link has a short end, a round side and a flat side. The flat side goes against the tool. The short end of the link goes on the jaw side. An easy way to install new links is to build a small assembly. Push the two remaining pins through the holes in one link, then place a spring washer over each pin. For best results, set the link assembly on a hard surface and place the tool over the link assembly as it sits on the table. Now place the other link over the pins and using a soft-faced hammer, put rings onto the pins ensuring that the ring is seated in the pin groove and closed.
- 8) Next replace the adjusting wheel and hitch pin, and adjust the tool as described before. If these procedures fail to restore the toggle to your crimp tool send the tool back to us for further evaluation. In our experience, we have heard several schools of thought. One is that if the tool

is used as a hammer or pliers it will have to be replaced at least once a year. Another is that if the tool is treated as a precision instrument it will last for years. And lastly, replace the tool once a year on the principle that it is sound business practice.

We believe all three have valid points. Learning how to use the tool properly and maintaining it will not only keep it accurately calibrated, but will eliminate extensive service calls to subscribers' homes for problems incurred by improper crimping of coaxial connectors. Quarterly recalls of tools in a system for checks by a tech manager while repaired tools are recycled back into the system have proven to be an efficient program for maintenance procedures.

Educating personnel is definitely a top priority. Have small teaching seminars to reinforce all procedures involved, from prepping the cable for connectorization, to crimping the connectors, to proper maintenance of the tools and how to use them. People will take fewer shortcuts in doing a job if they know why a certain procedure is deemed necessary. ■

Controlling your future

By Arthur Leisey

President, CableCom Specialists Inc.

I formed CableCom Specialists Inc. soon after Regency Electronics closed down its cable TV products division in 1986. As Regency's senior field engineer, I initially formed the company to handle all service-related problems with Regency addressable controllers and encoders installed throughout the country. I soon found myself developing and supplying pay-per-view tier switching equipment to top-10 MSOs currently utilizing their existing Regency addressable controllers for PPV.

With the syndicated exclusivity arena heating up again, a natural follow-through to the original PPV switching gear was my Time-Programmable Remote Access Switch (TPRAS). Versatility in this unit is shown by an ATC cable system controlling Zenith encoders for pay-per-view, VP5000 tape decks, routine headend switching needs and soon, syndex switching, all with the Time-Programmable Remote Access Switcher.

The controller is IBM compatible, which means that if syndex were ever overturned, your headend engineering department would not be stuck with high-priced obsolete headend gear. The optional remote control feature enables your cable system personnel to stay in contact with the headend clock controller from anywhere using a standard phone line (and it's easy to use). The remote control option also enables many headend sites to be controlled from one central editing location, which means you can have a mini-network utilizing the standard phone lines already installed in your headends.

The event capacity per day/month is unlimited. It is programmable for 31 days in advance and with the hard drive option, you can program each month of the year for years in advance. With 128 lines of output, the controller can take the place of many other controllers in a headend. This means that all headend switching routines, (syndex as well as normal switching activity), can be programmed against one

real-time clock and by one person. The TPRAS software that controls the IBM interface/output card will run in a multi-tasking 286/386 environment. This enables one PC installed at the headend the ability to run many other programs simultaneously.

Outputs for a variety of applications

Our PC-based switch controller has easy-to-read screens and a menu-driven program that allows the technical staff, as well as the non-technical staff, ease of control of headend switching, including the following:

- video feeds, modulators and processors
- TTL and momentary TTL inputs
- heavy current switches
- relays
- routing switchers
- matrix switches
- IF and video switches
- contact closures
- VCR decks

Built-in macros can control several lines simultaneously for routine and reoccurring switches. This saves time and effort when editing the switch schedule.

The Time-Programmable Remote Access Switcher

The TPRAS is capable of taking the place of several existing clock controllers. It connects directly to the various control devices already installed in the headend. This enables one real-time clock to synchronize many switching routines from one central location. For switch control expansion, you need only add more switches to your existing racks.

Real-time clock with battery backup and automatic reboot

The software and hardware are IBM compatible. A highly accurate real-time clock is used as the basis for switch schedule control. The main timer screen contains all switch numbers, names and current state of the switches. It can be customized by each cable system to contain relevant switch names for each indi-

vidual output (i.e., Switch 1 VCR 2, Switch 2 CNNI, Relay 1).

Through a series of screens, simple questions are presented as to the switch number, date to switch and the time of day the switch is to occur. Once the entry is made, the program checks the entry for accuracy within a range of number or letter inputs to identify wrong inputs. It then stores this information on the system diskette.

The diskette provides a hard copy of the switch schedule in the event of a loss of power to the computer. When the computer has its power restored the program will then seek the exact second of the day through its battery backed up real-time clock and automatically reboot itself to the correct time of day without cable system personnel intervention.

Easy phone access

With the optional remote access package all editing and changing of the switch schedule can be done from one main office and transmitted to the headend or to several headends that have the Time-Programmable Remote Access Switcher installed. If just a simple switch needs to be activated, the on-line editing feature can be used.

Since the communication to the headend is done utilizing a standard touch tone phone line, the on-call technician can access the headend (with password security) from his or her home any time of the day or night. This allows for important equipment to have total backup capability with only a phone call.

Cost-efficient

The price for a system to control 64 output lines (expandable to 128) including an IBM compatible PC computer, real-time clock, TPRAS software and hardware interface card is \$3,895. Remote access is available for \$495 per receive site and \$245 for the transmit site, which includes 1,200 baud modems and a remote communications software package. ■

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Current Date 5/01

Current Time 10:00

HBO 11:00 1→H	Cinemax 2→L	MovieCh 22:00 3→L	CNN 11:30 4→L
Westar 23:00 5→L	Playboy 12:30 6→L	A&E 19:00 7→L	ESPN 15:00 8→L
VCR #1 15:30 9→L	Sweep#2 17:00 10→H	Sweep#3 11→L	Sweep#4 12:30 12→L
Video#1 12:00 13→H	Video#2 14→H	Video#3 12:00 15→L	Video#4 16→H
HighIF1 17→L	Satcom1 14:30 18→L	Satcom2 19:30 19→L	Satcom3 20→L
Galaxy1 16:00 21→L	Galaxy2 10:00 22→L	Galaxy3 23→L	Alarm 20:00 24→L
Relay#1 14:50 25→L	Relay#2 20:30 26→L	Relay#3 11:00 27→L	Relay#4 18:00 28→L
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Unique measurement applications: Wavetek 1882A sweep analyzer

By Steve Windle

Senior Applications Engineer, Wavetek

Wavetek's 1882A sweep analyzer is a very versatile test instrument. Along with automated spectrum test capability, the 1882A provides a flexible frequency response measurement mode. This sweep mode enables the operator to perform some tests easier and more accurately than was previously possible with multiple

pieces of test equipment.

The 1882A sweep mode works using a measurement process called normalization, in which a reference measurement is made and any successive measurements are shown as comparisons between the stored reference and the new measurement. This is a very accurate measurement process, since any consistent errors due to instrument, test lead, or probe signa-

ture, etc., are cancelled out.

The 1882A measures active carrier levels (audio and/or video) as well as the signal of a continuous sweep generator. The reference is stored at the headend amplifier or the first amplifier in the system, and each successive amplifier is compared to the first. This will verify that the system is following the unity gain principle (every amplifier's output is identical according to design).

A quick, accurate rough balance technique

The usual procedure when sweeping is to connect a signal level meter to the test point first for a rough balance. The rough balance is simply a means of setting the gain and slope of the amplifier by monitoring the level of a carrier at the low and high ends of the system. Using a signal level meter for this is a relatively simple operation, but does require retuning from high to low carrier until the levels are set according to plan. It also requires the use of another piece of test equipment (the SAM).

This extra piece of equipment can be used by someone else when the 1882A is used for sweeping. This application makes use of the 1882A's second channel plan and one of the reference memories. The procedure is to first store a sweep "channel plan" that consists of only the low and high carriers. An easy way to do this is to remove the RF input and build the channel plan. (This will probably be Channel Plan B, with Channel Plan A used for full spectrum sweep.)

After the channel plan is built (with no RF input, no channels will be in the plan yet), when the analyzer asks for test carriers, enter in the low and high carrier frequencies. Now connect the RF input and store a reference using Channel Plan B at the first amplifier. Because only two channels are being monitored the update is very quick, making gain and slope adjustments easy.

To align for the same balance as the first amplifier, the normalized display is adjusted to a flat response. The alignment is very accurate because each amplifier's



The Wavetek 1882A sweep analyzer

balance is "normalized" (directly compared) with that of the first amplifier. Other references may be stored using the same channel plan—in instances where tilt changes in different parts of the system (bridger outputs).

Distance to fault measurement application

A common application for system sweeping is to analyze standing waves on the frequency response to determine the distance to a fault. This is done by determining the frequency range covered by one cycle of the standing wave and plugging that frequency into the following equation:

$$\text{Distance to fault} = \frac{492 \times \text{VP}}{f_{\text{MHz}}}$$

Where:

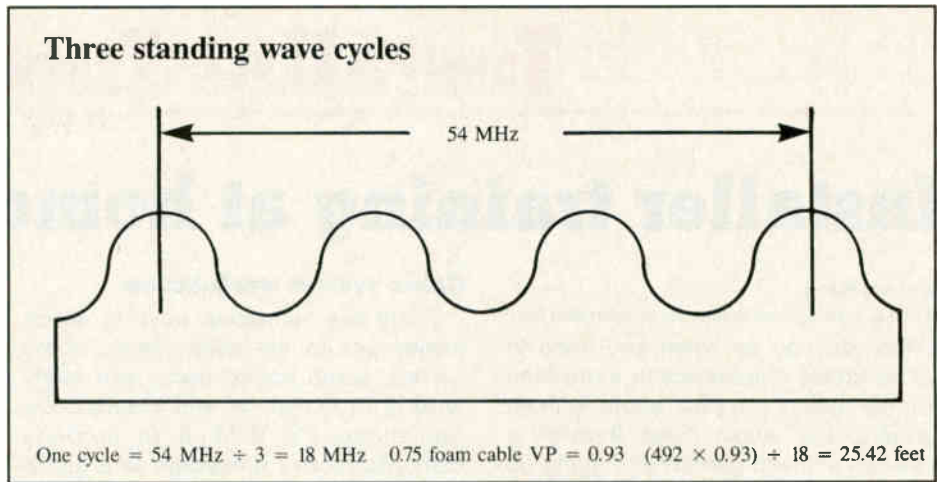
VP = the velocity of propagation factor of the cable

f_{MHz} = the frequency range covered by one cycle of the standing wave.

In the accompanying figure, the frequency of one cycle of the standing wave is 18 MHz (54 divided by three waves). Using foam cable, with a velocity of propagation factor of 0.93, the computations give us a distance of 25.42 feet to the fault. If the difference in frequency between the peaks happened to be 25 MHz, the distance would have been 18.3 feet.

The frequency resolution of the sweep affects the distance measurement capability in that if the resolution is too wide the standing waves may be overlooked or a false reading of the standing wave cycle may be made.

Another difficulty with this method of finding fault distance is that if the fault is



far away, the standing wave cycles will be very close together on the response display making it hard to determine the cycle frequency. The standing waves may be analyzed more closely and usually with higher resolution by narrowing the sweep width. Most sweep systems require a call back to the headend to change the transmitter parameters to cover a narrower frequency range at the low end of the spectrum (maybe 50 to 100 MHz).

With the 1882A no calls to the headend are needed since the sweep width is field-controllable. Channel Plan B may be used to store a high resolution sample at the low end of the spectrum (50 to 55 MHz with 100 kHz steps). A common bench sweep can be inserted with the same frequency parameters and at audio level to provide a reference for response measurement in that spectrum area.

When a standing wave is detected (while sweeping with Channel Plan A) the operator may switch to Channel Plan B for a higher resolution analysis of the standing wave cycles. At this resolution (100 kHz), a fault may be found up to 1,200 feet away.

Sweeping to 1 GHz

Sweeping to 1 GHz is easy with Wavetek's 1882A: If you don't have active carriers to use for a reference above 550 MHz you may fill this spectrum using a continuous sweep generator (Wavetek's 1801C, for example). During channel plan entry, when the 1882A asks for test carrier frequencies, or in the channel plan edit mode, enter the frequencies you would like to monitor for frequency response above 600 MHz. The rest is as easy as sweeping to 550 MHz.

The versatile 1882A sweep analyzer

Wavetek's 1882A sweep analyzer is extremely versatile, and ideal for cable TV system testing in that it was designed specifically for that purpose. Automated measurements, such as carrier-to-noise, cross modulation, and second and third order composite distortion, as well as frequency response analysis, make this instrument the answer for preventive maintenance and proof testing your system. Ready for the future, the 1882A measures frequency response up to 1 GHz. ■

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Installer training at home base

By Pam King

Technical Training Coordinator, Jones Intercable Inc.

What do you do when you need to train a group of installers in more than just the theory of installation, without tramping the whole class through a customer's flower garden or digging up the utility company's pole? How do you describe the procedure for properly attaching the messenger to the span clamp with mere words? One way is to take your installers "out in the field" right in your office. You don't need a lot of space, fancy equipment or a large training budget to create mini portable training stations.

Cable system workstation

There are numerous ways to attach messenger to the span clamp, some correct, some not so good, and many lacking in continuity and consistency. Sometimes it's difficult to properly demonstrate this procedure to a group of installers while you're up on a pole. A basic item you can create to ensure a consistent demonstration and give installers adequate practice is a hands-on workstation.

With the aid of this workstation, you can demonstrate all drop procedures related to the tap that may be difficult to demonstrate out in the field. The

installer can actually perform this part of the installation on the workstation while being observed and tested. If the plan is to train many installers at one time, you may want to create more than one station, as well as workstations for aerial and underground installation training.

It's easy to do and relatively inexpensive. The associates in the Jones Intercable system in Broward County, Fla. created four such workstations. Using the supplies listed in the accompanying table, and the aid of a couple of technicians equipped with tools, they were able to create four workstations in approximately one hour. Approximate costs to make two aerial and two underground hands-on workstations also are shown in the table.

Miscellaneous supplies include lashing wire and wood to create some kind of stand or base to support your "cable system." C clamps can be used to attach the base to a table top. If you plan to use the training station on a conference room table, be sure to protect the table by attaching felt, styrofoam or a similar type material to the bottom of your stand. The total cost for supplies for each individual work station is about \$25.

To assemble, cut the cable into four 1½-foot sections for the aerial work station and four 2-foot sections for the underground work station. These dimensions can be varied according to your applications. Connect the taps to the cable as normally would be done in the field. Secure the aerial cable and tap to the strand with lashing wire. Secure the underground cable to the pedestal with styrofoam packing material or build a base out of wood. A simple stand for the aerial system can be constructed of wood. Drill holes in the wood to support the ends of the cable and strand. Figure 1 illustrates one way to assemble the aerial system.

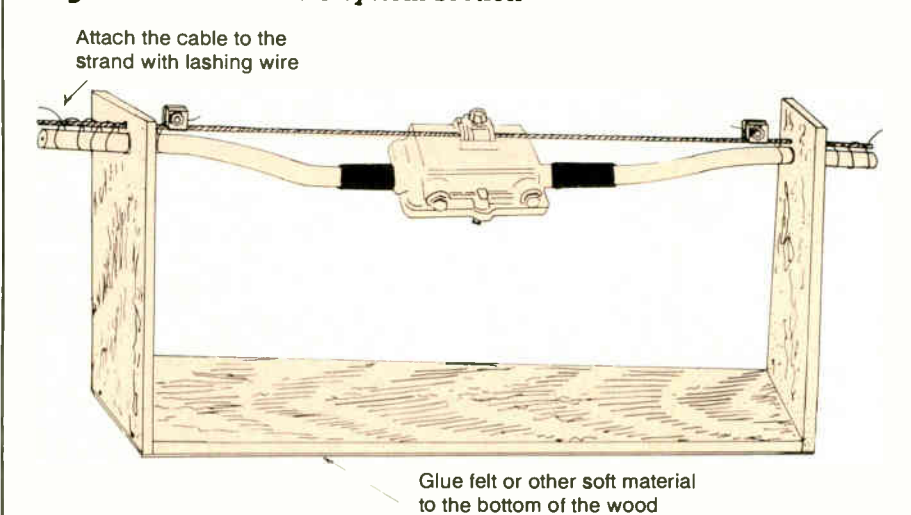
Drip loop board

There are probably as many ways to make a drip loop as there are to attach messenger to a span clamp or house hook. This too can be demonstrated in the classroom. The idea for a "drip loop



Associates from Jones' Broward County system put together a workstation.

Figure 1: Aerial cable system section



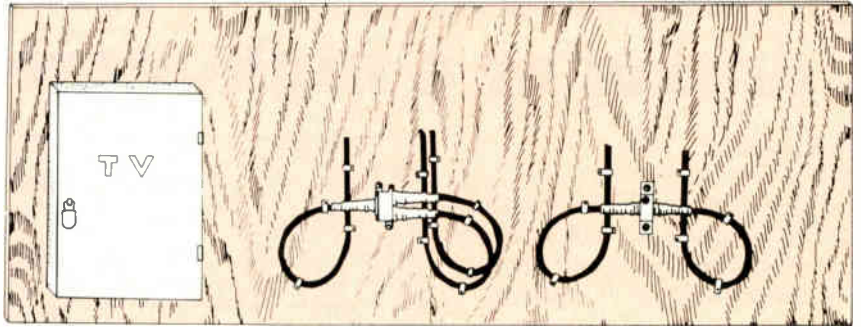
board" surfaced in our Independence, Mo. system. This board is especially helpful for contract installers who work in other systems and need to know a variety of specifications.

This board can be set up in a similar manner as the "knot board" you may have used in Boy Scouts. Sizes and shapes of drip loops can be set up and permanently attached. The range of what is in spec and what is out of spec can easily be explained. If your system uses house boxes a sample can be attached to the board. As with the tap workstation, the installer can actually perform this part of the installation in a controlled environment while being observed and tested. Figure 2 provides a sample of what may be done.

These training aids can be easily stored in a closet or office. Because they are portable, they can be transported to other systems as well as Society of Cable Television Engineers training seminars.

The previous descriptions just scratch the surface of what type of training aids you can develop on a low budget and with limited space. Of course, nothing replaces field experience, but it sometimes helps to have a little experience before getting out in the field. ■

Figure 2: Sample drip loop board



Workstations equipment and costs

Quantity	Item	Estimated cost/item	Total
2	Pedestals	\$14.00	\$28.00
4	Taps	9.00	36.00
14 feet	0.500 cable	0.25/foot	3.50
10 feet	Strand	0.08/foot	0.80
8	0.500 cable connectors	1.50	12.00
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Reader Service Number 22.

The installer and service truck: A dream or a nightmare?

By Dick Renard

Marketing Manager, Tailgater Inc.

The decision to procure an installation or service vehicle can result in peace or frustration, depending upon management's resourcefulness in investigating what meets a cable system's needs. If the truck is well organized, neatly carrying all tools and components, the work day can be pleasant. If the truck seems lacking, each day can be stressful, as one is running behind, locating items needed to finish (or even start) the job.

When initiating the search for a work vehicle, there are five upfitted combinations currently being used by most cable companies: 1) vans, with interior modifications, 2) pickup trucks modified with utility bodies, the bodies being in steel, aluminum or fiberglass, 3) pickup trucks fitted with lid systems in aluminum, steel or fiberglass, 4) pickup trucks with service or camper shells, in fiberglass, steel or aluminum, and 5) pickup trucks with tool boxes, in plastic, steel or aluminum.

After reviewing what is available, decide on the specific criteria to meet the system's requirements. Here are six apparent considerations: 1) payload capacity, 2) ease of access, 3) security, 4) visibility, 5) long-term costs and 6) resale value. For our analysis of these six upfitted combinations, we will consider mid-size pickups and small vans.

Payload capacity. Lids with racks and rack storage have the greatest capacity since there is no wasted space. Vans come next but have an amount of dead space, as crawl space is needed to reach the racks. Service shells hold an adequate amount, but unless they have side doors, it is very difficult to get to the middle of the vehicle. Utility bodies have a number of useful compartments, but it's difficult to organize, especially the narrow, open center section. Steel bodies, because of their weight, reduce the total payload of a mid-size pickup. Boxes, by their nature, will hold the least. Cross boxes hamper center storage, and the open space left in the truck does not lend itself to proper organization.

Ease of access. Low-profile, center-hinged lids will allow entry to all parts of the pickup truck. In a van, one has

	Payload capacity	Ease of access	Security	Safety and visibility	Long-term costs	Resale value	Total
Boxes	1	3	1	5	5	4	19
Lids	5	5	4	5	5	5	29
Shells	3	3	3	1	2	5	17
Vans	4	3	5	1	3	3	19
Utility bodies	2	3	2	3	1	1	12

Rating scale: 1 = Poor 5 = Excellent

to stoop or kneel to gain complete access. The outside compartments of utility bodies are very accessible, but a problem arises in reaching behind the cab into the open space. Shells and boxes are a toss-up because of reach. If the center area on a service shell is accessible, you've lost payload. Side boxes are easy to reach but are lacking in storage. The center portion of cross boxes are difficult to access unless you climb into the truck bed.

Security. Vans, especially without windows, are the most secure. Metal lids with hidden hinges are very secure. Service shells can be as secure as lids, but camper shells can be pried into fairly easily. Any fiberglass product shouldn't have exposed hinges or locking handles as these can be broken off easily. Compartments on utility bodies are generally secure, but nothing valuable should be stored in the center section. Toolboxes ultimately aren't secure, as they can be removed from the pickup bed.

Visibility. Lids and low-mounted toolboxes offer unobstructed views to the rear. Low height utility bodies have a blind spot toward the curb side. Full height utility bodies, tall side boxes, service shells and vans have serious rearward visibility problems.

Long-term costs. Boxes can be the cheapest investments if transferred to a replacement pickup. In actuality, boxes

are usually sold off when the truck is turned around. Transferable lids are a good investment as they are usually more robust than tool boxes. Shells generally need major refurbishing at the end of a truck's life. Van interiors are long-lasting and transferable, but vehicle replacement cost is significantly higher than pickup trucks. Utility bodies are the most costly. Not easily transferable, steel bodies will need repaint and the initial cost of aluminum and fiberglass bodies, while long lasting, is very high.

Resale value. Taking general vehicle condition into account, pickup trucks generally have a stronger resale value than industrial use vans. Therefore, pickup trucks with boxes, lids and camper shells, once removed, will have the best resale value. Boxes, without a bedliner, don't protect the bed and damage can occur to the floor and walls. Utility bodies traditionally have poor resale values and retrofitting the original bed is impractical, intensifying the original investment.

When considering the purchase of upfitted vehicles for the cable industry, remember to look at all the angles. Don't just look at what appears to be the cheapest solution. Cable is here to stay. Think long-term. Meet the needs of the serviceman in the field. With proper equipment, your long-term service response, reputation and profit will justify your choice. ■

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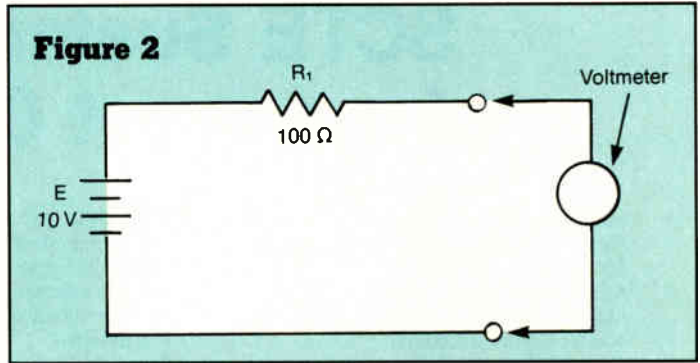
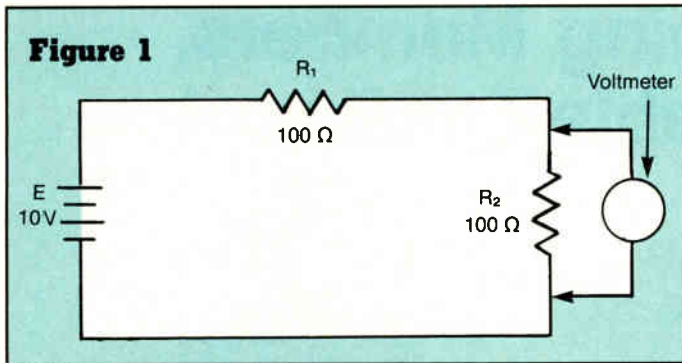
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Reader Service Number 23.

Troubleshooting



CATV and the voltmeter

By David Soldan

Lead/Bench Technician, Cablevision of Lincoln

The voltmeter is an essential tool for the CATV technician. But a little knowledge of this tool is necessary, or frustrating and time-consuming problems can arise, such as in the following case history.

The technician had arrived at the customer's house to find fine, horizontal lines in the pictures. Recognizing these

as the classic symptom for a power pack with low input voltage, the tech checked levels and verified pictures with his test set. Having confirmed his hunch, he set out to check the line extender that fed the customer.

Using an analog voltmeter, a check of the rectified DC voltage showed that there was not enough voltage for proper regulation. To make it easier to check input voltage, the tech pulled the module from the housing and checked for proper AC voltage on the center conductor seizure screw. This check showed a voltage of 48 VAC. Manufacturers' specs showed a low end of 42 VAC. Assuming the module was bad the technician changed it out only to find the replacement module exhibited the same symptoms.

A check with one of the lead techs solved one problem of checking input voltage with the module removed. Learning that the equipment needs to be in line to check voltages, the technician checked the input voltage again and found it to be about 45 VAC. This appeared to be sufficient but the power pack still would not regulate properly.

Two problems arose in this situation. The first was the problem of checking the line voltage with the equipment removed from the line. Going back to basic electronics and open circuit voltages, we can illustrate the problem using a simple circuit consisting of a DC voltage source with two series resistors across the source (Figure 1). A voltmeter across R_2 would show a reading of 5 volts. Using Ohm's law we can verify this reading:

$$R_T = R_1 + R_2 = 200 \text{ ohms}$$

$$I = E \div R_T = 50 \text{ mA}$$

"When checking an AC voltage the voltmeter responds to the average voltage of the AC waveform rather than the RMS voltage."

$$E_1 = I \times R_1 = 5 \text{ volts}$$

$$E_2 = E - E_1 = 5 \text{ volts}$$

Where:

R_T = total resistance

I = circuit current

E_1 = voltage drop across R_1

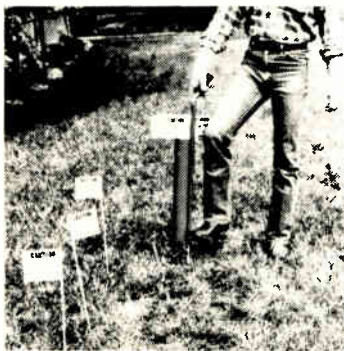
E_2 = voltage drop across R_2

E = source voltage

Now by removing R_2 (Figure 2) from circuit, the voltmeter will read 10 volts. With R_2 removed from circuit, R_T is now equal to infinity. This will give us a circuit current of 0 amperes. E_1 is equal to 0 volts. Thus E_2 will be equal to the source voltage of 10 volts.

Substituting the line extender for R_2 and the cable's DC loop resistance for R_1 we can see how this would affect our reading in the field by removing the module before checking voltages. Although the cable's DC loop resistance is very small, a line extender that is deep in cascade from the power supply can have cable lengths of around 12,000 feet. This will produce a resistance of several ohms and, with a current draw of around 0.5 ampere, this will drop voltage by several volts.

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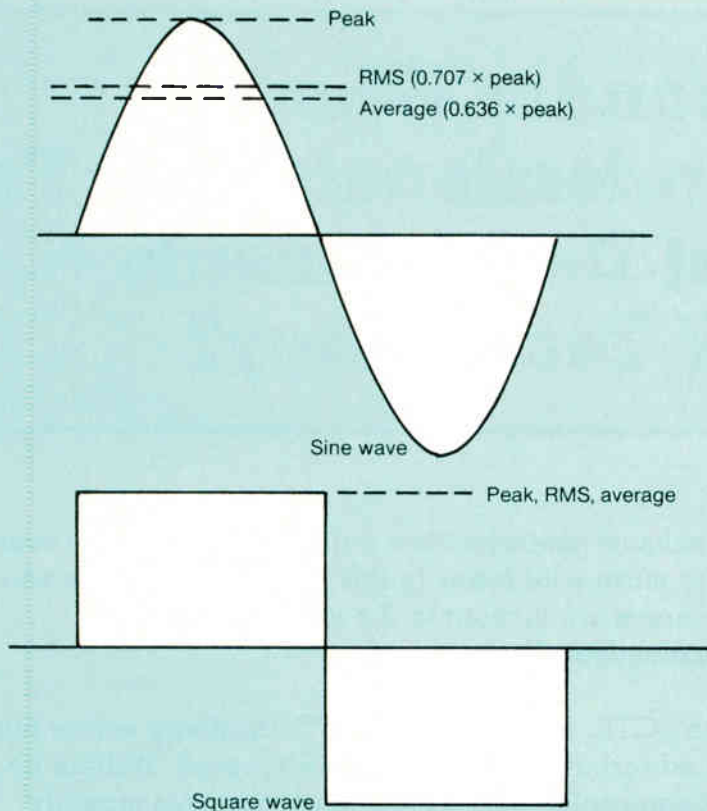
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Reader Service Number 24.

Figure 3



The trouble with squares

The second problem encountered by the technician was an inherent problem with using an inexpensive voltmeter. Most voltmeters were designed with sine wave voltages in mind. When checking an AC voltage the voltmeter responds to the average voltage of the AC waveform rather than the RMS voltage. Since we always refer to the RMS value, the voltmeter's AC scale has been calibrated to actually show us a RMS voltage.

The problem arises when checking AC voltages on the cable since CATV uses square wave voltages rather than sine wave. Looking at Figure 3 we see that the average and RMS voltage of a square wave is equal to the peak voltage. When using the voltmeter on the square wave it will respond to the average voltage but will read high since the scale is calibrated to correct for the difference of average and RMS voltage. The use of a true RMS voltmeter would solve this problem as they react to the RMS voltage rather than the average voltage, but they usually cost about three to five times as much as a good quality standard voltmeter. Because of the cost, most systems prefer the cheaper standard models.

We can calculate the amount of correction in a voltmeter by using the values in Figure 3:

$$E_a = 0.636 \times E_p$$

$$E_r = 0.707 \times E_p$$

Where:

$$E_a = \text{average voltage}$$

$$E_r = \text{RMS voltage}$$

By dividing 0.707 by 0.636 we find that RMS voltage is equal to the average voltage times 1.11. This is the correction factor. However, this assumes a perfect square wave, but since the square wave used in CATV has some rounding the correction factor is actually a little less than 1.1.

A good rule of thumb when checking square wave AC voltage on the cable is to remember that the reading will be approximately 1.1 times higher than the actual RMS voltage. Looking back at the reading the technician had earlier of 45 VAC and using the 1.1 correction factor we find the voltage actually is approximately 40.9 VAC. This was in fact tested and verified with a true RMS voltmeter.

When working with voltages out in a cable system, always remember to check voltages with all equipment in line and operating. Also, remember the voltage reading of a standard voltmeter when checking a square wave will be approximately 1.1 times the actual RMS voltage. ■

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Reader Service Number 25.

Ever Wonder Where Engineering Professionals Look For The Latest Developments In CATV Technology?

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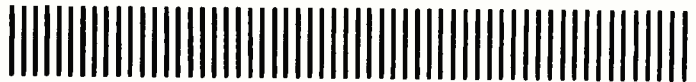
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IT 6/89



Installer's Tech Book

Converting dBmV to $\mu\text{V}/\text{m}$

By Ron Hranac
Senior Staff Engineer, Jones Intercable Inc.

Channel 5 (77.25 MHz)

dBmV	$\mu\text{V}/\text{m}$	dBmV	$\mu\text{V}/\text{m}$	dBmV	$\mu\text{V}/\text{m}$	dBmV	$\mu\text{V}/\text{m}$
-60	1.62	-35	28.85	-10	513.00	16	10235.71
-59	1.82	-34	32.37	-9	575.60	17	11484.65
-58	2.04	-33	36.32	-8	645.83	18	12885.99
-57	2.29	-32	40.75	-7	724.63	19	14458.32
-56	2.57	-31	45.72	-6	813.05	20	16222.50
-55	2.88	-30.22	50	-5	912.26	21	18201.94
-54	3.24	-30	51.30	-4	1023.57	22	20422.92
-53	3.63	-29	57.56	-3	1148.47	23	22914.89
-52	4.07	-28	64.58	-2	1288.60	24	25710.93
-51	4.57	-27	72.46	-1	1445.83	25	28848.14
-50	5.13	-26	81.31	0	1622.25	26	32368.14
-49	5.76	-25	91.23	1	1820.19	27	36317.65
-48	6.46	-24	102.36	2	2042.29	28	40749.08
-47	7.25	-23	114.85	3	2291.49	29	45721.22
-46	8.13	-22	128.86	4	2571.09	30	51300.05
-45	9.12	-21	144.58	5	2884.81	31	57559.60
-44	10.24	-20	162.23	6	3236.81	32	64582.94
-43	11.48	-19	182.02	7	3631.77	33	72463.25
-42	12.89	-18	204.23	8	4074.91	34	81305.10
-41	14.46	-17	229.15	9	4572.12	35	91225.82
-40	16.22	-16	257.11	10	5130.00	36	102357.06
-39	18.20	-15	288.48	11	5755.96	37	114846.50
-38.18	20	-14	323.68	12	6458.29	38	128859.90
-38	20.42	-13	363.18	13	7246.32	39	144583.18
-37	22.91	-12	407.49	14	8130.51	40	162225.00
-36	25.71	-11	457.21	15	9122.58		

Channel 6 (83.25 MHz)

dBmV	$\mu\text{V}/\text{m}$	dBmV	$\mu\text{V}/\text{m}$	dBmV	$\mu\text{V}/\text{m}$	dBmV	$\mu\text{V}/\text{m}$
-60	1.75	-35	31.09	-10	552.85	16	11030.71
-59	1.96	-34	34.88	-9	620.30	17	12376.66
-58	2.20	-33	39.14	-8	695.99	18	13886.84
-57	2.47	-32	43.91	-7	780.91	19	15581.29
-56	2.77	-31	49.27	-6	876.20	20	17482.50
-55	3.11	-30.87	50	-5	983.11	21	19615.69
-54	3.49	-30	55.28	-4	1103.07	22	22009.16
-53	3.91	-29	62.03	-3	1237.67	23	24694.69
-52	4.39	-28	69.60	-2	1388.68	24	27707.90
-51	4.93	-27	78.09	-1	1558.13	25	31088.77
-50	5.53	-26	87.62	0	1748.25	26	34882.17
-49	6.20	-25	98.31	1	1961.57	27	39138.44
-48	6.96	-24	110.31	2	2200.92	28	43914.05
-47	7.81	-23	123.77	3	2469.47	29	49272.38
-46	8.76	-22	138.87	4	2770.79	30	55284.52
-45	9.83	-21	155.81	5	3108.88	31	62030.25
-44	11.03	-20	174.83	6	3488.22	32	69599.09
-43	12.38	-19	196.16	7	3913.84	33	78091.46
-42	13.89	-18	220.09	8	4391.41	34	87620.06
-41	15.58	-17	246.95	9	4927.24	35	98311.32
-40	17.48	-16	277.08	10	5528.45	36	110307.12
-39	19.62	-15	310.89	11	6203.03	37	123766.62
-38.83	20	-14	348.82	12	6959.91	38	138868.43
-38	22.01	-13	391.38	13	7809.15	39	155812.95
-37	24.69	-12	439.14	14	8762.01	40	174825.00
-36	27.71	-11	492.72	15	9831.13		

Channel 98 or A-2 (109.275 MHz)

dBmV	μV/m	dBmV	μV/m	dBmV	μV/m	dBmV	μV/m
-60	2.29	-35	40.81	-10	725.67	16	14479.05
-59	2.57	-34	45.79	-9	814.22	17	16245.76
-58	2.89	-33.24	50	-8	913.57	18	18228.05
-57	3.24	-33	51.37	-7	1025.04	19	20452.20
-56	3.64	-32	57.64	-6	1150.11	20	22947.75
-55	4.08	-31	64.68	-5	1290.45	21	25747.80
-54	4.58	-30	72.57	-4	1447.91	22	28889.51
-53	5.14	-29	81.42	-3	1624.58	23	32414.56
-52	5.76	-28	91.36	-2	1822.80	24	36369.73
-51	6.47	-27	102.50	-1	2045.22	25	40807.51
-50	7.26	-26	115.01	0	2294.78	26	45786.78
-49	8.14	-25	129.04	1	2574.78	27	51373.61
-48	9.14	-24	144.79	2	2888.95	28	57642.14
-47	10.25	-23	162.46	3	3241.46	29	64675.55
-46	11.50	-22	182.28	4	3636.97	30	72567.16
-45	12.90	-21	204.52	5	4080.75	31	81421.69
-44	14.48	-20	229.48	6	4578.68	32	91356.64
-43	16.25	-19	257.48	7	5137.36	33	102503.83
-42	18.23	-18	288.90	8	5764.21	34	115011.19
-41.19	20	-17	324.15	9	6467.55	35	129044.68
-41	20.45	-16	363.70	10	7256.72	36	144790.51
-40	22.95	-15	408.08	11	8142.17	37	162457.63
-39	25.75	-14	457.87	12	9135.66	38	182280.46
-38	28.89	-13	513.74	13	10250.38	39	204522.04
-37	32.41	-12	576.42	14	11501.12	40	229477.50
-36	36.37	-11	646.76	15	12904.47		

Channel 99 or A-1 (115.275 MHz)

dBmV	μV/m	dBmV	μV/m	dBmV	μV/m	dBmV	μV/m
-60	2.42	-35	43.05	-10	765.52	16	15274.06
-59	2.72	-34	48.30	-9	858.92	17	17137.77
-58	3.05	-33.70	50	-8	963.73	18	19228.90
-57	3.42	-33	54.19	-7	1081.32	19	21575.18
-56	3.84	-32	60.81	-6	1213.26	20	24207.75
-55	4.30	-31	68.23	-5	1361.30	21	27161.54
-54	4.83	-30	76.55	-4	1527.41	22	30475.75
-53	5.42	-29	85.89	-3	1713.78	23	34194.36
-52	6.08	-28	96.37	-2	1922.89	24	38366.70
-51	6.82	-27	108.13	-1	2157.52	25	43048.14
-50	7.66	-26	121.33	0	2420.78	26	48300.81
-49	8.59	-25	136.13	1	2716.15	27	54194.40
-48	9.64	-24	152.74	2	3047.58	28	60807.12
-47	10.81	-23	171.38	3	3419.44	29	68226.71
-46	12.13	-22	192.29	4	3836.67	30	76551.63
-45	13.61	-21	215.75	5	4304.81	31	85892.34
-44	15.27	-20	242.08	6	4830.08	32	96372.79
-43	17.14	-19	271.62	7	5419.44	33	108132.05
-42	19.23	-18	304.76	8	6080.71	34	121326.15
-41.66	20	-17	341.94	9	6822.67	35	136130.18
-41	21.58	-16	383.67	10	7655.16	36	152740.58
-40	24.21	-15	430.48	11	8589.23	37	171377.75
-39	27.16	-14	483.01	12	9637.28	38	192288.99
-38	30.48	-13	541.94	13	10813.20	39	215751.80
-37	34.19	-12	608.07	14	12132.62	40	242077.50
-36	38.37	-11	682.27	15	13613.02		



From the NCTI

From the beginning, please

By Tom Brooksher

Marketing Director, National Cable Television Institute

After doing something for 21 years it is all too easy to take things for granted. Little things that to us are routine may be a mystery to people new to the process. If we aren't careful, that can happen to us at the National Cable Television Institute. When someone asks us about NCTI technical training, we often launch into long monologs about the headend, trunk system, feeder lines and drops, only to realize later that the blank look staring back at us was because the person asking the question didn't know the basics about NCTI training. The fact that our programs are self-study based, complement field experience, are organized into lessons and courses, require testing and certification, and a whole roster of other bits of information are facts we take for granted because we've been doing it for 21 years.

So from time to time it is helpful to review the basics. Things like what is NCTI? What do the courses cover? How do you enroll? How is your progress monitored? How is the program's validity maintained? How is certification achieved and what does it mean?

What is NCTI?

To start at the top, NCTI is an independent industrial training institute specializing in self-study programs in the technical area of the cable television industry. We train cable television technicians and engineers at cable systems, MSOs, contractors and cable industry vendors. We also train non-technical cable personnel, such as customer service representatives, managers and marketers, in the basics of the technical side of the business.

One of the reasons our program is unique is because it is built around a self-study format. Our course materials consist of training manuals in three-ring binders and book formats with study questions and exams. Since our students are already employed in the cable industry they study their NCTI courses on their own, answer review questions and submit exams. Also their work on the job serves as lab time in their overall

learning experience. Being able to actually practice what they are learning in their course work is one of the fundamental differences between the NCTI self-study concept and traditional correspondence schools. In addition, NCTI students have their supervisors and co-workers, as well as the NCTI staff, as resources should they need clarification or direction in their studies.

NCTI offers five basic career path courses as well as two special courses. Because the basic courses form a career path, they are designed on a building block concept. The advanced courses assume that the student has mastered fundamental concepts of electronic theory that are critical to advanced cable television engineering, and which are presented in previous courses. Thus, students must start at the first level and progress through each level of the program, or have studied electronic theory in another school or program.

The NCTI career path program begins by examining the drop system in the Installer and Installer Technician courses. From there a student progresses to the Service Technician course, which focuses on the feeder line system, then to the System Technician course, which covers the trunk line system. The final course, Advanced Technician, covers topics and equipment related to the headend.

The two special courses are the CATV System Overview and Broadband RF Technician. As its name implies, the Overview provides an introduction to the technical side of the industry. It consists of the same six lessons that any new student is required to take at the beginning of the first NCTI career path course enrolled in. As a stand-alone, special course, the Overview is often taken by non-technical cable personnel who want a general understanding of the components of the cable system and how they work.

The Broadband RF Technician course is a very specialized, advanced-level course designed for employees who have extensive training in electronics but who are new to the CATV industry. This course is ideal for employees with four-year or associates degrees in electronic

engineering or advanced military electronics training who need a comprehensive grounding in CATV technology.

Learning your lesson

All courses, career path and special, are comprised of a series of lessons. And each lesson is divided into segments. A student reads and studies a segment then completes a series of review questions at the end of the segment. After reading and studying each segment in a lesson, the student must complete a 10-item, multiple-question examination on the material covered in the lesson. The exam is submitted to NCTI on a grade card provided to the student by NCTI. Lesson exams are graded the day they are received, and the results are sent to the student in the next day's mail. The results show each answer submitted. Incorrect answers are marked as errors and the student is directed to the page in the text that contains the correct answer to the question. Should a student fail the exam, it must be retaken until a passing grade is received.

After the student studies each lesson and successfully passes each lesson exam, NCTI's computer creates an individualized final exam for the student. Because each final exam is built by random selection from a bank of questions covering the material in the course, each exam is unique to the student. The final exam is sent to the training contact designated for the system or company involved. The training contact, typically the student's supervisor, proctors the final exam. The fact that the exam is unique to the student and is supervised by a training contact ensures the integrity of the process.

Once the student successfully passes the final exam, notification of graduation is sent to his supervisor, along with a personalized certificate of graduation. The certificate attests to the student's successful completion of the program.

If you have any questions about NCTI's program, or need more detailed information on the material covered in each course, just call Jerry or Tom at (303) 761-8554. Or you can write to us at NCTI, P.O. Box 27277, Denver, CO 80227. ■



Saga for a Society

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

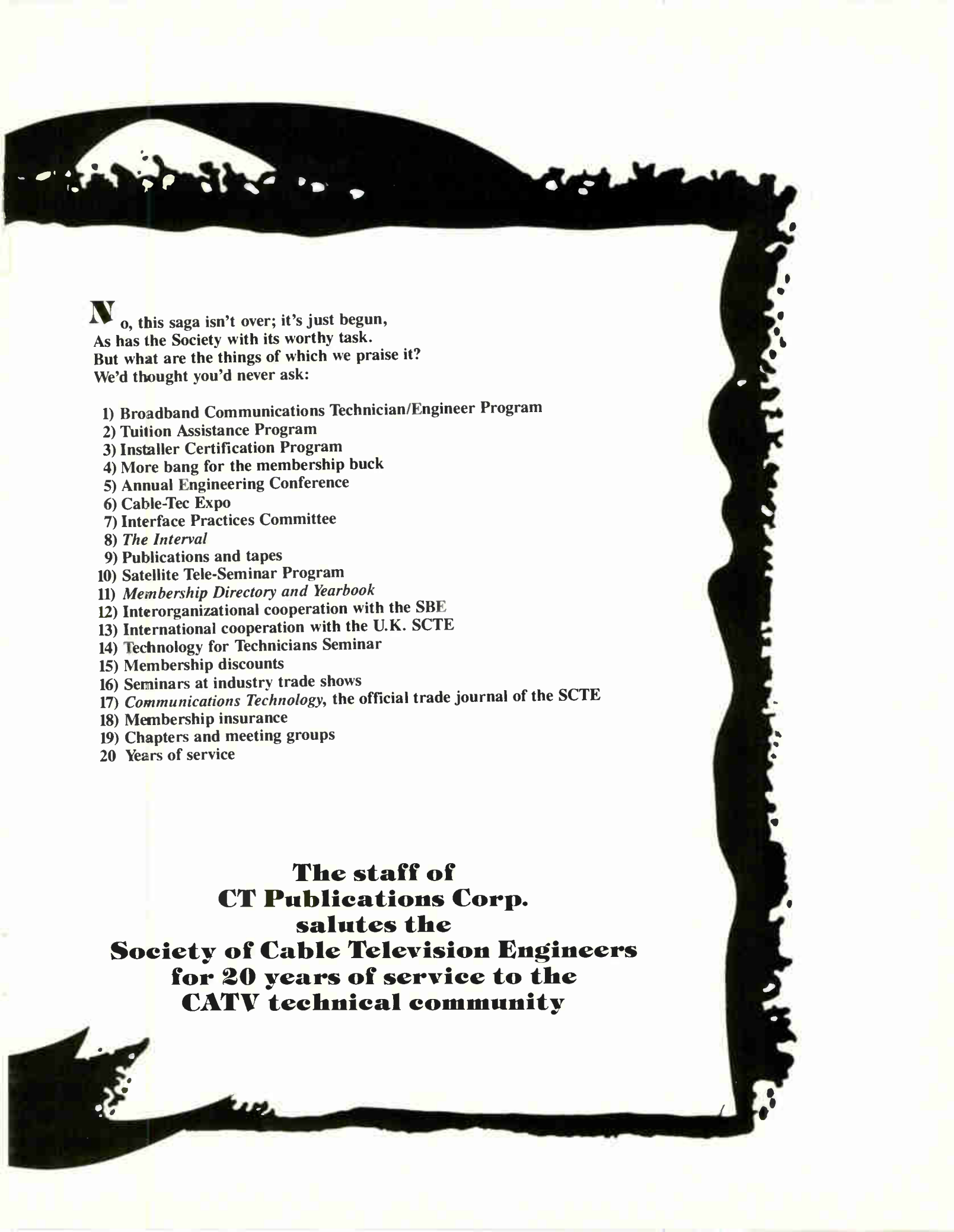
Once upon a time—no one knows the date
(Actually, it was June 22, 1969)—
At a small hostel in an unknown land
(Of course, it was the San Francisco Hilton),
A small gathering of noble descent
(Would you believe 79 CATV engineers)
Met to establish a secret band
(No secret—it was the SCTE).

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

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

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

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



No, this saga isn't over; it's just begun,
As has the Society with its worthy task.
But what are the things of which we praise it?
We'd thought you'd never ask:

- 1) Broadband Communications Technician/Engineer Program
- 2) Tuition Assistance Program
- 3) Installer Certification Program
- 4) More bang for the membership buck
- 5) Annual Engineering Conference
- 6) Cable-Tec Expo
- 7) Interface Practices Committee
- 8) *The Interval*
- 9) Publications and tapes
- 10) Satellite Tele-Seminar Program
- 11) *Membership Directory and Yearbook*
- 12) Interorganizational cooperation with the SBE
- 13) International cooperation with the U.K. SCTE
- 14) Technology for Technicians Seminar
- 15) Membership discounts
- 16) Seminars at industry trade shows
- 17) *Communications Technology*, the official trade journal of the SCTE
- 18) Membership insurance
- 19) Chapters and meeting groups
- 20) Years of service

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 LN TCH, N, 11/HR
 LN TCH, SW, 10/HR

TECHNICIANS

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 LN TCH, MW, 9/HR
 LN TCH, E, 12/HR
 LN TCH, MW, 9/HR
 LD TCH, SE, 10/HR
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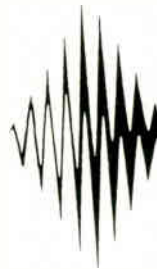
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PCMB-2H, HOUSING FOR PCMB-2

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PCM-4H, HOUSING FOR PCM-4

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PCSPL-4, SPLITTER

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PD-3, PAD

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PD-9, PAD

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T4BDL-12, PAD

T4CM, CONTINUITY MODULE

T4SPL, PAD

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TFM, TRUNK AMP MGC

TFPS, POWER SUPPLY

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XR2HM, LINE AMP HYBRID HRC

XR2LAF-1, POWER INPUT MOD

XR2LAF-2, POWER INPUT MOD

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XR2PS, POWER SUPPLY

XR2RHA110, REVERSE AGC MOD

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XRCE-6, LINE EXT

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XRLA, LINE AMP

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Another feature of the VSCST-1 is the snap-in blade replacement cartridge. Extra replacement cartridges are available. An allen wrench is supplied for blade adjustments.

For more information, contact Viewsonics Inc., 170 Eileen Way, Syosset, N.Y. 11791, (516) 921-7080; or circle #134 on the reader service card.



Tool kit

Jensen Tools Inc. modified its field engineer's kit, the JTK-87, to include a meter and oscilloscope. The JTK-87TEK includes the complete JTK-87 complement of 70+ tools for handling a wide variety of service or repair tasks, a Fluke 88 DMM and a Model 222 Tektronix oscilloscope. This kit is also available with other scope models or without a scope and meter for individual customizing.

For more information, contact Jensen Tools Inc., 7815 S. 46th St., Phoenix, Ariz. 85044, (602) 968-6231; or circle #125 on the reader service card.

Monitor/vectorscope

Leader Instruments announced the

availability of the Model 5872, a new combination waveform monitor/vectorscope. Features include simultaneous vector and waveform display for video signal monitoring and dual channel display for observation of two video sources on the same screen. According to Leader, a switching mode power supply automatically adapts the unit to a wide range of AC (90-250 VAC, 48-440 Hz) and DC (11-20 VDC) voltages

making the instrument ideal for ENG/EFP applications. The 5872 is housed in a metal cabinet with a handle and feet for bench use. The cabinet is removable for rack mounting purposes.

For further information, contact Leader Instruments Corp., 380 Oser Ave., Hauppauge, N.Y. 11788, (516) 231-6900; or circle #133 on the reader service card.

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And above all, keep your head

By Arnold Cisneros

Construction Manager, Heritage Cablevision

In 1919 the first hard hat was made out of several layers of varnished, resin-impregnated canvas. These were inspired by the World War I military helmets. They were lightweight, strong enough to deflect falling objects and electronically non-conductive. They worked! The original canvas was later replaced by aluminum, fiberglass and vulcanized fiber.

The world's first all "hard hat" project was in the 1930s. It was the making of the Golden Gate Bridge in San Francisco.

Are we wiring up?

While there are many types of equipment to protect an individual against any hazard, the most visible is the hard hat. Michael Bross, product manager at E.B. Bullard Co. of California says it best, "The hard hat is the most visible symbol of America's commitment to safety."¹ It appears that we have finally wised up to the fact that a hard hat can save your life or prevent serious injury. It seems like everyone is wearing them—linemen, plumbers, carpenters, surveyors, miners, and the list goes on.

Although the hard hat offers little protection when it comes to lateral blows, most of us in the cable industry are involved in direct blows from above us, although we have no business directly under the pole. Of course, the hard hat can protect us from an electrical line above that we may run into.

Hard hats finally have been accepted by individuals or forced on them by companies who realize the importance of head safety. (I think that the reason also is that we've all banged or bumped our head enough times to learn!) The same old excuses for not wearing a hard hat are still around. Ever heard them? Listen—"It doesn't feel good on me," "It doesn't look good on me," "It's too heavy and bulky," "The wind blows it off," "It makes my fat face look fatter and I look like Brutus (Popeye's foe),"—and the list goes on.

One of the most important pieces of safety equipment we wear is the hard

hat. This piece of protective gear is unfortunately the one taken the most for granted. We never appreciate it until something falls from the pole above us and hits our hard hat. At this time we think, "What if I had not been wearing my hard hat?" What if we were not wearing our hard hat? Well for starters, depending on the object that fell and from how high up, the chances of a bad injury are very likely.

Have you ever climbed up a pole and not realized that you were getting yourself into power? Of course you have! Here again, a hard hat protects you from up to 20,000 volts! Have you ever climbed a pole and, while looking down, bumped your head on a through bolt sticking out too far? Sure you have!

Horror stories

A construction lineman who was on a pole dropped a square washer, which hit a grunt below on the head. The grunt, of course, was not wearing his hat. The washer struck the head with one of its four corners and put a very nasty cut on the poor grunt's head. Had it been the lineman's bell wrench that fell, it might have killed him.

Another fellow I know very well was working with his buddy on a pole removing a power supply. The power supply came loose all of a sudden and fell on my friend's head, striking him with the sharp corner. He required several stitches and several days off work to recuperate. And he thought he was being smart before he started working by throwing his hard hat on the ground to make it look like the wind blew it off his head while he was working!

According to the National Safety Council's "Accident Facts," some 120,000 workplace head injuries were reported in the United States in 1987.² This cost is estimated at \$2.5 billion in workers compensation insurance, medical expenses, accident investigations and associated costs due to lost time and substitute workers. This is an average cost of more than \$22,500 per worker who received a head injury.

Because of requests by safety managers and safety officers, manu-

"Manufacturers have begun research on new types of industrial helmets that offer impact and penetration protection to a greater area of the head."

facturers have begun research on new types of industrial helmets that offer impact and penetration protection to a greater area of the head. Hard hats and helmets are being looked at by the American National Standards Institute Z89. They are the committee responsible for seeing that all specs are met on the manufacturing of hard hats. Hard hats are classed in four categories:

- 1) Class A—limited voltage, general duty
 - 2) Class B—high voltage protection
 - 3) Class C—no voltage protection (metal)
 - 4) Class D—fire fighter helmets
- Class B are most commonly used in our industry because of the voltage protection (20,000 volts) and the maximum force it withstands (850 pounds).

Remember hard hats do two things: provide protection from head injuries and provide protection from electrical shock. Always wear a hard hat, especially when working aloft, working under a pole, in trenches over 3 feet deep, in all building construction areas and when you are in danger of accidental contact with electrical objects. Also remember to inspect your hard hat. Check for physical damage or wear, check suspension for proper fit and make sure there are no unauthorized decals or missing plugs in the accessory slots.

It doesn't take but five seconds to put your hard hat on. If the wind is blowing, use a chin strap with it. Remember, it's your life you need to watch out for. No one's going to look after it for you. So remember, keep cool, be careful and, above all, keep your head! ■

References

¹Safety & Health Magazine, March 1989.

²Outside Plant Magazine, February 1989.

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Calendar

June

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

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

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

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

June 19-21: Magnavox CATV technical seminar, Orlando, Fla. Contact Amy Haube,

(800) 448-5171.

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

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

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

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

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

Upcoming

June 15-18: Cable-Tec Expo '89, Orange County Convention Center, Orlando, Fla.

Aug. 27-29: Eastern Show, Atlanta Merchandise Mart, Atlanta.

Sept. 20-22: Great Lakes Expo, Convention Center, Columbus, Ohio.

Oct. 3-5: Atlantic Show, Convention Center, Atlantic City, N.J.

Oct. 17-19: Mid-America Show, Hilton Plaza Inn, Kansas City, Mo.

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

June 26-29: Siecor Corp. technical seminar on fiber-optic installation and splicing for cable TV applications,

Hickory, N.C. Contact (704) 327-5539.

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

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

July

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

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

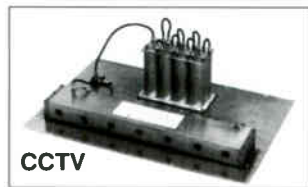
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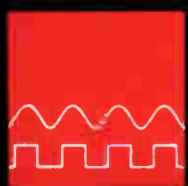
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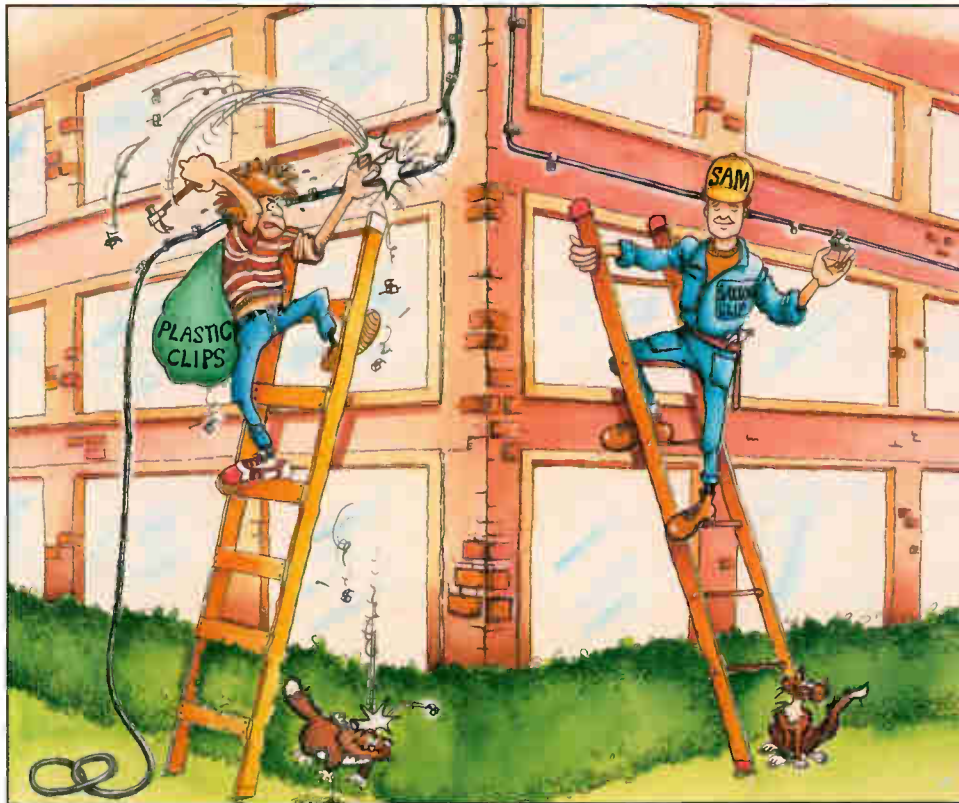
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