September 1988

Spotlight on system design

IT INSTALLER TECHNICIAN

The cable magazine for installers and technicians. Formerly CATJ, Cable Tech.

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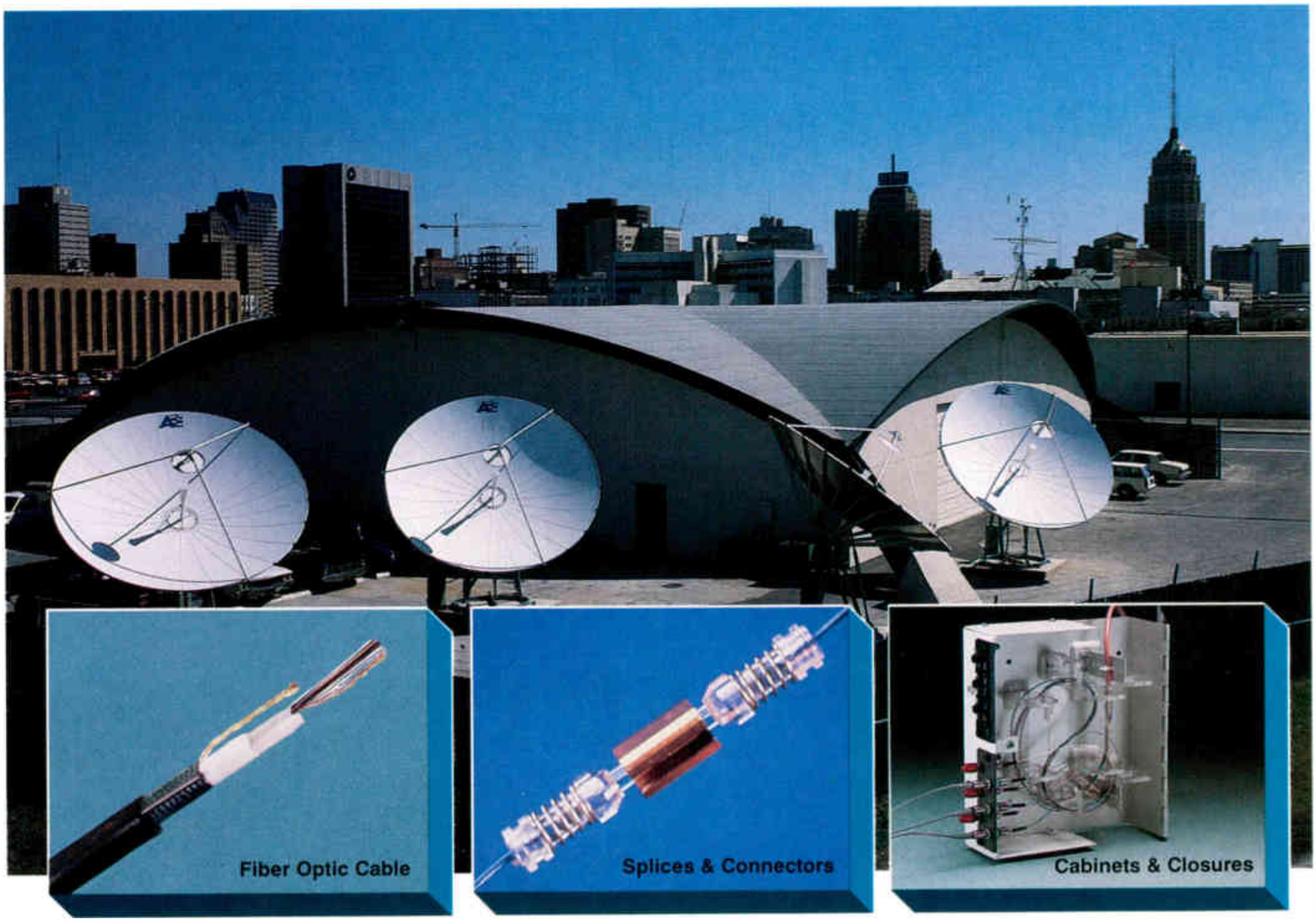

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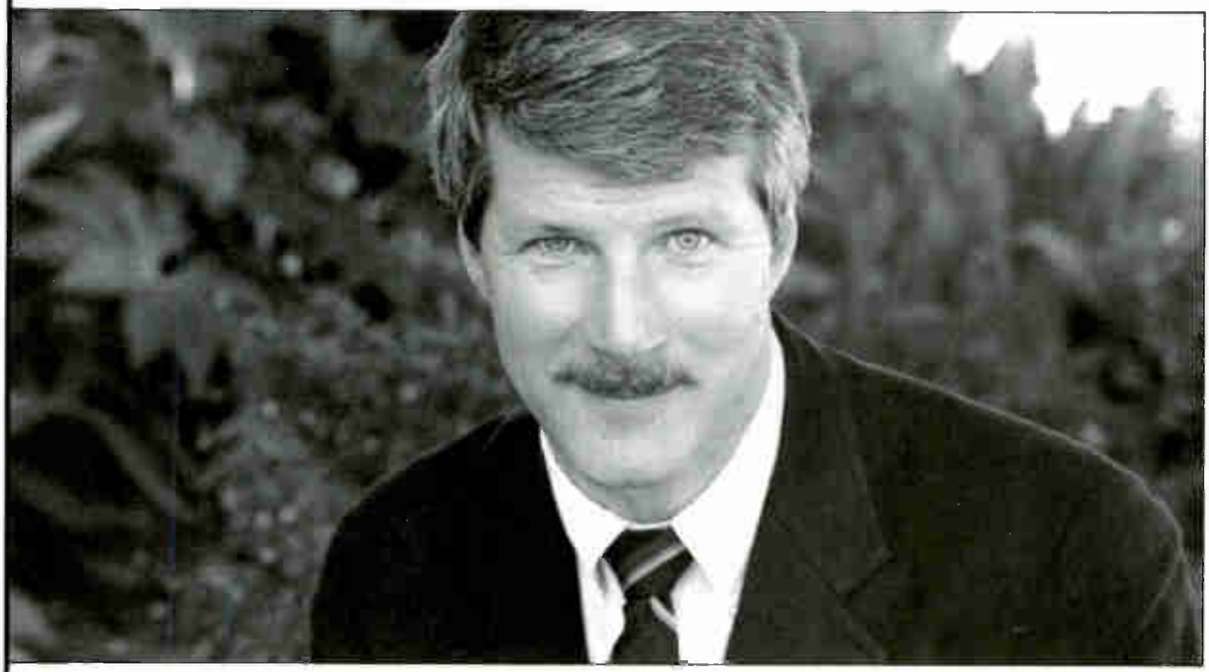

Bob Luff
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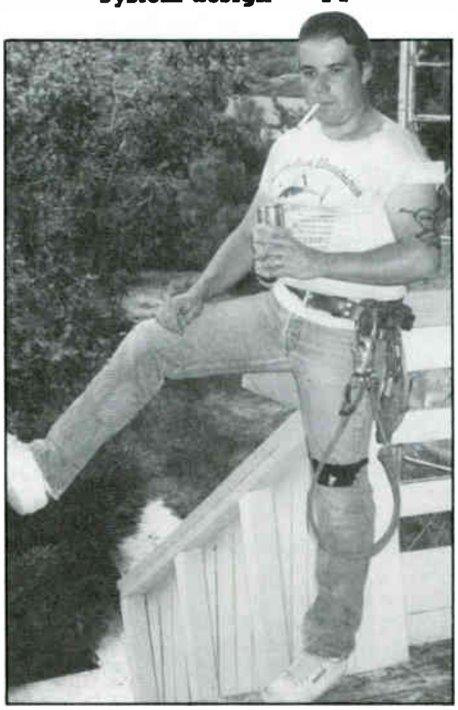
Contents

Departments

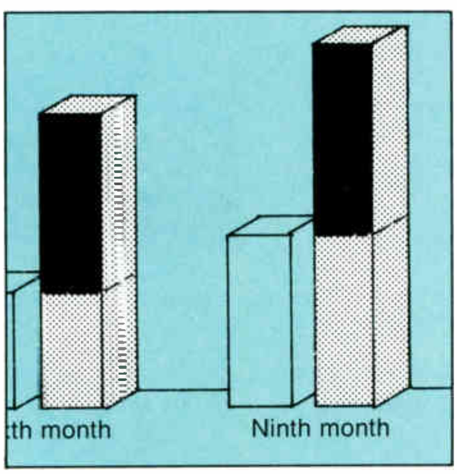
Cover

Designing a CATV system, an "enlightning" experience. Art by Geri Saye.

System design 14



Installer Input 32



From the NCTI 38

Features

Advertorials

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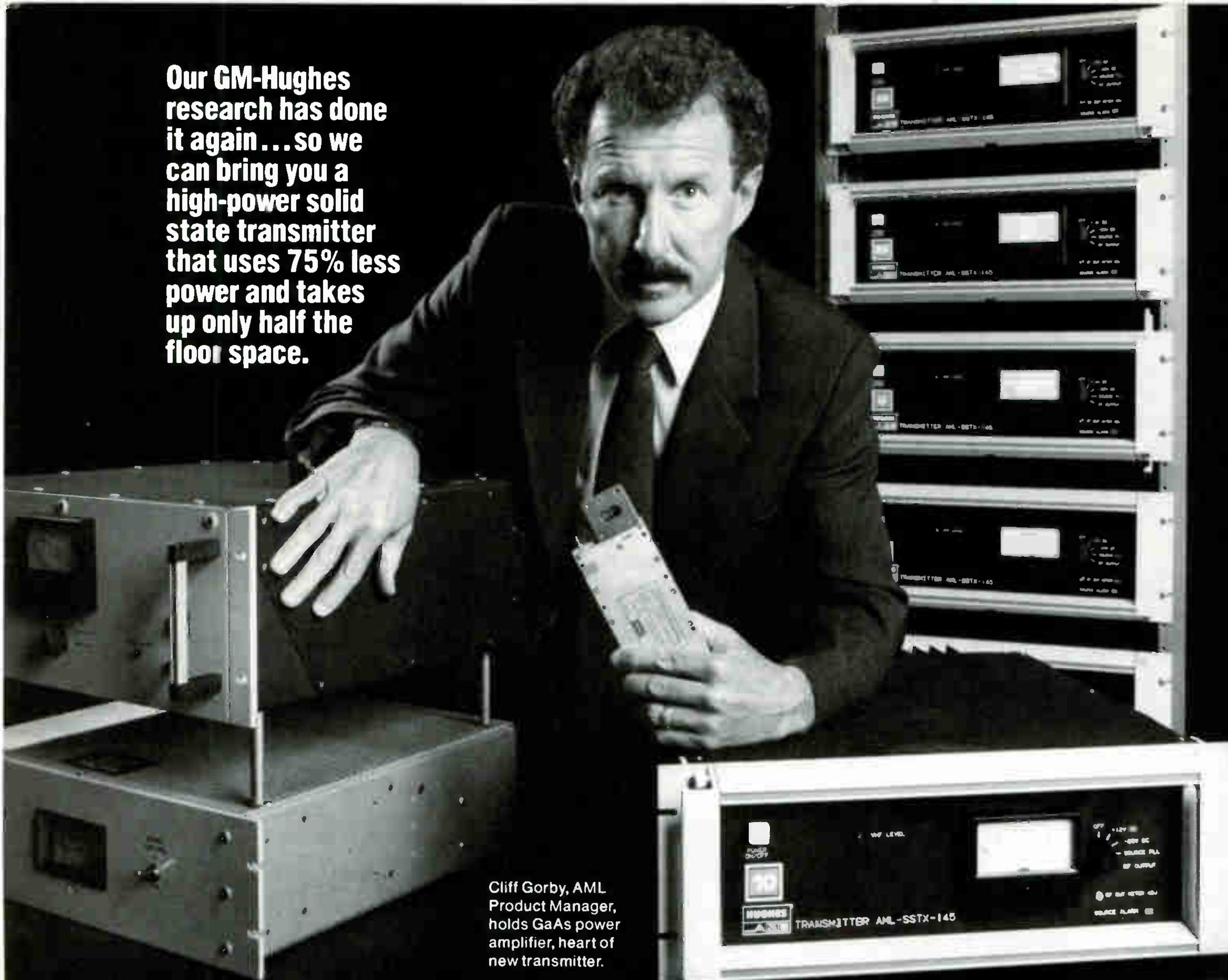

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From the Editor

Don't knock an opportunity

To repeat a common expression heard during September, "It's time to go back to school." We're not talking about grammar school or high school but your continuing technical education, which should be year-round. And in *IT* we try to announce as many possible training opportunities for CATV installers and technicians available throughout the year.

For outstanding service

But one institution of learning in particular stands head and shoulders above the rest in providing the most varied types of training for the entire CATV industry: the Society of Cable Television Engineers. How do they serve you and me? Let me count the ways:

1) *Chapters and meeting groups.* As of this writing, there are about 43 SCTE local chapters and groups in the United States composed of SCTE member technicians and engineers. (In the near future, SCTE will announce a new level of membership for installers.) Most of these groups regularly schedule technical seminars during the year, usually bimonthly. For more information on the group in your area, check the listing on page 11.

2) *BCT/E.* This certification program, developed by the Society in 1984, aims to encourage personal development in CATV technology, recognize individuals for the demonstration of their knowledge and assist management in hiring and promotion processes. To become fully certified at either the technician or engineer level, you must take (and pass) exams in each of seven categories. (Attention, installers: Be sure to watch the pages of *IT* for the latest news about the SCTE's Installer Certification Program.)

BCT/E certification is here to stay, and you ought to get involved in the program for your own personal and professional development. Do it today. BCT/E review courses and exams are regularly given at chapter and meeting group seminars, state and regional conventions and SCTE-sponsored national events. If you want to know more about the program, contact the SCTE at (215) 363-6888.

3) *Satellite Tele-Seminars.* This program has been around for several years; it's an excellent opportunity to "attend" a class without leaving your building. The last Tuesday of each month, the SCTE transmits a video seminar over Satcom F3R, Transponder 7 from 12-1 p.m. Eastern time. The session might be a BCT/E review course, a seminar from a local group or from the recent Cable-Tec Expo —or even covering a piece of equipment from a specific manufacturer. For more details about this month's Satellite Tele-Seminar Program event, check this month's "Calendar" (page 50) or call the SCTE.

4) *Publications, etc.* The SCTE national headquarters has many outstanding publications, videotapes, audio tapes and other merchandise available for purchase at special membership rates. Whether you're interested in learning more about signal leakage, safe pole climbing practices, preventive maintenance, implementing stereo headend equipment and on and on, you'll find what you're looking for in the SCTE's 1988 catalog. Contact the SCTE and order a copy; then, feast your eyes on what's available. (And if you're a member and don't have an SCTE lapel pin, coffee mug or T-shirt, this is your golden opportunity!)

5) *Cable-Tec Expo.* This annual event deserves a column all its own and one paragraph will not suffice (for a recap of Expo '88, read July's "From the Publisher"). Briefly, the expo is a series of seminars, hands-on demonstrations, exhibit booths, special events and much, much more. Next year's expo will be June 15-18 at the Orange County Convention Center in Orlando, Fla. Make an extra effort to be there.

Wait—There's more!

6, 7, 8...I've run out of space, and no time to tell you about the SCTE's Scholarship Assistance Program, "Technology for Technicians" traveling seminars with Ralph Haimowitz—or a dozen other opportunities available from the Society. Stop what you're doing and get involved in the SCTE. You'll be glad you did.

Toni I. Barnett

IT INSTALLER TECHNICIAN

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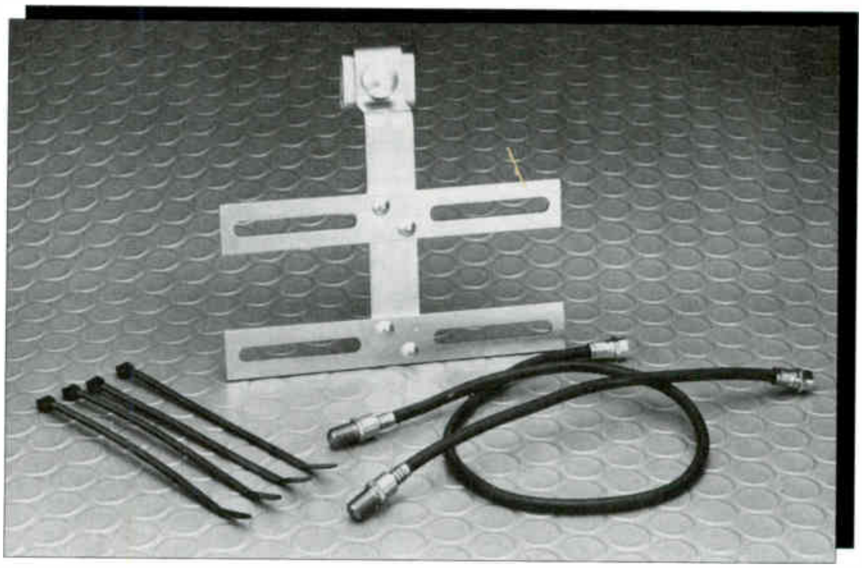

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News

Cerritos becomes "A City with Vision"

CERRITOS, Calif.—A citywide celebration here on Aug. 13 marked the advent of the nation's largest test of voice, data and video services. Sponsored by the City of Cerritos, Apollo CableVision and GTE-California, "Cerritos—A City With Vision" commemorated the construction of a 170-mile underground coaxial cable system serving 16,000 homes and 2,000 businesses. It also marked GTE's plans to construct fiber-optic facilities in the city.

During the celebration, hundreds of residents and guests experienced hands-on exhibits of the latest cable and telecommunications technology and equipment, much of which will be used and tested in Cerritos. Suppliers participating in the project are American Lightwave Systems, AT&T Network Systems, GTE Laboratories and Siecor Corp.

GTE recently received FCC approval to begin construction of the fiber-optic network that will serve approximately 5,000 homes. This will allow residents of this community to participate in the test comparing telephone wire, coaxial cable and fiber cable as transmission systems. Some of the services GTE hopes to test include video on demand, home banking, home shopping and security. The ultimate goal of the test is to determine how to develop a network that best utilizes these transmission systems in a user-friendly and economical way.

SCTE continues tuition assistance

EXTON, Pa.—In its continuing effort to further technical education in the industry, the Society of Cable Television Engineers recently awarded scholarships to five applicants. Those receiving tuition assistance were Danny Kivett (Freedom Cable), Paul Stephens (Catawba Valley CATV), Michael Palmisano (Metrovision), Rosa Rosas (Galaxy Cablevision) and Jane Lode (Daniels & Associates).

This effort began in 1985 when the Society's board of directors opened a certificate of deposit, with interest earmarked for educational assistance. The following year, the board established its Scholarship Committee to award tuition assistance. Additional funding came from Rex Porter, the National Cable Television Institute and the New York State Cable Commission. The ATC National Training Center and Cleveland Institute of Electronics plan to contribute courses to the program.

For more information on the SCTE's Tuition Assistance Program, contact SCTE, 669 Exton Commons, Exton, Pa. 19341, (215) 363-6888.

Biddle offers courses in testing techniques

BLUE BELL, Pa.—Specialized training courses covering several areas of electrical testing techniques are being offered this fall here at the Biddle Technical School. Each course will cover basics as well as utilize classroom demonstrations and analyze practical cases.

Courses will last two to five days and will cover topics including earth resistance testing, power-factor testing of power apparatus HV insulation and partial discharge detection in insulation systems. For more information, contact Biddle Technical School, Biddle Instruments, 510 Township Line Rd., Blue Bell, Pa. 19422, (215) 646-9200.

Installer certification— The final chapters

This month's column concludes its overview of the nine areas covered in the manual for the SCTE's new Installer Certification Program. This information is provided to inform industry installers of the program and inspire them to participate in this valuable educational undertaking. The manual was developed for the Society by Richard Covell and his fellow members of the Installer Certification Committee: Ron Cotten, Daniels & Associates; Allen Kirby, Anixter; Dave Pangrac, American Television and Communications Corp., Roy Tartaglia, RTK; and Dave Willis, Tele-Communications Inc.

The following topics are covered in the manual's nine chapters: 1) customer interface, 2) safety, 3) tools and materials, 4) cables and connectors, 5) house drops, 6) building prewires, 7) multiple dwelling units, 8) grounding and bonding and 9) testing/troubleshooting. Certification in the program will require written and practical demonstrations of a candidate's skills in each of these areas. Both written and hands-on testing will be administered by local SCTE chapters and meeting groups.

Multiple dwelling units is devoted to one of the most difficult and time-consuming tasks an installer will face—the wiring of multiple dwelling units (MDUs) such as apartment buildings, hotels and motels. The chapter begins with a listing of general guidelines to follow when undertaking the installation of an MDU. Many of these guidelines are special rules that differ from procedures to be followed when wiring an individual residence. Building access is the first step detailed. Gaining access to the building's cable installations and wiring requires securing permission from the unit's owner, who is usually not the resident requesting service. This section details methods of dealing with the owner and the legal considerations to take into account when securing access to the MDU.

The next section explains methods of surveying the site to ensure that the service will not result in a large amount of unsightly outside wiring. Careful planning based on close examination of the site also will lessen the chances of illegal tapping into wires. This section lists and explains the steps to follow when conducting a site survey such as mapping out a floor plan, determining wiring origination points, measuring footage, considering the use of an amplifier in the system, and what to do in the case of a high-rise building.

The chapter next discusses some factors to consider when routing cable, such as vacant conduits, drop ceilings, elevator shafts, existing wiring from antenna systems, molding ducts and outside wiring. With a series of illustrations as examples, the next section discusses the differences between two methods of configuring the inside wiring for MDUs, "loop-through" and "home-run." The authors of the manual declare which method they prefer and provide the reasoning behind their choice.

Grounding and bonding covers one of the most important procedures a CATV installer will face—the bonding and grounding of the drop running into the subscriber's home. It explains how important these procedures are due to the potential for equipment failure and safety hazards resulting from poorly grounded and bonded drops. The various factors to take into consideration when performing this task are detailed, including the building's electrode system, the site's "common ground" potential, the proper materials to be used and preferred methods (listed according to the authors' preference).

Testing and troubleshooting focuses on methods of testing the effectiveness of the service, as well as how to solve any problems that may arise in a prompt and efficient manner. It also includes information on proper customer relations when handling such difficulties. The chapter opens with information on testing the installation's quality using a signal level meter. The next section discusses testing for picture quality on all channels.

The chapter goes on to describe a technique known as "troubleshooting by halving." This section lists steps to follow with this technique and how to take the necessary corrective action once the problem has been located. It also discusses what to do if the problems persist. The next step, once all possible problems have been tested for and solved, is to clean up the work site and instruct the subscriber. Details are provided on this often-overlooked portion of the installation and the importance of a professional and courteous exit is emphasized. The chapter concludes with illustrations and charts showing the various problems, causes and corrective actions that most frequently occur in cable installations.

The manual's *appendix* is a handy resource offering concise information on general dos and don'ts, drop installation guidelines and subscriber dos and don'ts. Article 820 of the National Electrical Code, dealing with community antenna television and radio distribution systems, also appears.

The *glossary* lists, in alphabetical order, a variety of important terms used in the manual with which installers should be familiar. A helpful resource for those participating in the SCTE Installer Certification Program, the glossary also will help installers in their everyday duties.

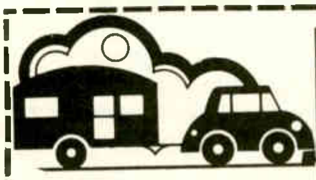
Watch future editions of *IT* for further news and information on the Installer Certification Program. ■

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: Ron Mountain, (717) 684-2878
Cactus Chapter
Contact: Harold Mackey, (602) 866-0072
Cascade Range Chapter
Contact: Norrie Bush, (206) 254-3228
Central Indiana Chapter
Contact: Steve Murray, (317) 788-5968; or Joe Shanks, (317) 649-0407
Chattahoochee Chapter
Contact: Richard Amell, (404) 394-8837



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Central California Meeting Group
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Reader Service Number 8.

Step by step: A system design primer

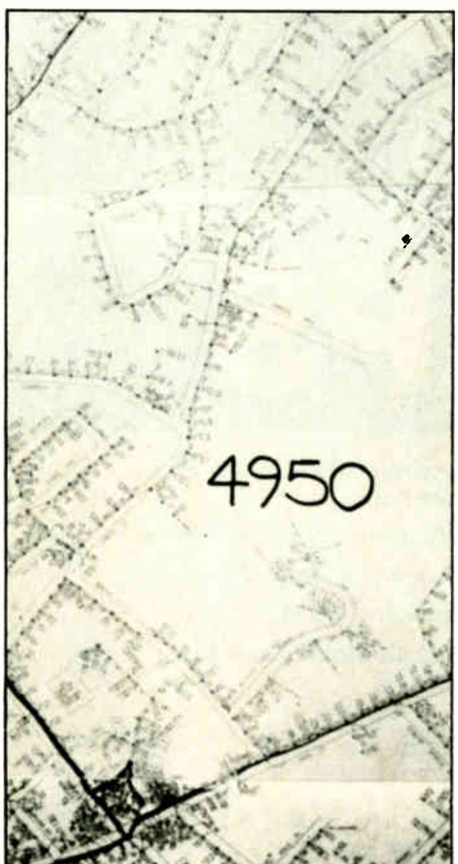
Frequency (MHz)	Channel capacity
300	35
330	40
400	52
450	60

By Paul M. Bischke
Technical Writer, Magnavox CATV Systems Inc.

So you want to design a cable system. Or maybe you need to understand how it's done so you can oversee someone else's design work and do so intelligently. This article speaks to those who are new to system design or need to refresh their memories; it will not offer profound new insights to the experts.

Our story begins after you've settled the politics of the franchise. Matters of zoning, easements, permits, and clearances could complicate your plans immensely —so settle them before you begin design work.

The following pages will explain the basic steps you must take to design a system, emphasizing matters of distribution equipment and soft-pedaling matters concerning headend and subscriber gear. We will limit our discussion to subscriber coaxial systems; and we will proceed from the global to the particular, from system mapping to the equipping of mainstations.



Strand maps developed from utility or telco records form the basis for system mapping.

Step 1: Draw strand maps

You will define your franchise area on strand maps, which are usually derived from the documents of the local power or telephone company. Your strand map will include four vital parameters for your system:

1) A house count that tells you how many potential subscribers will be served off a pole (or pedestal for underground plant);
2) A street layout;
3) A record of the utility companies' aerial and underground routings; and
4) A record of pole locations and distances between poles.

Since designers will work from the strand map in developing their system design maps, the strand map must be accurate and complete. Have your strand maps prepared by a competent professional.

Step 2: Locate your headend or hub site

Knowing where your subscribers are, find the best place for your headend or hub. The best place, of course, is where you can reach the most customers with the least amount of hardware. Unless your headend is merely a pickup point for signals arriving on a "transportation trunk" or "supertrunk," you must choose a place where you can receive microwave, satellite and off-air signals.

Unfortunately, the ideal criteria for receiving satellite signals conflict with those for receiving microwave and off-air signals. Ideally, you would locate a satellite dish slightly below the lay of the surrounding land to shield it from microwave interference. But you want to locate microwave and off-air antennas on high ground. The best you could hope for is high ground with a dip in the terrain to shield your satellite antenna. In general, avoid airports and sources of off-air interference.

Step 3: Specify highest frequency

Determine the highest frequency you need in the forward bandwidth. These are the standard top frequencies used and the channel capacity for each:

Extended bandwidth ranges as high as 600 MHz also are available. Some of this extra bandwidth may be allocated to return signals, perhaps using 5-108 MHz instead of the 5-30 MHz that is standard for subscriber systems. This extra return bandwidth gives ample opportunities for commercial data traffic in a subscriber system.

Prepare for possible future expansion of services. Amplifier spacing depends upon the highest frequency used because of the way coaxial cable behaves. Coaxial cable attenuates high frequencies more than lower frequencies. For example, 2,000 feet of one type of ¾-inch cable would attenuate a 450 MHz signal by 22.4 dB, a 300 MHz signal by 18 dB—more than a two-fold difference in signal power. If you underallocate and need a higher forward bandwidth later, you would need to change out trunk amplifiers for higher gain models and do significant respacing in feeder networks.

Step 4: Find maximum trunk amplifier cascade depth

The maximum trunk amplifier cascade is the number of mainstations (in a row) that you must run to reach your most distant subscriber. You must choose the most appropriate combination of cable diameter, trunk amplifier and headend equipment to deliver acceptable signals to meet your most distant subscriber. The diameter of cable used determines its attenuation per foot. Trunk amplifiers are available in different gain values. And both the specifications of the headend equipment and its delivery system (standard, HRC or IRC), as well as the trunk amplifier you choose, will determine how far your signal can reach before distortion and noise become objectionable.

We will arrive at our worst-case cascade through four substeps:

a) Measure distance to remotest subscriber
b) Choose carrier allotment scheme (headend type)
c) Select best combination of cable diameter and trunk amplifier type
d) Find average mainstation spacing

Step 4a: Measure distance to remotest subscriber using your strand maps.

Measure along a reasonable path of thoroughfares and side streets along the strand. Headend signals will reach that farthest subscriber using cable and a cascade of amplifiers.

Step 4b: Choose carrier-frequency allotment scheme (headend type)—You can use standard carriers, harmonically related carriers (HRC) or incrementally related carriers (IRC). The HRC and IRC frequency allotment schemes reduce certain kinds of distortion but the equipment costs more. (Cable operators use HRC more often than IRC.)

Because the HRC scheme "hides" the beat products where the TV doesn't see them, you can run a longer cascade before intermodulation becomes objectionable. You also can run your system at higher levels, which means you'll have less trouble with system noise. The intermodulation advantage of the HRC headend also means you can load more channels without causing objectionable distortions. Your choice of carrier schemes will affect the maximum reach of your amplifier cascades.

Step 4c: Select best combination of cable diameter and amplifier type—You now must choose the most beneficial combination of cable diameters and amplifier types to determine spacing between mainstations and the depth of your cascade. You will use the amplifier's gain ratings and the cable's dB/100 feet ratings to find the spacing, i.e, the length of a single mainstation-to-mainstation run.

The larger the diameter of the cable, the less it attenuates RF signals. For example, 22 dB of spacing at 450 MHz means 1,913 feet of ¾-inch cable whereas it means 1,333 feet of ½-inch cable.

Push-pull, parallel hybrid (power doubling) and feedforward trunk amplifiers have different gain ratings and different distortion and noise characteristics. These characteristics will determine how deep a cascade can be, i.e., how many mainstations you can have in a row before distortion and/or noise become unacceptable.

Make a nominal selection of cable diameter and amplifier type. Note that you will certainly use more than one cable diameter in your system: large cable in the trunk, smaller cable in the feeder. You also may mix amplifier types in your system.

Keep in mind that you can change your initial selection of amplifier types. For example, a deep cascade could force you to switch to power doubling amplifiers if your end-of-the-line distortion characteristics are unacceptable. More on this later.

The satellite antenna placed near protected, low ground for good reception.

Step 4d: Find average mainstation spacing using the cable's dB/100 feet rating and the trunk amplifier's operational gain figure. Manufacturers tell you the trunk amplifier's operational gain. To get the average gain used for designing, subtract 2 dB from the operational gain for 300 to 330 MHz trunk amplifiers; subtract 3 dB from the operational gain of 400 to 450 MHz amplifiers; for 600 MHz, subtract 4 dB. This "average gain" is a rule-of-thumb figure that designers have found convenient; it gives them enough leeway for the inevitable variations in actual pole footages.

Now divide the trunk amplifier's average gain figure by the cable's dB/100 feet figure to get the average mainstation spacing in feet.

$$\frac{\text{Average gain (in dB)}}{\text{Cable rating (in dB/100 ft. at highest freq.)}} = \text{Avg. spacing (in ft.)}$$

For example, suppose your 400 MHz system uses a standard push-pull trunk amplifier, whose operational gain is 22 dB, with ¾-inch cable. In this case, the amplifier's average gain is 19 dB and the cable's rating is 1.07 dB/100 feet at 400 MHz. The average spacing is:

$$\frac{19\text{ dB}}{1.07\text{ dB/100 ft.}} = \frac{19}{1.07} \times 100\text{ ft.} = 1.776\text{ feet between mainstations}$$

We can find the maximum cascade depth by dividing the distance to the most remote user (from step 4a) by the average spacing figure. This gives you the cascade depth, which is the number of mainstations you need in your longest cascade.

$$\frac{\text{Distance of remotest user}}{\text{Average mainstation spacing}} = \text{Cascade depth}$$

If you get a fraction here, round it *up*.

Again, these mainstation spacing and cascade depth figures reflect the worst case you will encounter in your system.

Step 5: Calculate distortions and determine operating levels

Having established your spacing and cascade depth, you must confirm that your combination of headend type and trunk amplifier type will deliver acceptable signals to that worst-case point in the system, and at what level. But what is an acceptable signal?

Designers have found that the FCC's guidelines do not produce a TV picture you'd want to watch. (Note that the FCC's standards are not ill-informed, merely antiquated. It established the standards during the early days of rural CATV when some picture was better than none at all.) Compare the FCC's minimum standards to those used by reputable system designers:

	FCC minimum	Normal design standard
Carrier-to-noise ratio	36 dB	44 dB
Cross modulation	−47 dB	−52 dB
Composite triple beat	−47 dB	−53 dB

Once you have established your standard for distortions, calculate your worst-case distortions to see if they measure up.

Distortion calculations will be performed by the system designer or engineer, who will calculate noise and intermodulation for single amplifiers and for amplifiers in cascade. (*Intermodulation* is a catch-all term for several types of distortion, including composite triple beat and cross modulation.) The most critical parameters for modern systems are: carrier-to-noise (C/N) ratio, carrier-to-composite triple beat ratio and cross modulation. You can find formulas for these calculations in cable textbooks.

Worst-case distortions are based on the maximum trunk amplifier cascade, a bridger, and the maximum line extender cascade (usually two or three). Note that there is a hierarchy among our noise and distortion villains; as a cascade deepens, the first distortion parameter to become objectionable acts as the limiting factor. Manufacturers should be able to identify the limiting factor of their amplifiers. Each type has its own limiting factor. These factors also depend upon the highest frequency you use. How soon in the cascade you reach the limit depends, of course, upon the manufacturer's specifications.

Since composite triple beat (CTB) and

cross modulation (X-mod) depend upon channel loading, you must leave some headroom in your allowances for these distortions if you plan to add more channels later.

Knowing the amplifier's limiting factor can be very handy. It tells you that by the time this limiting factor distortion has become objectionable, all other distortions would still be tolerable. You will still want to calculate all the distortions, but the limiting factor distortion tells you very quickly where you stand.

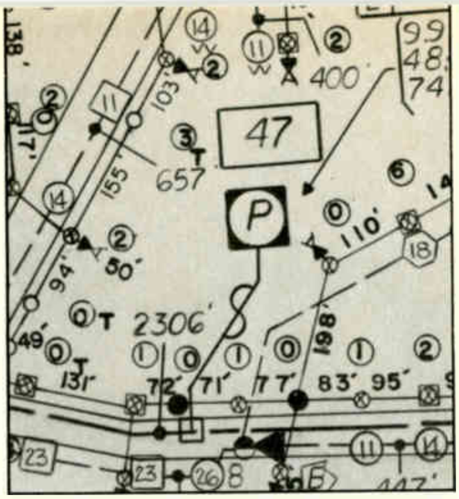
Operating levels and operating gains are constrained by noise and distortion. If your operation levels and gains are too high, you get excessive distortion; if they are too low, excessive noise results. Manufacturers recommend an input level for their amplifiers, or rather a range of possible input levels.

Noise and distortion will constrain level and gain selection inversely. In fact, an inverse square law applies. For every dB of improvement in C/N you get by raising operating levels, you should expect a degradation of 2 dB in X-mod and in CTB. In effect, there is more reason to keep trunk levels low than to keep them high—though, of course, not too low!

The trunk amplifier/bridger amplifier junction also constrains your choice of operating levels (for reasons related to our discussion of the opposing influences that noise and distortion exert upon operation levels). A well-designed system minimizes trunk splits (subtrunks) and covers as much territory as possible by judicious use of the feeder system, i.e., the bridger amplifier and line extender. This means you want the bridger's output level as high as possible without producing objectionable distortion. If the trunk signal levels are low, the signal portion handed on to the feeder system will have the low distortion characteristics needed to use high gain figures in the feeder system.

Reaching subscribers along an extended feeder system is much more efficient than reaching them using subtrunks. In this context, one advantage of power doubling equipment is that it lets you make better use of your feeder system. Specifically, power doubling trunk amplifiers operate at lower levels so that feeder networks can operate at higher levels without violating noise specifications.

The input and output operating levels you establish will be standard for each device type. Every trunk amplifier in the system should have the same input level; every bridger should have the same output level. Input levels for line extenders will vary according to the lengths of their cascades. For example, each line extender in a cascade of two would operate at lower levels than a single line extender. Input levels to each device type should not fall below the standard.



Each line power supply sends AC to several mainstations as shown on map.

Inevitably, because poles do not stand exactly where you want them (and are ever so reluctant to move), some input levels will be too high. For situations where the input is so high that the amplifier's potentiometer alone cannot compensate for it, manufacturers make input attenuators that diminish the signal so it is within the manufacturer's acceptable range. Such attenuators are standard attachments that plug into the amplifier.

Let us consider an example of trunk operating levels in a system whose forward bandwidth is 50 to 450 MHz. Suppose we chose standard output levels as 26/32 dBmV. That means the signal level of a 50 MHz signal is 26 dBmV and that of a 450 MHz signal is 32 dBmV. If the trunk amplifier's standard gain is 22 dB we would need a minimum input level of 10 dBmV at 450 MHz.

Most feeder systems and some trunk systems operate with a "sloped" or "tilted" output. We specify slope in dB. If a bridger's output levels are 40 dBmV at 50 MHz and 46 dBmV at 450 MHz we say it has a positive slope of 6 dB; i.e., its highest carrier operates at a power level 6 dB above (or about four times) that of the lowest carrier. Sloped outputs offer the advantage of lower overall distortion.

Step 6: Account for return system

The next question you might ask is, "Is this a two-way or one-way system?" Of course, you wouldn't proceed with a complete spacing scheme without knowing this. The presence of return signal would influence the designer's choice of levels and spacing.

A principal problem in return design is the signal loss through passive devices (flat loss). The cable attenuates the 5-30 MHz return bandwidth much less than the high end of the forward bandwidth. For example, the same length of cable that attenuates a 450 MHz signal by 22 dB would only attenuate a 30 MHz signal by about 5 dB. (Because of this attenuation pattern, you can sometimes substitute jumper wires for return amplifiers in certain transportation trunk stations.) But passive devices attenuate all frequencies roughly equally. Therefore, when passive devices account for a large part of that 22 dB of attenuation at 450 MHz, they would attenuate the return bandwidth beyond the return amplifier's gain range (typically 12 dB or so).

Although the return bandwidth influences spacing and level decisions, the forward bandwidth comes first. It is much better to fit your return design to a properly designed forward bandwidth than vice versa. Most system operators nowadays design for a return system even though they don't use it immediately. Addressable converter systems and system monitoring devices require the use of the return bandwidth.

Step 7: Determine tap types, specs

Look over the strand maps noting the house counts. The tap used at any given pole depends upon how many houses you will serve from that pole. You can buy two-, four- and eight-way taps. Your final bill of materials will call for a selection of these two tap types.

It is possible to use two four-way taps instead of a single eight-way tap in a dense location. Such an arrangement offers the advantage of having a more homogeneous (and hence less extensive) inventory of backup taps. However, the eight-way tap offers both cost and maintenance advantages over the dual four-way arrangement. Also, you may need to equip your system with plated tap housings, particularly if the system is in a highly corrosive environment. Systems in maritime and northerly climates, for example, may have corrosion problems from salt.

Step 8: Select signal-splitting devices for trunk and feeder splits

As noted earlier, a good system design minimizes trunk splits but, of course, it does not eliminate them. Signal splitting devices will divide both trunk and feeder lines and send appropriate signal portions along multiple paths. For trunk lines, you can buy two- and three-way splitters that distribute equal or unequal signal portions to their output legs. And as with taps, you can buy standard or plated splitter housings, depending upon their operating environment.

Step 9: Route trunks and feeders

Once you have decided upon your levels, based on worst-case trunk runs, you must establish your trunk network and your feeder networks. You want to cover your territory making most efficient use of the feeder system and minimizing trunk splits, so the routing of trunk lines is something of an art.

One thing to watch for is that every section of cable and every subscriber must have a path back to the headend. If not, you might end up with a situation like that of two railroad crews working from opposite directions, where the left rail joins the right rail and trains from both sides derail. Just as you don't want to be caught with bits of networked cable that lead nowhere, you don't want to arrive at a multiple dwelling building with insufficient signal. Don't expect to feed an apartment building with a depleted signal at the tail end of a line extender run.

Step 10: Place line power supplies

Once you know where to install each mainstation, you must place the line power supplies throughout the system. A line power supply feeds power into the cable; the mainstation's (or line extender's) DC power supply converts this AC into the DC that powers active devices. A single line power supply will serve several mainstations and their feeder networks.

The number of line power supplies you need depends upon how many mainstations (and line extenders) each can serve, which depends upon the mainstation's power consumption and upon the efficiency of its DC power supply. Generally, advanced technology amplifiers (feedforward and power doubling) consume more power than standard push-pull units. Also, mainstations containing an ASC/AGC (automatic slope control/automatic gain control) unit and/or status monitoring circuitry will draw a bit more current. A switching DC power supply operates more efficiently than its linear counterpart.

You already may have deduced that the higher power consumption of the advanced amplifiers calls for the improved efficiency of the switching power supply. Indeed, they go hand in hand. You want to locate line power supplies to make good use of their power capabilities; however, practical considerations keep you from mounting them on transformer poles or easement poles (e.g., poles in someone's backyard). Also, if your status monitoring system monitors the line power supply, it should be close to a mainstation.

Step 11: Outfit mainstations

Let us quickly summarize the basic set of equipment you will find in a mainstation.

Baseplate (also called "chassis" or "motherboard")—Wiring in the baseplate routes RF, AC and DC signals to the appropriate equipment modules. The baseplate is the heart of each mainstation.

Trunk amplifier—Amplifies trunk signals. Sends a portion of its signal to the bridger for distribution in the feeder network; sends a portion of its signal to the ASC/AGC unit for monitoring. Every mainstation in a cascade, except the last, contains a trunk amplifier.

Distribution amplifier—Replaces the trunk amplifier in the last mainstation of a cascade. Performs the same functions as the trunk amplifier except that it need not amplify trunk signals for another span of trunk cable.

Bridger amplifier—Amplifies a portion of the trunk amplifier's output signal and sends it out on the feeder lines that originate in that mainstation. Each mainstation from which feeder lines originate needs a bridger module.

Feedermaker—A signal splitter that divides the bridger's output into one, two, three or four parts, for outgoing feeder lines. Each mainstation from which feeder lines originate must contain a feedermaker of some sort.

Return amplifier—Amplifies signals in the return bandwidth, usually the 5-30 MHz range. If your system uses the return bandwidth, every mainstation will have its own return amplifier module.

ASC/AGC module—Maintains proper signal levels by monitoring two channels in the forward bandwidth (one low and one high) and sending control voltages to the trunk amplifier. (We call the monitored channels "pilots.") The control voltages adjust the trunk amplifier's slope and gain to compensate for deviations caused by temperature fluctuations. Usually an operator need only monitor and adjust the forward bandwidth; return ASC/AGC units are rare in subscriber systems.

Thermal compensating unit—Adjusts the trunk amplifier's levels on the basis of temperature changes sensed inside the mainstation. Uses no pilots. This method of slope and gain correction is cheaper but is usually considered inferior to the pilot monitoring method. If used it replaces the ASC/AGC module in alternate mainstations (every other or every third mainstation).

DC power supply—Converts AC, which is generated by the line power supply and arrives via the coaxial cable, into the DC needed by the mainstation's electronics. A switching power supply produces power more efficiently than a conventional (linear) power supply. Each mainstation has its own DC power supply.

Status monitoring devices—Usually these are not separate units but are built into a return amplifier or ASC/AGC unit. These devices monitor the status of line power supplies and DC power supplies, help detect system breakdowns, locate ingress, etc. These devices send status reports back to the headend via the return bandwidth. If you have equipped your headend with such a system, you will need to buy the corresponding equipment for all monitored mainstations.

Step 12: Conclusion—Count the cost

When your system's design is complete, you'll receive a bill of materials. You can specify how you want that bill broken down. For example, if your bill is broken down by power supply, you will receive a list of the materials for the distribution gear served by each line power supply. The designer also may list all materials associated with each mainstation, or all equipment located on each strand map section, or in other ways.

Your primary concern in designing a system will be to minimize costs. But you cannot totally separate your build budget from the completed system's operating budget. A full cost analysis includes the day-to-day maintenance of the system when it is operating.

The project overseer must keep costs down; however, it would be a mistake to urge your designer to cheapen the design to the point of its being only just satisfactorily operational. Operating on the "hairy edge" of the equipment's capability invites line maintenance problems and subscriber dissatisfaction.

Indeed, conscientious designers may resist cost-reducing shortcuts if they see resultant maintenance problems for the completed system. In such a case, they are doing right by you in the long run. A good system design finds the middle ground between technical laxity and extravagance. A system design proposal should be as inexpensive as a reliable and maintainable system can be. ■

Author's note: Special thanks to Jerry Redmond, Magnavox's system design supervisor, for his help in developing this article. Reprinted from the April 1985 issue of "Communications Technology."

Lightning and grounding

By Dale Kelchner
CATV Engineer, City of Miami

According to *Merriam-Webster*, a ground is "a large conducting body (as the Earth) used as a common return for an electrical circuit and as an arbitrary zero of potential." Ask 20 different cable TV technicians why the house drop is grounded and you will most likely get about 15 different answers. Probably the most predominant responses will be "to comply with the National Electrical Code" and "for lightning protection." Many times policy takes precedence over technology. True, an installation can be made to comply with the NEC, but can it be protected from lightning?

Lightning kills scores of people every year and causes staggering economic losses through forest fires, power outages and electrical damage. A single stroke of lightning can develop as much as 20,000 MW of power. In electrical terms, this is nearly unimaginable. In comparison, a 110 volt electric line would have to carry a current of 182,000 amperes to produce an equivalent amount of power and would require a conductor over 50 feet in diameter. (This may sound a bit absurd, but it is to prove a point to be brought up in later discussion.) Before getting to specifics, a brief discussion of electrostatic theory is needed.

Physics is based on the concept that all matter is made of atoms; these atoms in turn are made up of electrically charged particles whose behavior is governed by quantum dynamics.

The basic law of electrostatics, discovered by C.A. Coulomb in 1785, is that electrically charged bodies whose size is small compared with the distance between them interact with equal and opposite forces that vary inversely to the square of the distance between them. There are two kinds of charges: Like charges of either kind interact with repulsive forces and unlike (or opposite) charges attract each other.

As two oppositely charged bodies approach each other (one negative-charged and the other positive-charged), a force develops that has an algebraic behavior proportional to the product of the charges of the two bodies. The force acting on a small charged test body at any point in space, when it is under the influence of other charged bodies, will be proportional to its own charge and to a vector field characteristic of the influence charge. This electrical field can, in principle, be determined by measuring the force on a test body at each point in space, even without knowledge of the locations of such charges within the body.

The charges giving rise to the field must be in bodies that are small compared to the distance between them. This is because the electrostatic effects observed in usual experiments result from a very slight imbalance in the normally *equal* amounts of positive and negative charge in "uncharged" (or neutral) matter. The effects of charges contained in matter neutralize each other only when the amounts of positive and negative charged elements are equal in volume. A body is said to be "uncharged" only when the total algebraic charge on the body is zero. Such a "neutral" body may still modify an electrostatic field due to effects known as *electrostatic induction*. The charged particles in the matter are not bound to specific locations in the matter but have varying freedom to move.

When a body is placed in an electric field, positive charges in it tend to move in the direction of the field, while the negative charges move in the opposite direction. The extent to which they actually move is a specific property of the matter under test and the time frame of the test. Insofar as any motion may occur, the result will be a partial separation of the positive and negative charges in the body. The body is then said to be "polarized." This polarized matter, when placed in an electrical field, will influence the field. Such alterations of the field due to polarization of the matter tend to be small when the distance is large compared to the size of the bodies influencing the field.

When a conductor is placed in an electric field, free positive charges in it move in the direction of the field and free negative charges move in the opposite direction. These charges accumulate at the surface of the conductor where it is surrounded by free space or a dielectric material. The result of this separation of charge contributes to the field in such a way as to reduce the electric field or electric vector within the conductor. This process of flow continues until the overall effect is that the electrical field is reduced to zero at all points within the conductor, or the conductor is said to be discharged.

All matter contains a vast amount of electric charge, of which there are two kinds, positive and negative. For example, two tons of rock will contain about one-half pound of positive-charged material, and 1,999.5 pounds of negative charged material. The same is true for water or any other earthbound material.

A good, brief explanation of lightning would be as follows: In a thunderstorm, raindrops falling through a cloud become charged due to friction. These drops become positively charged. As the raindrops leave the upper portion of the cloud and pass through the lower portion, the upper portion becomes negative and the lower portion of the clouds becomes positively charged. This separation of charge within the cloud body is of no particular consequence. But if the body were to separate (as clouds do because of wind and air currents), then we now have two bodies of opposite charge and as these bodies are forced apart, a tremendous exchange of charges will take place between them.

In keeping with the law of electrostatics, the force of this electric field (or "spark," if you will) is at its greatest potential. This is why many times as a storm approaches, the first bolt of lightning is generally the strongest. The thunder is the result of the rapid heating of the atmosphere in the path of the charge, due to the tremendous electron flow in a very short time, and the collapsing of the vacuum; just as in any explosion.

Sometimes this discharge from the upper body is so great that it will pass through the lower body and seek a path to Earth. If the upper portion separates without a discharge to the lower portion, the lower cloud will then discharge to Earth. Remember that the lower cloud is positively charged and the earth matter is negatively charged. When a tall object protrudes from Earth and is of a conducting material, it is negatively charged to the cloud. The positively charged cloud will discharge into this protruding matter. If the highest point of this matter were given a low resistance "connection" to the Earth it would then present a highly concentrated charge to the surrounding air.

This is precisely what a lightning rod does. It dissipates itself gradually by charging molecules of air and repelling them into the positively charged cloud thus "neutralizing" the cloud. Even if a slight discharge does occur it will be quickly dissipated to Earth without damage.

Lightning and cable

In discussing the effects of lightning on a cable system we must realize, using the aforementioned knowledge, that a direct strike in the cable itself would be devastating, grounds or no grounds. So, in retrospect, we cannot protect against a lightning "strike."

During a thunderstorm, huge amounts of static charge are present in anything that is above earth potential. Overhead wires are very susceptible to this phenomenon. As this charge rises it can build in potential and begin to surge as storm clouds pass. These charges can be hazardous to appliances and persons at the end of a charged cable or wire. Although this charge can be hazardous, it is not unmanageable. In this Instance an earth ground potential on the cable will dissipate this charge and keep the cable at near zero potential.

Another well-known factor of thunderstorms is the power surge. A lightning strike near power lines can induce heavy electrical charges on the power system, causing the automatic protection equipment to temporarily disconnect the power source. The reconnection of the circuit can cause a power surge on the power lines. This surge can induce a charge in the outer conductor of a coaxial cable, having the same effect (sometimes more severe) as the static charge mentioned earlier. Likewise, if two conductors were suspended above ground for considerable distance parallel to each other it would be possible to create a difference in potential between the two conductors. If one conductor was connected to a source and was at proper distance to the other conductor an electrical charge could be induced to the "free" conductor.

As long as the second conductor is in free space this is merely a "charge" and not a current flow. If the first conductor were connected to a circuit and given a current flow, the second conductor would not have a current flow until it was given a *resistive* path to ground. A wooden pole or human body would make an excellent resistive path to ground. This second conductor could be known as a "hot neutral." Bear in mind we are now concerned with the difference in potential between the second conductor and ground. If we give this conductor a very *low* resistance connection to ground then the potential becomes near zero.

Thus the whole purpose of grounding is to keep a conductor at ground potential (commonly referred to as "neutral")—be it a copper conductor, a strand or a coaxial shield. The goal is to maintain a zero voltage potential to ground and in doing so this satisfies the two main objectives of grounding: safety from electrical shock and protection of equipment from damage.

CATV installation ground connections are of two types: those made to the cold water pipe and those connected to so-called "made-grounds," consisting of driven rods. Water pipes are by far the best grounds, provided the connection is made to metallic pipes that run directly to the main water source. The best driven ground is the power company ground rod. The ideal situation is to have all cables entering the house or building to be grounded at the same point. Difference in a potential from one ground to another can have the same effect as no ground at all. The main requirements for an effective ground are low resistance, sufficient current carrying capacity and permanence. The size of the ground conductor must be large enough so that it will not burn off or open up under large fault conditions. Always consult the NEC for the proper wire size and never use wire of a lesser size than required. ■

References

Theodore A. Ashford, *From Atoms to Stars*, 1960, Holt, Rinehart and Winston Inc.

E.U. Condon and Hugh Odishaw, *Handbook of Physics* (Second Edition), 1967, McGraw-Hill.

Henry B. Hasteen, *Electrician's Reference Book*, 1973, Prentice-Hall.

Basic electronics theory

By Kenneth Deschler
Cable Correspondence Courses

This month we are going to conclude our study of direct current (DC) circuits by analyzing a series-parallel circuit using its characteristics and Ohm's law. Also covered this month will be the principles that govern electromagnets.

A *series-parallel* circuit is a combination of both series and parallel devices generally powered by a single source of energy. Figure 1 is an example of a series-parallel circuit containing resistor R_1 in series with a parallel circuit containing resistors R_2 and R_3. Also shown are a battery, a switch and ammeters to measure current flow in each branch of the parallel circuit.

Figure 1: Series-parallel circuit

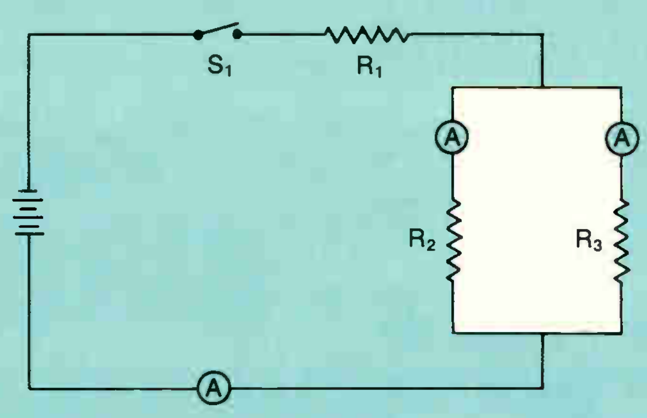
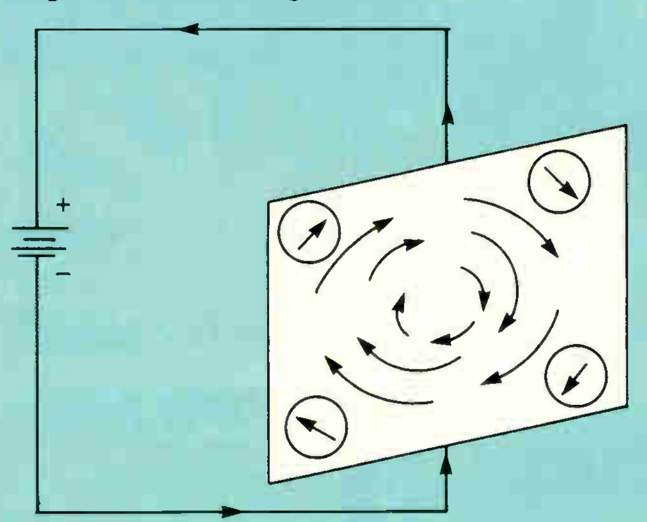


Figure 2: Electromagnetic field



In addition, another ammeter is placed in the return path to measure the total current flowing in this series-parallel circuit.

Series-parallel circuit analysis

Using Figure 1, let us assign some values and find the remaining ones using the characteristics of both series and parallel DC circuits as well as Ohm's law.

Given:

$E_T = 50$ volts $R_2 = 15$ ohms
$R_1 = 10$ ohms $R_3 = 20$ ohms

Find:

$R_T =$	$I_{R2} =$	$E_{R3} =$
$I_T =$	$I_{R3} =$	$P_{R1} =$
$P_T =$	$E_{R1} =$	$P_{R2} =$
$I_{R1} =$	$E_{R2} =$	$P_{R3} =$

The following answers are approximate values:

Step #1:

$$R_T = R_1 + \frac{R_2 \times R_3}{R_2 + R_3}$$
$$= 10 + \frac{15 \times 20}{15 + 20}$$
$$= 10 + \frac{300}{35}$$
$$= 10 + 8.57$$
$$= 18.57 \text{ ohms}$$

Step #2:

$I_T = E_T/R_T$
$= 50/18.57$
$= 2.7$ amperes

Step #3:

$P_T = E_T \times I_T$
$= 50 \times 2.7$
$= 135$ watts

Step #4:

$I_{R1} = 2.7$ amperes (I_T)

Step #5:

$E_{R1} = I_{R1} \times R_1$
$= 2.7 \times 10$
$= 27$ volts

Step #6:

E_{R2} & $E_{R3} = E_T - E_{R1}$
$= 50 - 27$
$= 23$ volts

Step #7:

$I_{R2} = E_{R2}/R_2$
$= 23/15$
$= 1.533$ amperes

Step #8:

$I_{R3} = E_{R3}/R_3$
$= 23/20$
$= 1.15$ amperes

Step #9:

$P_{R1} = I_{R1} \times E_{R1}$
$= 2.7 \times 27$
$= 72.9$ watts

Figure 3: Magnetic polarity

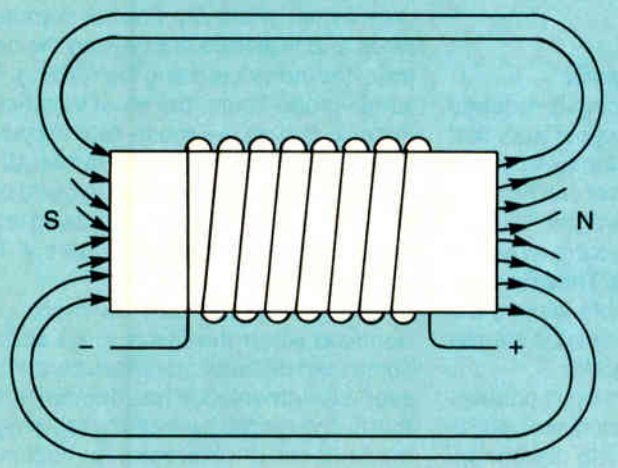
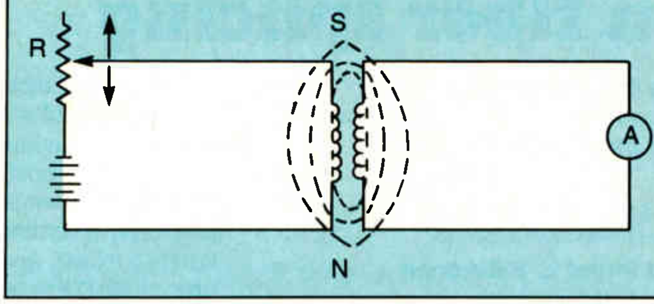


Figure 4: Induction from one coil to another



Step #10:

$P_{R2} = I_{R2} \times E_{R2}$
$= 1.533 \times 23$
$= 35.26$ watts

Step #11:

$P_{R3} = I_{R3} \times E_{R3}$
$= 1.15 \times 23$
$= 26.45$ watts

Electromagnets

In Part 1 of this series we studied the basic principles of magnetic fields. The type of magnet we studied was a permanent magnet and its field is referred to as a *permanent magnetic field*. In this lesson we are going to study electromagnets and their fields.

The magnetic field produced by electricity is called an *electromagnetic field*. In 1819 a Danish physicist named Hans Oersted found a relationship between the field of a permanent magnet and the field that is produced when current flows through a conductor. Oersted discovered that if a compass is placed near a current carrying conductor, the needle will align itself at a right angle to that conductor. He also found that if the direction of current were changed, the needle would point in the opposite direction.

The field that surrounds a current carrying conductor can be seen if the conductor is placed through a piece of cardboard as in Figure 2. By sprinkling iron filings on the cardboard we can see that the field is circular and that its strength is determined by the amount of current that flows through the conductor. We also can see, if a compass is used, that the direction of the field changes if the direction of the current is changed. If we were to wind the conductor in the form of a coil, these electromagnetic lines of force would reinforce each other and a much stronger field would be created, having a north and south pole. By winding the coil around a piece of soft iron, the strength of the field would again be increased. Therefore, it can be said that the strength of the field of an electromagnet is dependent on the following factors: number of turns, amount of current, ratio of the coil's length to width and the type of material that the coil is wound on (core).

Figure 3 shows a coil of wire wound around a core of soft iron. Note the polarity of the electromagnet as well as the direction of the current flow through the coil.

Just as current flowing through a conductor produces an associated magnetic field, an expanding or contracting magnetic field can cause a current to flow in a nearby conductor. This principle is known as *induction*. Figure 4 shows a coil of wire energized by a battery. The amount of current in the coil is controlled by a variable resistor. As the value of the resistor is changed, the strength of the electromagnetic field is changed. As this changing magnetic field cuts the turns of the other coil, a current is induced into this second coil.

Some of the more common terms used when dealing with magnetic circuits are:

1) *Permeability* is the ease with which magnetic lines of force can pass through a material. Because the permeability of soft iron is greater than air, by using a soft iron core the strength of the field is increased.

2) Hysteresis is loss of energy associated with magnetizing the core in one direction then magnetizing it in the other direction. The hysteresis losses can be shown by the use of a graph. When plotting the variations of the field against the strength of the field, loops are formed (known as *hysteresis loops*).

3) *Residual magnetism* is the amount of magnetism left in the iron core after the magnetizing force is removed.

4) *Flux density* is the number of lines of force (flux lines) contained in a square centimeter of area.

5) *Field intensity* is the strength of the electromagnetic field.

Typical uses of electromagnets in CATV work include videocassette recording heads and relays.

Check yourself

Using Figure 1 and the following circuit values:

E_T = 100 volts	E_{R2} = 40 volts
I_T = 3 amperes	I_{R3} = 1 ampere
R_1 = 20 ohms	P_{R3} = 40 watts

Find:

1) I_{R2} =
2) R_T =
3) E_{R1} =
4) P_{R2} =
5) What determines the strength of the electromagnetic field around a current carrying conductor?

Next month we will continue our study of the characteristics of conductors and magnetic fields by exploring the principles of operation of both AC and DC generators and motors. Also covered will be terms used with alternating currents. ■

Answers to quiz

1) 2 amperes
2) 33.3 ohms
3) 60 volts
4) 80 watts
5) The amount of current flowing.

Shedding light on fiber splicing

This is the second installment of a series on optical fiber. The next part will cover fiber cable strengths.

By Scott A. Esty
Market Development Supervisor
And Stuart L. Saikkonen
Senior Product Engineer
Telecommunications Products Division
Corning Glass Works

Just looking at an optical fiber, it's understandable that you might be nervous about splicing together the fine glass strands. When you think about the almost unlimited information-carrying capacity offered by the fiber, the need for a reliable, continuous light path seems even more evident.

Excellent fiber splices, both optical and mechanical, can be made routinely today. But predictability has not always been the case. Thankfully, we have come a long way in practical techniques and equipment that have reduced the difficulty in consistently achieving low-loss, reliable fiber splices. Yet certain care still is demanded. Splicing techniques are well-defined, and training of field installers and emergency restoration crews can be readily accomplished.

For CATV installers and technicians, fiber splicing may seem time-consuming and complex compared to crimping on and screwing down an F connector. In the fiber world, there is a need for a similarly simple and inexpensive "shirt-pocket" splice that can be quickly snapped together. Several manufacturers are developing such products for taking fiber all the way to the home. In the meantime, today's splicing technology is very functional for supertrunk and distribution/feeder applications.

In this article, we'll review some of the theory behind present state-of-the-art optical fiber splicing and cover some step-by-step procedures. We'll also discuss the difference between a good splice and one that needs to be redone and highlight some new information and test results from the lab that shed light on fusion-splicing one manufacturer's fiber to another's. (The focus of this article will be splicing single-mode fiber, which will probably be the fiber of choice for most CATV applications. Multimode fiber also may play a role, but with its larger core sizes, splicing precision is much less important and even more easily accomplished.)

Creating an optical path

Why splice at all? Splicing is required to create a continuous optical path that transmits light-encoded signals from one fiber length to another. Fiber can be manufactured in continuous lengths up to 25 km (15.5 miles), and cables are available up to 12 km (7.5 miles) long. These lengths minimize the need for cable jointing but existing real estate often dictates shorter runs and more splicing joints.

Why not just use a fiber-optic connector? Demountable connectors are used in applications where periodic disconnection is required for maintenance, testing, repairs or reconfiguration of a system. The penalties for this flexibility include higher cost, larger size and possibly an additional loss of optical power at the connector interface. The alternative to connectorization is some form of splice.

In fiber splicing, the objectives are to cost-effectively achieve the lowest possible induced loss and greatest possible long-term reliability. There are two types of fiber splicing in use today: mechanical and fusion.

Mechanical splices are either temporary or permanent. Usually, they are relatively easy to install, require few specialized installation tools and have losses ranging from 0.05 to 0.5 dB for single-mode fibers. A number of mechanical splice products are available that hold adjacent fibers together in alignment by different proprietary designs. Parts range from $10 to $40 per splice and some products may require capital equipment outlays of a few thousand dollars for a product-specific workstation. There is typically a tradeoff of lowest-loss performance against speed and cost.

Fusion splicing produces a permanent fiber alignment. The fibers are essentially "welded" together to form a virtually continuous, high tensile strength optical fiber. Average losses range from 0.05 to 0.2 dB for single-mode fibers. Whenever large numbers of splices are required, fusion splicing can be more economical than mechanical splicing. After the initial capital outlay for the splicer ($10,000-$30,000), there are no significant recurring costs for material or consumables. Some of the new automated machines can splice in 30 to 40 seconds once the fiber-end preparation is completed, achieving single-mode fiber splice losses in the 0.05 dB range.

Factors that determine loss in any fiber joining method can be classified as intrinsic and extrinsic. *Intrinsic* factors are determined when the fiber is manufactured and therefore are beyond the control of the individual doing the splicing. For single-mode fibers, the most significant intrinsic factors are mode-field diameter (MFD) mismatch and core/cladding concentricity offsets. It is possible to correct for the latter by using a splicing technique that aligns the fiber cores at the splice point.

MFD mismatch can be more pronounced when the fibers to be spliced come from different manufacturers. However, experimentation has demonstrated that fusion splices between typical single-mode fibers of different manufacturers and manufacturing processes with different nominal mode-field diameters result in repeatedly low splice loss. Average intrinsic splice losses for an array of fiber combinations from different manufacturers were less than 0.1 dB.

Extrinsic factors are those induced by splicing methods and procedures. They can be controlled or minimized by the individual doing the splicing and, more recently, by automated fusing cycles found on new equipment. Extrinsic factors include fiber-end preparation and separation, lateral and angular misalignment, back reflection, contamination and core deformation from the fusion step.

In practice, design engineers, construction supervisors and installers tend to push for the lowest possible loss fusion and mechanical splices, regardless of the time or cost. This lowest-loss performance is not always needed, particularly as fiber links are proven for shorter spans. In fact, attenuators now are often required to reduce signal power to the responsive range of receiver detectors. Design engineers can define specific splice loss requirements from which loss vs. time and cost tradeoffs can be made.

Much of the procedure for setup and preparation is common to all methods of mechanical and fusion splicing. Other steps are specific to one technique.

Equipment and preparation

Successful splicing under field conditions requires organization, coordination among team members for splice testing and proper equipment, materials and training. Tools, materials and techniques are continually improving, so it is important to keep current. There is no substitute for proper training and familiarity with equipment and hardware options.

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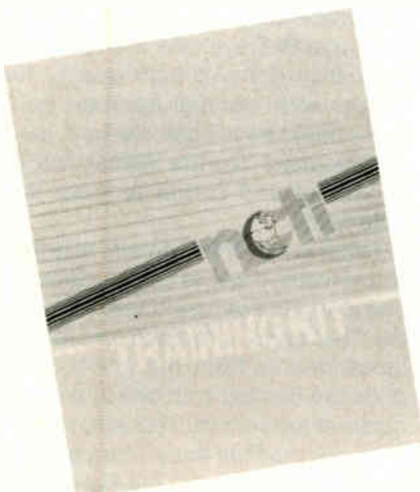

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productive and reliable splicing. The work area must be clean and well organized. Adverse environmental conditions such as dust, high winds, rain or snow must be controlled to avoid problems with fiber alignment and contamination. When splicing in remote, confined areas (aerial, for example), make sure that all tools and supplies are on-site before proceeding. Once the fiber is stripped, cleaved and cleaned, speed is essential to minimize contamination-related problems. Contamination on the bare fiber surfaces may increase splice loss, reduce splice tensile strength or both.

When monitoring the splicing operation by either the optical time domain reflectometer (OTDR) or power loss testing method, it should be standard procedure to verify the integrity of the fibers before and after the cable pulling for reference purposes. If splices are to be tested with an OTDR or other remote means during the operation, a reliable radio or other communication link needs to be established between the splicing and testing personnel before proceeding.

All cable and fiber length measurements made while preparing an optical cable for splicing must be precise and should be double-checked. Cables should be laid up in the trays, racks or other supports. All points where cables will enter the splice enclosures and anchor points to the splice organizers need to be precisely and clearly marked; tape works well for this. The organizer and closure instructions should be consulted for each particular design. Any required cable slack also must be taken into account before cutting.

Cable jackets, shields, core wrappings, strength members and buffer tubes must be carefully and neatly trimmed to length. Also, remove any water-resistant compounds and install any required cable breakout fittings according to the manufacturer's instructions. At this point, cables and strength members can be fastened to the splice organizer, the organizer mounted on or near the splice work station and each fiber labeled or otherwise identified to avoid later confusion during the splicing operations.

Before stripping the fiber, any protective tube or jacket selected for enclosing the finished splice should be slid onto the fiber and moved out of the way. The fiber buffer coating can be removed by a number of techniques such as a mechanical stripping tool, thermal stripping equipment or a chemical stripper (such as methylene chloride). However, mechanical stripping is preferred since it is fast, safe, inexpensive and creates a well-defined coating termination. Care must be taken to avoid damaging the fiber surface. The stripping tool should be the proper size and design for the fiber and buffer combination being stripped. Do not strip off too much of the coating at once or the fiber could break.

Any buffer coating residue that remains after stripping should be removed from the bare fiber surface because it can degrade the ability of typical fiber cleaving tools to produce acceptable fiber-end faces in the subsequent cleaving operation. A clean, dry cotton pad gently pulled over the fiber surface works well for most mechanically stripped fibers with acrylate buffer coatings.

It is important to handle bare fibers as little as possible from this point until the splice is completed. This will minimize the chance of contaminating them with dust or body oils, which contribute to high extrinsic splice loss and low tensile strength. It also is important to complete the remaining splicing process as quickly as possible since delays will expose the fiber to additional airborne contaminants.

The goal of fiber cleaving is to produce a flat, smooth perpendicular fiber-end face. Quality of the end cleave is one of the most important factors in producing the lowest-loss fusion and mechanical splices. The method used must produce a clean surface with no lips or chips and a fiber-end angle of less than 1 degree. It also is important to cleave the cable so only the minimum required length of fiber is exposed beyond the buffer coating. This minimizes mechanical damage to the glass due to inadvertent contact with other objects and reduces the glass surface area exposed to airborne contamination. Before proceeding, cleave quality should be verified under approximately 100× magnification and redone if necessary. Some fusion splicers have built-in viewers for this purpose. At this point fusion and mechanical splice procedures diverge.

Fiber alignment for fusion splicing

The fiber clamps and stages on the fusion splicer must be thoroughly cleaned before proceeding. Manual wiping with a clean cotton swab dampened with alcohol will accomplish this. Mount the clean, cleaved fibers into the alignment blocks and/or holding mechanism of the splicer.

First, visually align the fibers in the lateral (X-Y) directions. Visual alignment requires maintaining the smallest gap possible between the fibers, thus reducing the visual errors that may occur when manually aligning the edges of the fibers under magnification. However, visual alignment usually is not precise enough, for even if the outer cladding surfaces of single-mode fiber could be perfectly aligned, fiber core/cladding concentricity offset error may lead to lateral core offsets of up to 2 microns. That offset alone would contribute nearly 0.2 dB of loss, since single-mode fiber cores are only 8 to 10 microns in diameter.

Power alignment is a better way to align the fiber prior to fusing. It determines optimum fiber alignment by the amount of optical power transferred through the splice point. A light source is connected to the input end of one fiber, then light is transmitted through the splice point and detected by an optical power meter at the output end. This alignment method requires a technician to monitor the output power level at a remote location with a communications link back to the individual operating the splicer. This method optimally aligns the fiber cores rather than the cladding.

An alternative to power alignment is to use a local injection and detection system (LIDS), now found on many fusion splicers. Essentially, it is a power alignment system self-contained at the fusion site. LIDS eliminates the need for remote monitoring; the fibers on either side of the splice point are bent around cylindrical mandrels small enough to allow the injection of light through the buffer on the input side and detection on the output side.

Profile alignment systems (PAS) represent the state-of-the-art in fiber alignment. Collimated light is directed through the fibers at right angles to the fiber axis at the splice point itself, and is used to produced an image of the fiber cores that can be brought into alignment. PAS units create a computer-generated image of the core centerlines that the computer brings into alignment automatically prior to fusing. Although PAS systems are more expensive, they achieve high quality fusion splices with minimal operator training. Once fibers have been cleaved, cleaned and inserted into the splicer, the entire alignment and fusion process is fully automated.

Once fibers are optimally aligned, the actual fusing process can be initiated. The first step prior to fusion is to "arc clean" the fiber ends to remove any remaining contaminants from the end-faces. The ends are blasted with one or more short bursts of arc current. This step also slightly rounds the fiber ends. Many automated splicers integrate this pre-fusion step into the subsequent fusion cycle.

The fibers are now ready to be fused. Most splicers initiate an automatic, time-fused cycle when the arc button is pressed. Some, as previously noted, incorporate a completely preprogrammed alignment and fusing cycle.

After the fiber is fused, two main parameters determine the quality of the splice: fiber strength and induced loss at the splice point. To test for strength, some splicers incorporate a preprogrammed pull test after the fiber is fused; if the fiber doesn't break, it passes the test. Strength also can be estimated simply by pulling gently on the completed joint after releasing the fiber from the holding platform. Induced loss generally is checked by remote OTDR or power testing in a fashion similar to that described for alignment. If the loss is unacceptable, the fiber needs to be respliced.

Once the fiber is satisfactorily spliced, slide the splice protection sleeve over the joint and fasten it to the fiber. Depending on the type of sleeve used, this may involve mechnical crimping, UV-cured adhesives or heat shrinking. Then secure the completed splice assemblies into the splice organizer.

Fiber alignment for mechnical splicing

Most mechnical splices rely on the precision forming and/or machining of the splice parts for optimum positioning. Some splices consist of one all-inclusive splice body. Other splices are assembled from three main parts: a ferrule attached to both fibers being joined and a housing to hold them together. The bare glass fiber is fixed in the splice ferrules or capillary channels by an epoxy cured either by heat or UV light.

The fiber cladding is guided by the inside surface of the splice cavities. Consequently, the relative positioning of the fiber cores is dependent on the geometric precision of the splice parts and the core/clad concentricity of the fibers. With the fibers initially positioned, typically butted up against each other, some mechanical splice designs allow for further fine tuning. This is accomplished by rotating the fibers relative to one another. Power maximization is identified by one of the power alignment, OTDR or LIDS techniques described previously. Once the optimum power position is identified, the ferrules are clamped in place or the bonding agent is cured, making the splice permanent.

An index matching gel or epoxy is often used to fill any potential air gap between the fiber-end faces. Such an interface with a medium, like air, with a different index of refraction than the glass will result in some reflected light back into the fiber. Filling the gap with an index matching gel can minimize this effect. Control of this problem is particularly important in analog transmission of video signals, where back-reflected light can induce modal noise that interferes with transmission quality.

The installation of over 5 million miles of fiber, with thousands of fiber splices, has taken fiber technology comfortably beyond its initial birth pangs. The rough edges of fiber-system design, installation and operation procedures have been worked out and are now routine and established. Splicing techniques, whether mechanical or fusion, produce reliable, repeatable results. Training of installers and technicians can be readily accomplished.

Optical fiber splices are not as simple and inexpensive as an F fitting on coax, but fiber splicing need not be a hurdle in the total system analysis of fiber vs. coaxial cable. Cable systems are establishing a firm track record with fiber supertrunks now. Fiber distribution systems are being planned to leapfrog troublesome amplifier cascades. Chances are you will have an opportunity to work with fiber sooner than you'd have bet a year ago. ■

Connector excellence

By Rex Porter and David Butchko
Pyramid Industries

During the past two decades, research and development toward better cables and amplifiers has led to great engineering achievements in both products. But, while these major breakthroughs were being announced in cable and amplifiers, the connectors had not changed as dramatically. The emphasis on marketing connectors seemed to have become a pitched battle whether three-piece connectors were superior or whether two-piece connectors were cost-effective enough to offset that presumed superiority.

At the start of 1988, marketing and engineering at Pyramid Industries began scheduled meetings to research and plan improvements to assure CATV connectors would become as "user-friendly" as possible for the technician/splicer under the following guidelines:

1) The connector line should include both two-piece and three-piece versions.

2) The two-piece connector should be equal to both the mechanical and electrical specifications of the three-piece product.

3) The connector prices should remain competitive with other leading manufacturers.

4) The connectors should have visible improvements that a small, but local, direct sales/service force and a large, but remote, distributor sales force could sell its features and benefits against older, unimproved connectors.

Figure 1

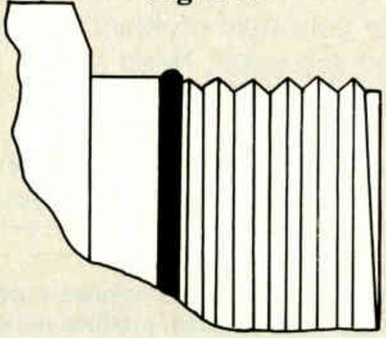
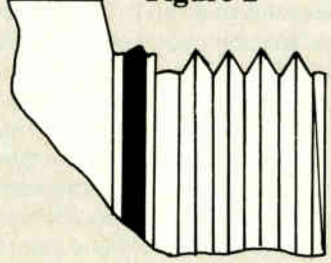


Figure 2



To begin this march to connector excellence, Pyramid first had to make some changes to designs of connectors already being produced in its Phoenix, Ariz., plant:

A) Pyramid had historically promoted the three-piece over the two-piece version.

B) Pyramid connectors were being lubricated with a "wet" lubricating agent.

C) Pyramid connectors used an internally threaded seizing or ferrule assembly that might be screwed out of the connector when the connector was being removed from a tight fit over cable.

D) Pyramid connectors used a grade of O-ring that had to be treated in-plant to help protect against ozone damage. Other competitors used a superior neoprene rubber that might not have to be treated inplant if they passed a fail/safe test in an ozone chamber.

E) Pyramid connectors used a flat rubber washer in the back nut that would sometimes restrict movement over cable.

William Morris, director of Pyramid's engineering department, had already begun design of a radically improved two-piece connector. As a result, he applied for final disposition of a U.S. patent in December 1987. Now, Pyramid began to initiate changes:

A) Pyramid improved the internal seizing for both the two- and three-piece connectors. Now, users of the new two-piece "PI" Series would realize the same service and life expectancy as users of the improved three-piece "PRS" Series. Since Pyramid upgraded both versions to match or surpass seizing capabilities of competitor's connectors, the decision was made to sell either version according to the customer's preference. But the warranty for both would be the same.

B) Investigation led Pyramid to an improved dry lubricant applied to threaded areas.

C) Pyramid replaced the previously threaded internal seizing assembly with an assembly held in place by a metal retaining clip. This clip was seated into a retaining slot so the internal parts could no longer be removed from the connectors.

D) Studying materials available for use in O-rings, Pyramid discovered a material was available which was superior to the neoprene being used by their competitors. Comparative tests showed competitors were using neoprene grades with "batch tests" for fail/pass results. This new material, E-P or ethylene-propylene, is more expensive as a raw material. But its use does not require batch testing because it is not affected by ozone or other weather demons that can cause O-rings to harden, shrink and crack. Knowing that a connector is only as good as its O-ring quality, Pyramid decided to continue its commitment to excellence and use only E-P for all its O-ring needs.

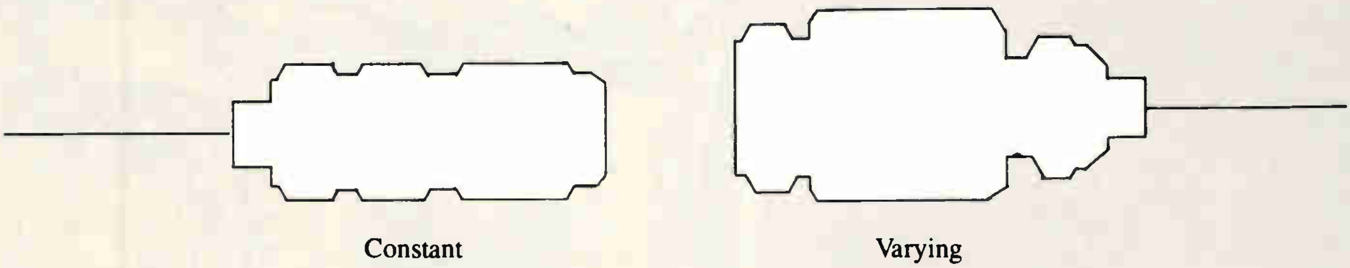
E) Pyramid replaced the flat washer in its back nut with the new E-P O-ring.

If Pyramid had simply stopped its improvements at this point, it could have claimed superiority over its competitors. But, having lost a market lead in earlier years, Earl Gilbert, chairman, CEO and the man who introduced the first 75 ohm connectors to an "infant" CATV industry, decided that Pyramid's R&D had just begun. To Earl, user-friendly meant the technician/splicer should be comfortable with all phases of connector use—whether assembling it onto the cable or removing it for repairs to the CATV equipment.

Constant feedback from the field was that O-rings at the back of connectors sometimes would bind up under the nut during its removal and the O-ring would "walk" across the threads. This would require the connector to be cut from the cable or could destroy the O-ring's shape and usefulness. Figure 1 shows a connector design where the O-ring is at the threads.

Pyramid decided to move the O-rings back from the threaded areas and machined a slot into which the O-ring would seat. This would not allow the O-ring to walk at all and certainly improved the security of the seal. Now, by machining the forward lip of the back nut, the O-ring was properly compressed during tightening and Pyramid could now guarantee a true

Figure 3



metal to metal "positive stop." No longer would there be a need for torque-wrench use or formulas consisting of "hand-tight" and some number of flats. As the abstract of the patent states, "A positive visually apparent physical interference between the rear and front nut bodies prevents overtightening and resulting damage." It should be added that its true positive-stop nature prevents undertightening in all but intentional cases. Figure 2 shows the improved O-ring location.

Another complaint was that the technician/splicer had to use different size wrenches to tighten the one connector size. So Pyramid decided to continue the use of common-size bar stock throughout each connector body/front nut/back nut assembly. This also would allow the splicer maximum clearance at multi-port locations. Various tests, using larger connector sections proved that the inherent weakness of any connector is its 5/8 KS-port area. Intentionally overtightening connectors during tests proved that the connectors either broke at the KS-port or else the threads stripped out in that port. Figure 3 is a comparison of "constant" vs. "varying" sectional sizes throughout a connector body.

From time to time, technicians complained that cable cracked at the rear of connectors for no apparent reason. Close inspection showed that the cable's aluminum sheath was more properly secured and fully supported if the RFI sleeve was even with the end of the connector after it is fully tightened. These tests led Pyramid to develop a "captive sleeve" for its PI Series. The captive sleeve will allow the installation of the aluminum sheath onto the steel sleeve even at some slight angle as it is movable until the connector is tightened. The superiority of this sleeve can be proven by:

1) Remove the back nut from the main body, with no cable attached.

2) Looking directly into the rear end of the connector, as you begin to thread the nut on, watch the steel sleeve position.

3) You will see the sleeve begin to lock into position and tightening will drive the sleeve back until it is exactly even with the end of the connector.

4) This also visually demonstrates proper support for the cable. Figure 4 compares the new captive sleeve to the older integral sleeve.

Figure 4

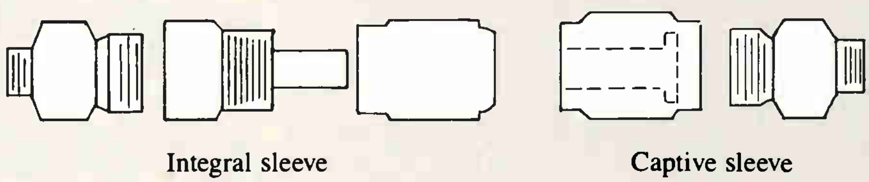
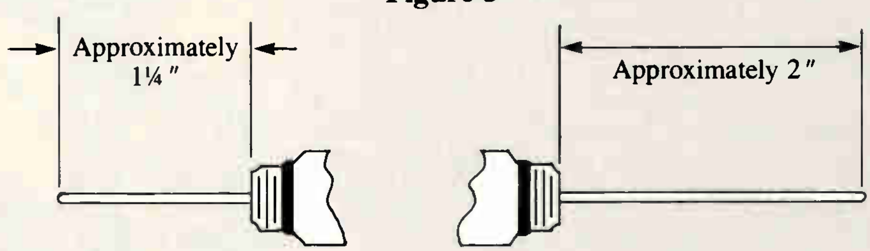


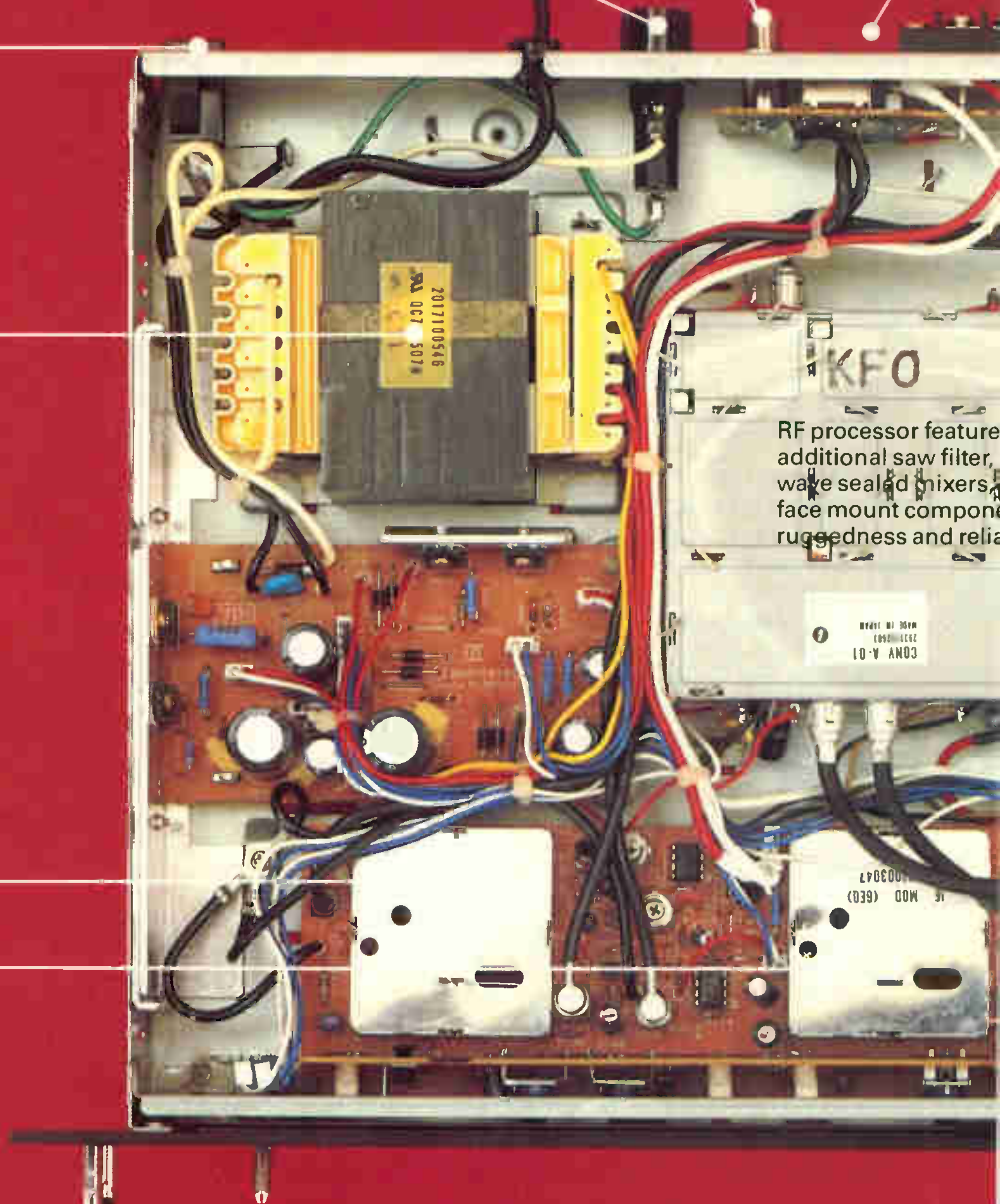
Figure 5



Construction projects are often shut down because connectors with regular pins were received at the job site when the equipment required the longer T-pins. Pyramid felt that charging extra for T-pins might jeopardize the use of certain products, so the decision was made to only manufacture connectors with T-pins, at no extra charge. Figure 5 compares the length of each pin version.

At a recent marketing/engineering meeting, the fact that Pyramid was the only connector supplier to offer a one-year warranty was discussed. Because Pyramid's distributors must feel secure with shipping times from both the manufacturer to their stocking locations and then from the stocking location to the job sites, Pyramid felt that a 90-day warranty might not cover construction projects with enough time to guarantee anything. So, as a pledge to continuing efforts in connector excellence, Pyramid will continue to ship its products backed by a full 365-day warranty.

These are positive changes that Pyramid believes will help propel it back into the leadership role as the '80s come to a close and a new decade begins. ■



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Installation of a frequency agile headend

By Karl Witbeck
Applications Engineer
And John Coiro
Vice President, Sales, ISS Engineering

ISS Engineering equipment is designed for ease of installation into a new or existing headend. However, proper planning and preparation must be given prior to the actual installation. This often means simply assuring an adequate supply of quad shielded cable, quality "F" fittings, a good set of hex crimpers and the elusive 10-32 rack screws (of which every job seems to be three or four short of enough!). The next consideration will be the combiner or a combining network using high quality directional couplers available from various manufacturers. The key words *high quality* cannot be stressed enough in relation to the installation of a headend. Regardless of the care, superior construction and materials used in the system, the limiting factor is the quality of the headend. The savings of a relatively few dollars in materials for the headend can degrade the picture quality throughout the entire system. But, if you have quality leaving the headend, then and only then will the system have the opportunity to deliver a qualitative signal.

When racking the equipment, consideration should be given at the initial stage of headend planning. The common temptation is to put 100 pounds of equipment in a 10-pound box. (We have heard stories of 1,000 pounds put into a 5-pound box!) When planning a rack layout, equipment should be spaced with vent panels so that convection cooling can take place. We highly recommend this be considered in the rack layout. Using a standard rack layout form for a rack with 19-inch rack rail spacing, equipment can be penciled in to determine the amount of space needed and the number of racks required. Also, it is recommended to leave some space for future expansion.

Figure 1 shows a headend rack layout in a 77-inch rack. Note that the entire rack is filled and vents are used above the modulators. When a rack of this size is installed, the location should be equipped with air conditioning or ventilation of sufficient size.

It is important to give attention to the routing of cables to avoid the spaghetti factory look. There is nothing worse than getting lost in a cable jungle. There are a few basic rules to follow when cabling a headend (see Figure 2):

1) Incoming and outgoing cables should be harnessed separately and, in most cases, should be routed to opposite sides of the rack.

2) Leave a 2-foot service loop on cables going to and from individual pieces of equipment for future removal for service, troubleshooting or relocation.

3) Audio, video and RF cables should be harnessed separately and preferably run in separate conduit or tray to and from the rack. This is especially true when using subchannels (or T-channels).

4) Ty-wrap all cable harnesses to harness straps bolted to the sides of the rack. The straps are $^1/_8$-inch by $1^1/_4$-inch angle metal stock run the full height of the rack. They are available at most hardware stores.

5) All distribution equipment such as splitters, combiners and taps that are not directly rack-mountable should be bolted to a piece of ½-inch plywood (preferably painted black) fastened to the inner sides of the rack. The strips of plywood should be small enough to allow room for the harness straps.

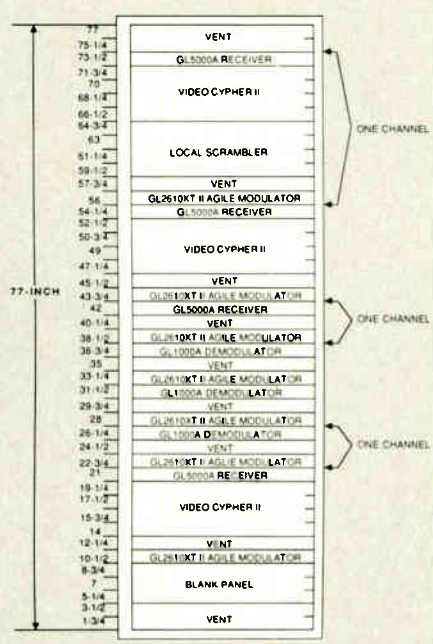
6) Always avoid sharp bends in cable runs and provide plastic or rubber bushings over any metal edges in the path of the cable harness.

7) It is always recommended to keep all cables off the floor. Once coaxial cable is stepped on, it damages the dielectric and alters the impedance characteristics.

Channel processors utilizing the ISS Magnum Series afford the system an "any channel in/any channel out" format through the use of a demod/remod process. To set up the demodulator portion of the Magnum Series processor the only requirements are the known signal level of the desired channel, and attenuators to allow the signal to be padded slightly below the maximum input of the demodulator's specification (maximum of +20 dBmV, minimum of −10 dBmV). Always attenuate at the input of the demod section, using a male/female-type attenuator available from any number of manufacturers. Once the proper input channel is selected and levels are established, you must decide *who* is going to be in the headend and the probability of an inadvertent channel change on the processor. The demodulator (GL-1000A) has front panel switches as a feature, to facilitate the ease of channel change. In light of this, the ease of inadvertent change is also always present. To correct this situation there is a non-volatile "lockout" memory incorporated into the GL-1000A. You simply add the desired channel into memory, thereby locking out all others. Then an accidental brushup against the channel selection switch or the best efforts of helpful, but unauthorized, persons cannot force a channel change until you specifically add other channels to the memory.

In the setup of the processor's modulator portion, the same considerations are present for output level and aural carrier level (typically 15 dB below video); however, the major difference is in areas where the off-air signal is transmitted offset due to proximity to another signal on the same channel (or a desired offset where on-channel processing takes place, in lieu of "phaselock"). This feature causes the tuner of the cable converter to seek out the strongest signal present with the AFT

Figure 1: Headend rack layout



(automatic fine tuning) window and lock onto it instead of the weaker undesired signal. To achieve the same offset in the system, the technician only needs to access the front panel offset switch and apply the same (or greater) degree of offset (i.e., 12.5 or 25 kHz). This is a detent-type recessed screw adjustment from the front panel and requires no special equipment or tools to perform. However, as a matter of good practice, it is always advisable to use a frequency counter to verify and note the measured offset frequency on this and any change or new installation of headend equipment.

Although the ISS Engineering series of modulators all have front panel LED indicators for overmodulation, it is suggested that at the time of installation (and on a periodic basis as a good engineering practice with all headend equipment from any manufacturer) a spectrum analyzer be used to adjust the depth of modulation to 87.5 percent according to the operating instructions of the analyzer. The LEDs serve as a "quick" method when you do not have an analyzer readily available or a quick check to ensure you are not overmodulating. To set modulation using the LEDs, simply insert an alignment tool into the modulation adjustment on the front panel and rotate the adjustment clockwise until the LED is illuminated. Then slowly rotate the adjustment in a counterclockwise direction until the LED just extinguishes and stays off. If there is a "flicker" in the LED, the unit is still overmodulating.

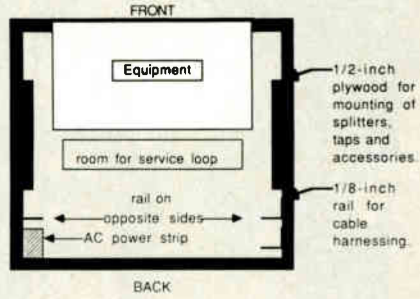
Demodulating a "sub-channel" signal is just as easily accomplished with the GL-1000A. To access the subchannel spectrum on demodulators with the T-channel option, an F-to-F jumper is connected between the "midband out" port and the "A input," select "A input" on the front panel and connect the incoming T-channel source to the connector marked "T CH" and tune the appropriate channel desired. The channel selector will show Channel 14 corresponding to T7 and T14 represented as Channel 21, inclusive.

Satellite-delivered channels are as simple to install as off-air, assuming that proper dish alignment has been achieved and an adequate interference-free signal is present. Powering of the LNA or LNB has often caused the most confusion regardless of the receiver manufacturer. With the GL-5000A, each input from the LNB has a powered output. As a matter of good practice, we recommend that each receiver's LNB fuse (located on the rear panel) be removed and stored for future use. Only one receiver per polarity should have a fuse left in it to power the LNB. The confusion as to if a splitter has more than one power passing leg and which receiver provides power, has caused many a blown fuse, frayed nerves and headaches. By removing *all but one* fuse, the problems quickly vanish.

The GL-5000A satellite receiver takes into consideration a multitude of available signal conditions (−60 to −20 dBm/carrier) and provides a switchable attenuator on the input to accommodate for your local area. The receiver is shipped with the attenuator switched "in," providing an attenuated signal at the input of the tuner for all uses except in the extremely low signal areas. In these areas the attenuation may be switched out to provide an extended range of acceptable signal. The appearance of "sparkies" is the first visual indication of a low signal level, requiring the attenuator to be switched back in and/or additional power passing attenuators be added at the input to the receiver starting with 3 dB and increasing in 3 dB steps until the attenuation is sufficient. It is important that the attenuation is placed at the receiver, as power varies from transponder to transponder and attenuating at the signal splitter of LNB might cause lower than acceptable levels to the rest of the receivers on that polarity and create more work for you to switch out attenuation on those other receivers.

The modulator setup for use of a satellite-delivered channel is the same for a processor with the following exceptions. Closely follow the VideoCipher (VC) installation and authorization process. Once the sync light on the VC is illuminated and a clear picture available, install the modulator as before. If a BTSC stereo encoder is to be used, the pre-emphasis selector on the rear panel of the ISS modulators must be set to the "off" position to allow for the stereo signal to properly pass to the system. If the signal is not encoded with a BTSC encoder the selector must be left in the "on" position to provide the necessary pre-emphasis. The modulator can be reconfigured as required for stereo with the simple switch selection.

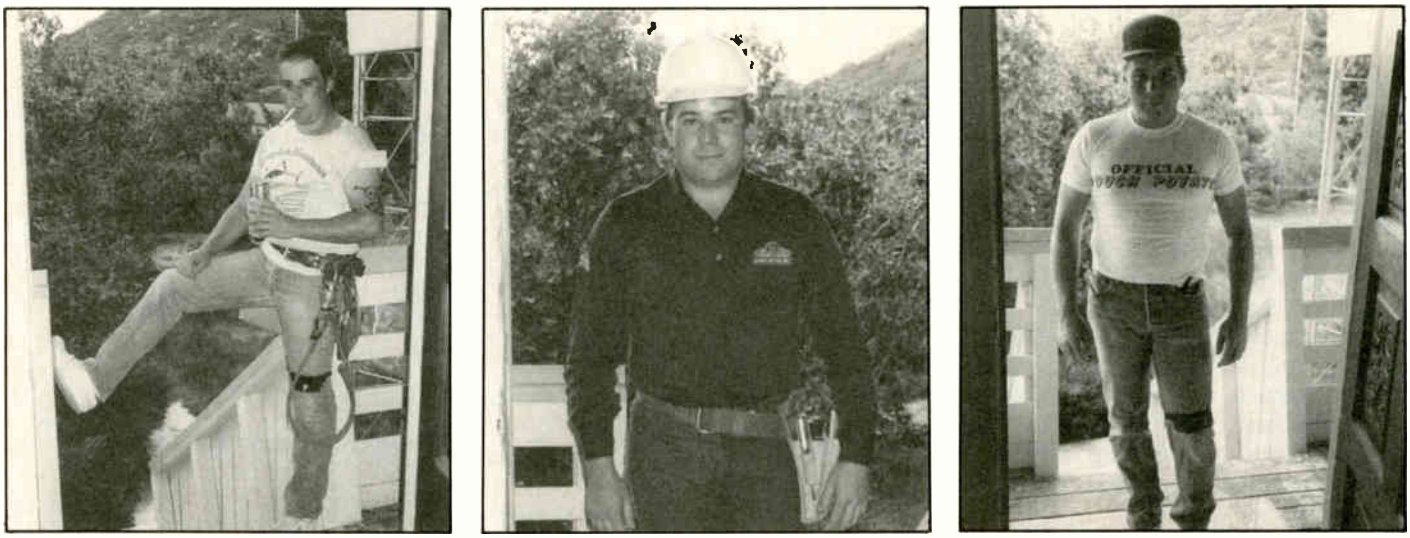
Figure 2: Top view of rack layout



An important note to modulator setup is an unfounded rumor in the industry that the only "legal" offset is "positive." Numerous inquiries have been made to the FCC's (Cable Compliance) office in Washington, D.C., and all have received the same answer: Offset—there is no required or desired direction, positive or negative, as long as the specified channel is offset by the required amount (12.5 to 25 kHz) and the FCC is advised of this action as is required. It is even "legal" to mix positive and negative offsets in the same system, as long as you fulfill your requirements to notify the FCC.

The myths of carrier-to-noise (C/N) are dispelled by a simple addition of logic. In a traditional fixed-channel modulator, a bandpass filter is located immediately before the output connector. With the ISS series of modulators the bandpass filter is located *after* the output connector. When ordering your channels, designate a channel for each Series II modulator (no charge with the Series II). This is a non-permanent filter that may be removed and changed as your channel lineup changes, affording you complete agility and a C/N of up to 90 dB per channel. If a replacement filter is required, a nominal charge of less than $30 is the total ISS cost. If an emergency change is required and a filter is not immediately available, there is no serious degradation in operating several modulators without filters (we recommend no more than four) until new ones can be obtained. ■

Installer Input



Will the CATV installer with the best customer relations practices please step forward and connect the subscriber's set?

Customer relations in two acts: Act I

Taken from the Performance Plus Installer Manual, this two-part article will discuss ideas and methods of customer relations for installers and field personnel.

By Dana Eggert
President, Performance Plus

Scene I: The first impression

Action: An installer swings his vehicle into the driveway of a normal house anywhere in suburbia and slams on the brakes; he appears to be late. He jumps out of the vehicle, leaving the door open, and hurries up to the front door. He rings the doorbell twice and knocks on the screen door.

Inside, the homeowner, annoyed at the excessive noise at the front door, gets up and walks toward the door. She looks through the peephole, but only can see a man wearing a baseball cap, T-shirt and faded jeans, and a vehicle in the driveway. She thinks to herself, "Could this be the man from the cable company?" (Audio under: Theme from *Jaws*) "Maybe I should call the cable company first, just in case. Oh well, I'll just leave the chain on and open the door slightly." She opens the door...

Will she let this man into her home based on her first impression? The odds are probably against him at this point. But why does she have a negative and apprehensive attitude about this man when she hasn't even talked to him?

You are allowed only *one* first impression. Once a customer has formed that initial feeling or attitude about you it is difficult to change, especially if it is a negative impression. While first impressions may seem to take only a split second to develop, customers often process a great deal of information to come to that impression. Appearance plays a significant part in forming that impression, but other things like being late or on time, driving and parking the vehicle, the number of times you ring the doorbell and other already established biases are all part of forming that first important impression.

Our customer started forming her impression of that installer before he ever got out of the vehicle, and for reasons that he may not have even thought were very important (like being a few minutes late and parking the vehicle on her property). Once he did get out of the vehicle, the installer continued to dissolve the customer's first impression by ringing the doorbell excessively. Only after all this data was collected did she finally see the installer for the first time and that was all she needed to pass the final sentence.

Your appearance affects the customer's first impression of you *and* your cable company. Because you represent the company, the customer assumes that your appearance reflects the attitudes and expectations of the company. Showing up with faded and torn jeans, tennis shoes and a worn-out T-shirt conveys that the company isn't very concerned about providing a positive image and therefore may not be too concerned about providing quality service. On the other hand, when you appear at the front door in clean jeans, work boots and a uniform work shirt with company name and logo on it, the customer assumes a positive impression of you and that you represent a service-oriented company.

What would happen to our customer's impression if instead of the installer showing up in a T-shirt and faded jeans, he was wearing a clean uniform shirt and clean jeans? Isn't it possible that all the annoying behavior already exhibited by the installer might now be perceived by the customer as quality-minded and enthusiastic? "Well, he knew he was a little late, so he was just hurrying so as not to inconvenience me any further."

Part of your appearance and professional image also relies on good hygiene. While it can be difficult and sensitive to discuss, it is one that you must be aware of as a direct customer contact.

It is important to present a clean image—hair combed or brushed, hands and face clean and as odor-free as possible. Obviously, it is more difficult to be fresh and clean on the last job of the day as it is the first, but the last customer's impression of you and the company is just as important as the first. If the drop installation occurred only outside it would be much easier, but since you are inside the customer's personal living space you should be sensitive to your body hygiene.

Checking your appearance in the vehicle mirror before approaching the customer's door is an easy way to ensure a good first impression. You also may want to carry an extra uniform shirt on those particularly hot days. Your appearance is perhaps the single most important factor in affecting the customer's first impression. A neat uniform and clean image will help create the positive, professional impression you want that customer to have.

Scene II: A stranger in the house

Action: Slowly, the door opens three inches. The installer, a bit puzzled, moves his face close to the doorway and says, "Uh, I'm here to install your cable. Can I come in and see your TV sets?" The customer, now extremely apprehensive, asks him for company identification. "Oh, sure, lady—right here."

Reluctantly, the customer removes the chain and lets the installer inside. As they walk toward the first TV set in the family room, she starts to stay that there will be another hookup in the master bedroom, but instead says, "I've changed my mind about two hookups. I only want this one TV hooked up." Would the customer have hooked up both TV sets if the installer made her feel just a little more comfortable about being in her house?

As an installer, you perform maybe five or six drops per day—or 30 per week, 120 per month and 1,400 drops per year. You are used to going in and out of other people's homes as part of the job—it is routine. But it isn't routine for the average cable subscriber who experiences a drop installation, with the installer in the home (not including service calls), maybe five or six times in this lifetime.

Nobody likes to let a stranger into his own personal living space. It is his private, unviolated territory. But just by being there to install cable service you threaten that space.

Think about how you differ from other service installers for a moment. If you were a plumber, you might be there to fix a specific problem or install a new hot water heater. The customer knows exactly what to expect, what a hot water heater does, and pays a one-time fee. Or say you were a carpet installer. Again, the customer knows exactly what he is buying. In fact, he even picked it out himself.

But you're there to install ongoing service that the customer pays for on a monthly basis, with multiple choices and options, different fees for different services, additional charges for equipment and outlets, a strange-looking box on top of the TV—a confusing service. Additionally, the customer may have expectations of cable that are not entirely realistic, but as the installer, you have to deal with. "I thought there were 60 channels." "This will clear up my fuzzy pictures, right?" "What do you mean, I can't use my remote control?" "Don't you have any pastel colors in those horrid boxes?" And so forth.

In essence, then, during the entire drop installation process you are forming what will be the ongoing relationship between the customer and the cable company. You are what the customer will remember about the company. By making a good first impression and putting your customer at ease with your being in his private space, you will develop a positive relationship for the company.

Making the customer feel less concerned with your presence should start right away with a positive attitude and a smile at all times. When meeting the customer for the first time, greet the customer by name (found on the work order), give your name and why you are there. Always offer company identification. Review the scheduled services with the customer and verify the amount of money to be collected before ever proceeding inside. Remember not to get too close to the customer; always allow for personal space.

Once you determine where the outlets will be installed, explain the entire process to the customer: where the cable will be routed, how many drill holes, how long it will take both inside and out, etc. Don't wait for the customer to ask, "What are you doing to my house?!" Then give the customer the opportunity to ask questions and request changes to your plan where appropriate.

Always be patient. If the customer has questions during the process, listen carefully and try to solve any problems or answer any questions quickly but courteously. This is an important relationship you're building.

Because you are a stranger in the house, one of the most important ways to set the customer at ease and earn his respect is to show extra care and caution with property, both inside and out.

Here are some dos and don'ts of courtesy during the drop process:

- Park your vehicle on public roadways whenever possible; avoid parking on the customer's property.
- Wipe your feet each time you enter the customer's house.
- Clean up all debris caused by the installation and dispose of it off the customer's property.
- Ask the customer before you use the telephone, when necessary.
- Be extra careful when moving ladders inside the house to keep from damaging walls or molding.
- Don't smoke inside the house or leave cigarette butts on the property.
- Don't sit on the customer's furniture.
- Don't put tools on the furniture or TV set.
- Don't make smudges on the walls from dirty hands or tools.
- Don't make unnecessary noise.
- Don't use the customer's bathroom.
- Don't accept food or beverages (other than water) or monetary tips from the customer.

Showing the customer simple courtesy does not take any extra time and is well worth the effort in establishing that healthy relationship between the customer and the cable company. As the representative from the company, you are the vital link between the two. Because the installation is often the customer's first opportunity to deal face-to-face with the cable company, your appearance, performance, customer relations skills and attitude are key in developing a positive, professional image that the customer will remember.

Scene III: Conclusion

Action: Three weeks later, the customer is watching television and notices an unusual, almost herringbone pattern on the picture. She attempts to correct the fine tuning, but only makes it worse. She begins to get a sinking feeling in her stomach. "Maybe I could just live with it a while longer; it might clear up." But after another 30 minutes she knows..."No, no, oh please, not the cable company again." (Audio up: Theme from *Jaws*; fade to black.) ■

To be continued...

Regulations and reporting

The following is the policy of American Television and Communications Corp., taken from an ATC training manual, and is the second of two parts.

By Gary Wesa
Technical Development Specialist
ATC National Training Center

"A properly planned safety program will establish a hazard-free workplace for all employees."

Cable television, which falls into the telecommunications field by OSHA standards, is not considered to have a high accident rate when compared to other types of industries or professions. Nevertheless, linemen and technical personnel frequently perform job duties requiring extensive knowledge of safety equipment, rules, regulations and proper climbing techniques, in order to perform under sometimes adverse conditions. Commonly, it is a lack of knowledge or training that creates carelessness on the employee's part. Proper training certainly helps deter accidents.

The employees' safety responsibility is to report any job-related injury or illness to their supervisor promptly and seek treatment. Employees should always be encouraged to seek needed medical attention. They should feel a responsibility to bring to their immediate supervisor's attention any "near misses" that could have caused an accident. These close calls can be corrected before they become serious accidents. With people involved, accidents can have a very detrimental effect on the entire workforce.

The most important reason for reporting accidents is to avoid any recurrence. Once notified, the supervisor is to seek elimination of any unsafe condition or act to prevent a similar type of accident. Before any correction takes place, the supervisor should conduct an accident investigation, creating a feedback loop for increased emphasis in safety. Some benefits of conducting an investigation are:

1) determining the cause,
2) preventing breakdowns,
3) developing better methods,
4) pinpointing training needs,
5) showing employees concern for their well-being,
6) adding knowledge to all jobs and
7) evaluating the training the supervisor is giving.

Costs incurred by accidents affect the employee and employer in many ways. In addition to the suffering that accidents cause, there are two types of costs that affect business efficiency. The direct costs, known as *insured costs*, are those paid to injured employees for workers' compensation and medical treatment. The indirect costs are the *uninsured costs* that affect supervisors, co-workers and productivity. There is usually considerable time lost in repairing, replacing and cleaning up. Indirect costs also may include overtime wages of substitute employee(s) picking up the slack for the injured employee, thus creating a loss of business income. Losses may even become serious enough to affect public relations.

All cable systems are required by the Occupational Safety and Health Act of 1970 to maintain a log of all recordable occupational deaths, injuries and illnesses on OSHA Form 200 (available from the Department of Labor). The safety officer may be responsible for assuring that this form gets filled out and posted properly. Each recordable case on the log must be filled out within six work days after learning of its occurrence.

Logs must be kept and maintained for five years following the end of the calendar year to which they relate. Logs must be available at each system or operating location for inspection and copying by representatives of the Department of Labor or the Department of Health and Human Services and any states accorded jurisdiction under the act. Employees, former employees and/or their authorized representatives also have access to the log.

The posting requirements for Form 200 state that a copy of the totals and information following the fold line of the last page for the year must be posted in each system regardless of the number of system employees. It must be posted the following year no later than Feb. 1 and must remain in place until at least March 1 of that year.

Even if there were no injuries or illnesses during the year, zeros must be entered on the total line and the form posted. The person who compiles the annual summary totals certifies that the totals are true and complete by signing the bottom of the form.

To supplement Form 200, each system must maintain a more detailed record of each recordable injury and illness on OSHA Form 101. Other forms, such as workers' compensation, insurance or other reports, are acceptable as records if they contain all facts listed on Form 101. With the exception of annual posting requirements, all other guidelines for Form 200 also applies to Form 101. Instructions for each form are given on the back side of the form.

Remember that OSHA rules, and safety and health guidelines in general, apply to all employees and not just to outside linemen and technicians. A secretary can trip on an electrical cord and hit her head on a desk as easily as a lineman can fall from a pole.

Inspections

To convey the importance of safety rules and regulations, periodic safety inspections should be performed. These tell the employees that the supervisor is concerned about their safety and well-being. The three essential steps when performing any safety inspection are to 1) plan ahead, 2) communicate and 3) follow up.

When planning safety inspections, it is necessary to organize all materials and equipment needed well in advance. Items needed may be checklists, previous records, any measuring devices, gaff gauge, tire wear indicator, etc.) or reference copies of OSHA regulations and company procedures. Safety inspections should become a common occurrence for most personnel; however, it is suggested to notify employees in advance of when and why the inspection is being performed. This will allow for employee feedback of specific known problems prior to the inspection. It also will prevent employees from thinking you are trying to surprise and catch them doing something wrong.

While performing the inspection, it is necessary to communicate with the employee(s) whose equipment or procedures you are observing. Answer any questions or clarify any confusion that may arise at the time. The inspection should be a learning experience for all involved.

There should always be a follow-up to any safety inspection, including any reports or forms to be completed promptly, filed or forwarded as required by the system or corporate safety officer. Department memos can be assembled or training sessions scheduled for any corrective action needed. Also, spot checks can be effective in updating safety awareness. The follow-up will improve employee awareness of management's concern for safety.

Accident control is management's responsibility. Senior management formulates policy and the supervisors interpret and support it by providing training, enforcing safe work practices and performing their own duties in a safe manner. All this helps develop the proper employee attitude toward safety, but there must be other means of maintaining interest in safety and its enforcement.

Safety training can be obtained from supervisory management when made part of their yearly employee development goals. Goals also should include improvements in the system's safety record from previous years.

Employees should feel they are involved in making a contribution to the work group. It is important for personnel to be able to express their thoughts without fear of ridicule or retaliation by supervisors as this reduces strong, pent-up emotions. Properly organized employee committees can motivate employees and allow them to blow off steam before morale problems surface.

Company suggestion boxes are an excellent way to generate new ideas. This also can be linked with company contests or award programs that create competition among employees and are usually very popular. They can be cost beneficial to employees and company alike.

A properly planned safety program will establish a hazard-free workplace for all employees. Emphasizing safety on an ongoing basis shows that cable TV can be an enjoyable and safe profession. ■

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What's causing the problem?

The following article is an excerpt from the Jones Intercable Qualified Installer Program manual.

To determine if a problem is caused by the customer's TV set or the cable after the cable has been connected, use a test set or small TV set in good working order to test the cable. If the problem is the customer's set, point out the differences between the two sets, explaining the problem is not the cable.

Troubleshooting the installation

The goal of the installation is to produce high quality pictures and sound on the customer's set and high quality sound on the FM receiver. Occasionally, there can be problems with the picture quality, sound quality or both once the installation has been completed. When problems occur, the installer should troubleshoot the installation.

The installer is responsible for troubleshooting the drop from the tap port to the TV set. It is assumed the installer has a signal level meter, volt ohmmeter (VOM) and a test set. Troubleshooting procedures can easily be changed when the installer does not have one or more of these testing devices.

Generally, the best troubleshooting method is to start at the set and work your way back to the tap, but experience will at times tell you to try other ways. Reception problems are generally caused by system problems, drop problems or set problems.

The first step in troubleshooting is to determine if the signal is good at the connection to the customer's set (or input to converter, if used). If the signal levels are not in the acceptable range, troubleshoot the drop using the troubleshooting guide to help you find the problem. As you work your way back through the drop, you will be looking for unexpected changes in signal level. Let's work through an example to show you how this works.

Let's assume you measured a −20 dBmV on Channel W (36) and −10 dBmV on Channel 2. From 0 to 10 dBmV is the range of signal levels that produces quality pictures, so you can see that the signal levels are quite low. It is helpful to know that coaxial cable causes signal levels to decrease at different rates, depending on which channel you're measuring. For example, RG-59 will cause the signal level of Ch. W (36) to decrease about 2 dB for every 100 feet of cable that the signal passes through, but will cause signal level of Ch. W to decrease about 4.5 dB for every 100 feet of cable. With a −20 dBmV on Ch. W at the set and 50 feet of RG-59 between the ground block and the set, you should expect about −17.5 to −18 dBmV at the ground block.

If the signal level is much higher than this (by 2 dB or more), there is a problem in this part of the drop. Repair or replace this part of the drop as required. If the signal level is close to this or if the signal is still low after repairs, continue troubleshooting. The ground block should not cause more than a 0.5 dB loss in signal level, splitters (if used) should cause a loss of about 3.5 dB or 7 dB depending on how many ports the splitter has and which port you use. Most splitters are marked so you can easily tell this. Traps should not cause more than a 0.5 dB loss each. Use this procedure until you find the problem(s) or reach the tap port. You should measure a minimum signal level of +7 dBmV on Ch. 2 and +11 dBmV on the highest channel your system uses. If signal levels are lower than this, report this to your supervisor. Arrange to have a service call scheduled and explain this to the customer.

If the installer does not have a signal level meter, there are two ways to proceed. If a test set is available, connect the drop to it. If the test set also shows a bad picture, then you know you have a problem in the drop or in the cable system. Continue by making a test jumper from about 200 feet non-messenger cable with F fittings on each end. If you do not have a test set, make the test jumper and proceed. Plug one end of the jumper into the TV set and connect the other end to the output of any splitters if used, the ground block and then the tap. If the picture quality suddenly gets better, you know that you've just bypassed the defective part of the drop. To test a splitter or ground block, disconnect the input connector and connect the jumper to the input cable with an F-81 splice. If you still have a bad picture when you connect the test jumper to the tap, you have a system problem. Reconnect all parts of the drop and report the problem to your supervisor. Coil the jumper and store in your truck for future use.

> *"Generally, the best troubleshooting method is to start at the set and work your way back to the tap."*

If the signal levels measured good and/or the test set shows good pictures, troubleshoot through any converters, decoders and connecting jumpers that are used. If none are used, or the picture is still bad, then you have a set problem. Refer to the troubleshooting guide for any consumer adjustable controls that might solve the problem. If the problem cannot be solved with control adjustments, there is a problem with the set. Discuss the system policy for set problems with your supervisor.

Troubleshooting guide

To help you in troubleshooting, examples of possible problems you might experience have been divided into three areas: sound, picture and miscellaneous.

Sound problems

Symptom: Picture but no sound
Causes/solutions:

1) Bad or improperly adjusted converter —Adjust converter if applicable or replace converter.
2) Bad set—Verify with test set if available. If unable to resolve, contact supervisor and follow system policy for set problem.
3) Volume turned down—Turn volume up.
4) Wrong audio inputs selected on set—Make sure any audio switches on set are positioned correctly.
5) Earphone plugged into earphone jack —Unplug earphone.
6) Bad audio leads from VCR or stereo decoder—Verify good sound with test set. If unable to resolve, contact supervisor.

Symptom: No sound; FM receiver
Causes/solutions:

1) Low signal—Troubleshoot under "snowy picture" guide.
2) Bad FM receiver—Verify with test FM receiver if available. Contact supervisor.
3) System problem—Contact supervisor.

Picture problems

Symptom: Snow, no picture
Causes/solutions:
1) Drop not connected to tap—Retrace line, make connection.
2) Drop failure—Troubleshoot drop.
3) Bad matching transformer—Replace.
4) No AC to converter—Check outlet with VOM or use a lamp, etc. Try another converter. If using remote, try switching converter on/off. Replace batteries or remote if needed.
5) Bad converter—Replace converter. If converter is addressable, request office to "restart" converter. Replace if it won't work.
6) System outage—Contact office to verify outage; report to supervisor.

Symptom: Snowy pictures
Causes/solutions:
1) Loose F fittings—Check and tighten all F fittings, replace any that are not installed correctly.
2) Bad converter—Replace.
3) Bad drop cable—Troubleshoot drop, replace complete length of defective cable. Splicing drop is not permitted.
4) Bad matching transformer—Replace.
5) Splitters bad, installed wrong (backwards) if a reconnect or possibly illegal—Troubleshoot splitter, make sure it is installed properly; remove illegals.
6) Wrong type splitter (FM) used for set —Use proper splitter.
7) Staples through drop cable—Replace damaged cable.
8) Bad decoders, traps, filters—Replace.
9) Low signal from tap—Verify and contact supervisor.
10) Bad set—Verify if test set is available; contact supervisor; follow system policy for set problem.
11) Cable hooked to UHF terminals—Connect to VHF terminals.
12) 75/300 switch in wrong position—Put switch in correct position.
13) Bad VCR (if used)—Bypass VCR to verify.
14) VCR hooked up backwards—Hook up correctly.
15) Bad A/B switch (for converter, VCR, computer, video game, etc.)—Bypass switch. Replace switch if company supplied. Inform customer if it is customer's switch.
16) TV/monitor switch in wrong position —Move to TV position.
17) Bad stereo decoder—Bypass to verify. Replace if company supplied. Inform customer if it is customer's decoder.
18) Ingress (ignition or impulse noise)—Most likely caused by loose F fittings or damaged drop cable; repair or replace. Check with test jumper from tap. If still there, it could be system problem. It can also be caused by set plugged into same circuit as electric motor. Try another circuit.
19) Sun outage—Explain sun outage to customer.

Symptom: Horizontal lines rolling through picture
Causes/solutions:
1) Bad converter—Replace.
2) Bad set—Verify with test set if available. If unable to resolve call supervisor. Follow system policy for set problem.
3) System problem—Contact supervisor.

Symptom: Herringbone pattern
Causes/solutions:
1) Loose F fittings—Tighten fittings.
2) Damaged drop cable—Troubleshoot; replace as needed.
3) Bad converter—Replace.
4) Fine-tuning off—Fine-tune set, VCR, converter.
5) System problem—Contact supervisor.

Symptom: Ghosts
Causes/solutions:
1) Loose F fittings—Check and tighten.
2) Damaged drop cable—Troubleshoot and replace as needed.
3) Low signal—Troubleshoot drop, repair as needed.
4) Bad matching transformer—Replace.
5) Direct pickup—Try with converter. If ghost disappears set will need converter to solve problem.
6) System problem—Contact supervisor.

Symptom: Vertical roll
Causes/solutions:
1) Loose F fittings—Check and tighten.
2) TV set controls—Adjust vertical control.
3) Bad converter—Replace.
4) Bad TV set—Verify with test set if available. If unable to resolve, contact supervisor and follow system policy for set problem.
5) System problem—Contact supervisor.

Symptom: Flash or blip in picture
Cause/solution:
1) Sweep pulse from headend every few seconds—Explain to customer this is a test signal the company puts in system.

Symptom: Channels off by one channel
Causes/solutions:
1) Set is tuned to wrong channel—Turn set to proper channel.
2) Set is on right channel number, but is fine-tuned one channel off—Fine-tune to correct channel.

Symptom: Black border at top or bottom of screen
Causes/solutions:
1) Vertical control on set out of adjustment—Recheck control setting.
2) Bad set—Verify with test set. If unable to resolve contact supervisor and follow system policy for set problem.
3) System problem—Contact supervisor.

Symptom: White border at top or bottom of screen
Cause/solution:
1) System problem—Contact supervisor.

Symptom: No picture; blank white screen; no snow, no audio
Causes/solutions:
1) Bad TV tuner—Verify with test set if available. If unable to resolve, contact supervisor and follow system policy for set problem.
2) Bad converter—Replace.

Symptom: Distorted picture/bright white washed-out screen/buzzing audio
Cause/solution:
1) System problem—Contact supervisor.

Miscellaneous

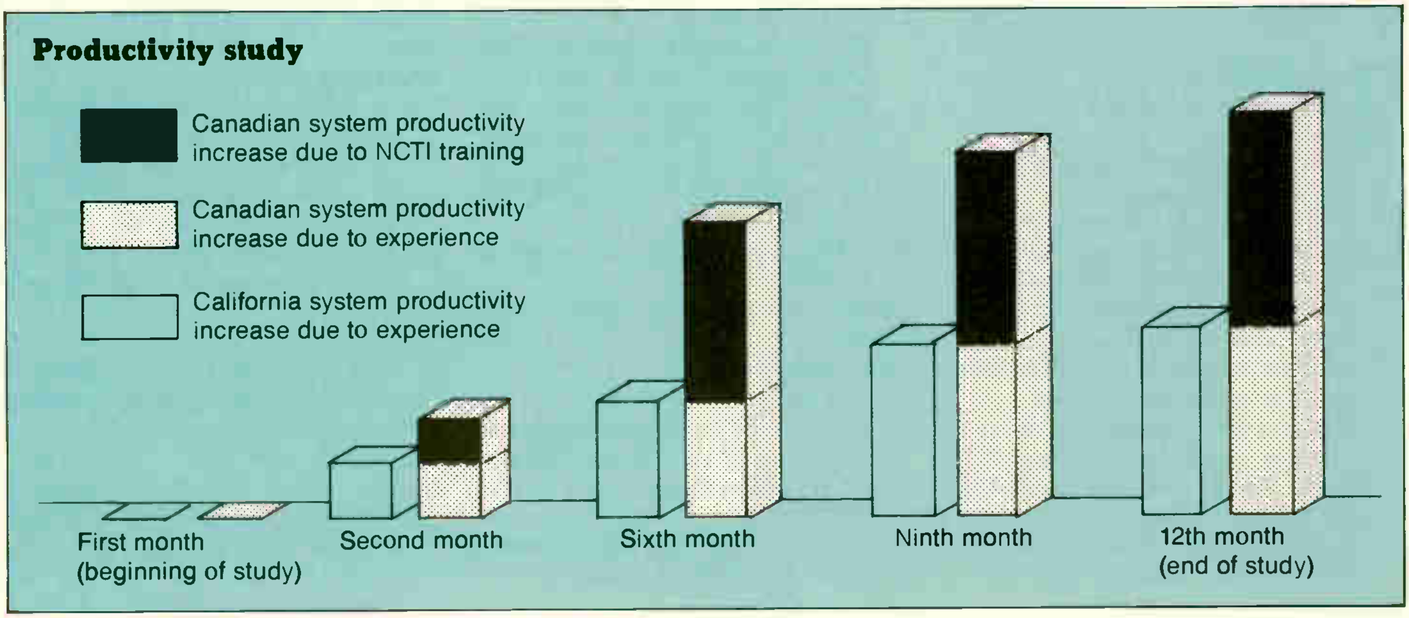
Symptom: Converter won't turn on or won't turn set on
Causes/solutions:
1) No AC from wall outlet—Check for possible wall switch in off position. Possible bad receptacle. Test with VOM. Try another outlet.
2) No AC from converter to outlet—Try another converter.
3) Bad set—Verify with test set if available. Contact supervisor and follow system policy for set problem.

Symptom: Handset won't change channel
Causes/solutions:
1) Set not on correct channel—Turn set to correct channel.
2) Low handset batteries—Change batteries.
3) Bad handset—Replace handset.
4) Bad converter—Replace converter.

Symptom: Remote won't turn set on or off
Causes/solutions:
1) Set not plugged into converter—Plug set into converter.
2) Low handset batteries—Replace batteries.
3) Bad handset—Replace handset.
4) Bad converter—Replace it. ■

Reprinted with permission from the Jones Intercable Qualified Installer Program manual.

From the NCTI



It's back-to-school time again

It's that time again when most households are faced with someone going back to school. NCTI enrolls and graduates students all year long so this time of year does not seem so special. However, since so many people are thinking about training we would like to take this opportunity to discuss it.

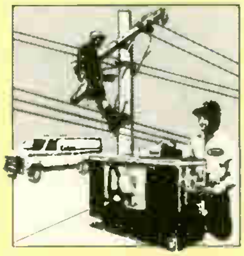
In almost every industry survey we, the operations people, rank training in the top five categories of greatest need. While the need exists, the budget is often not available to do the job. The reason it is difficult to get the dollars for training is that management is not generally made aware of how this can affect the bottom line.

Because it is a direct, up-front expense, it's usually considered an expense only. If they were faced with the purchase of office equipment, but could see that it would pay for itself in the first year of use and also would eliminate the need for additional personnel to meet the demands of growth, management would probably find the budget to purchase the equipment. In 1984 NCTI did a productivity study in two similarly sized systems in California and Canada. One used NCTI training and one did not. The system that trained their people did the same amount of work over the year with two less people and saved the company four times the amount that it cost to train those people (see accompanying figure).

Training pays in real dollars as well as in better customer satisfaction and less churn. NCTI has experienced more than a 30 percent increase in student enrollments so far this year. More and more systems are taking advantage of the savings and benefits that training provides.

It's your job to convince management that dollars in the training budget are a good investment. If you are interested, NCTI can help you devise a productivity study for your system that will give you the hard facts to present to management. It takes work and recordkeeping on your part, but it could pay off with a bigger training budget and smoother system operation—all of which will make your life easier.

So, back to school? Let's talk about it. For more information call Byron Leech, (303) 761-8554; or write to National Cable Television Institute, P.O. Box 27277, Denver, Colo. 80227. ■



Tech Tips

To simply complete service requests in a timely manner may not be sufficient. One must minimize the requests. In order to minimize service calls and achieve continued reliability, one must maintain the system plant at all times. Steps which should be policy for all systems are as follows:

1) picture quality and signal checks at the headend each day.

2) daily sweeping of the plant. Each active component should be rechecked twice a year.

3) a means of monitoring the longest cascades for the sole purpose of pointing out potential problems before our customers do.

4) the timely completion of service requests. A next-day service commitment must be met to minimize consumer irritation.

5) All outages must be addressed the same day and in most cases resolved within 60 minutes.

6) On-call technicians must be available 24 hours per day, seven days a week.

Subscribers today demand and deserve the best possible service at all times. Only well-trained and totally dedicated service personnel will survive as the future service technician.

— Wes De Vall

SACHS®

A MESSAGE FROM THE PRESIDENT

We often don't take time to say "Thank You" to our customers, and I feel I must say THANKS to the System Operators, Engineers, Technicians, and Installers who have, over the last 14 years, supported and assisted us in our growth and development.

As a result of the support from the cable community, Sachs is now able to say Thanks by offering expanded services to the industry in the form of FULL TRAINING SEMINARS on product applications, with our larger field training staff, INSTALLATION TRAINING at our new Denver, CO. facility; WAREHOUSING in Denver to provide shorter lead times on product delivery.

Another way of expressing our gratitude is by offering the new SACHS TRAINING AND INSTALLATION KIT (S.T.I.K.) program. At last, the System Operator has the opportunity to combine Sachs training, services, and products.

It is our sincerest desire to continue servicing you and addressing your needs through new and innovative products and programs for years to come.

Sincerely,
SACHS COMMUNICATIONS INC.

Jack Sachs
President

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New York • Colorado
Tel.: 1-800-361-3685

☐ **SACHS CANADA INC.**
745 Avoca Ave. Dorval, Que. H9P 1G4
Tel.: (514) 636-6560

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Stik With SACHS

INTRODUCING

THE

S.T.I.K.

SACHS TRAINING INSTALLATION KIT

PROGRAM

FEATURING

- **SaxPak 100 PLUS**

&

- **SaxPak 300 PLUS**

Kits of 100 and 300 installs for

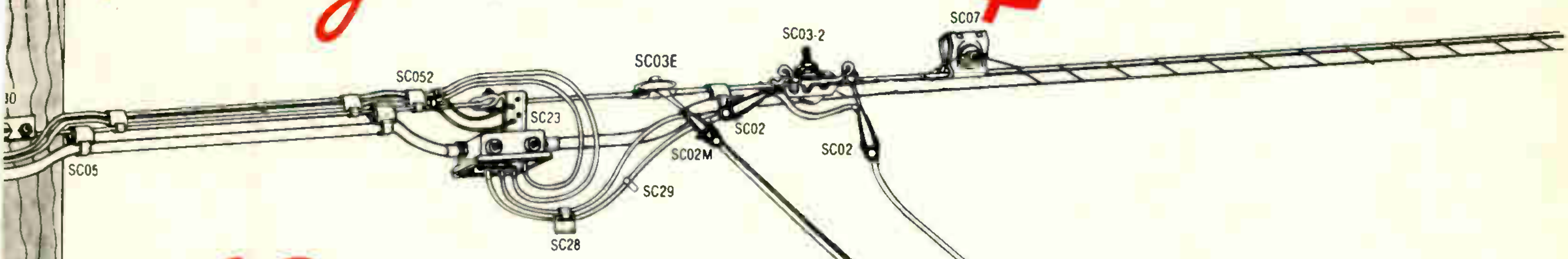
MESSENGER

or

NON MESSENGER

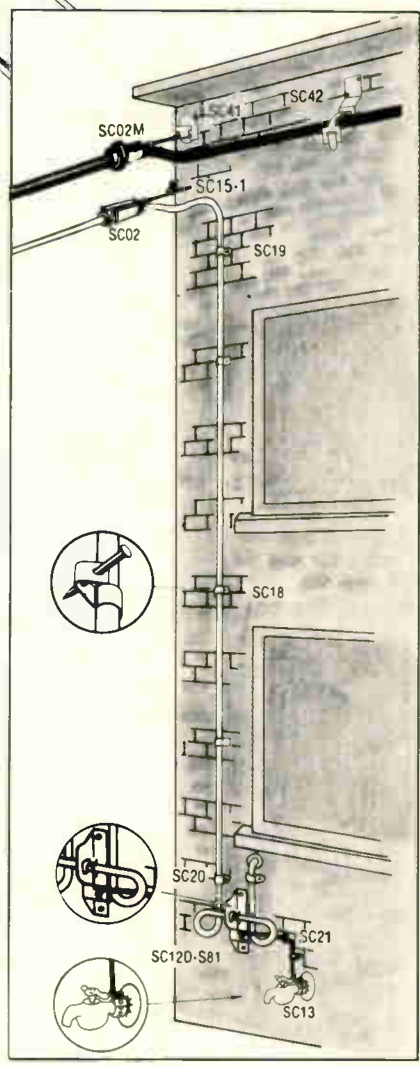
Systems

... A Drop Installation Evaluation Package that makes ¢ents



10 GOOD REASONS TO TRY...

...the better alternative!...



1. Acquaints the System Operator with the full product line so products can be selected that best meet the system's needs.
2. The **S.T.I.K.** exchange program allows the System Operator to exchange unused products for equal dollar value for products that more accurately meet the System's needs.
3. Introduction **S.T.I.K.** Package includes **FREE** product application training (a $ 300.⁰⁰ value) for installation staff.
4. Will provide training for sub contractors to assist system in contract labor and quality control to project positive company image within service community.
5. Use of products included in the **S.T.I.K.** package may reduce future service calls by as much as 25 %.
6. Extended life of products reduces lifetime costs of drop installation. Long term versos short term costing.
7. Helps reduce labor costs by 12 to 20 %
8. **U.L.** listed approval for Sachs Ground Block and Ground Strap COMBINATION.
9. No freight charge on SaxPak 300M Plus or SaxPak 300 Plus.
10. Receive six **FREE** SC50 Terminal Wrenches with purchase.

... When support counts.

The S.T.I.K. Program...

MESSENGER CABLE

SaxPak 100M PLUS
SaxPak 300M PLUS

NON MESSENGER CABLE

SaxPak 100 PLUS
SaxPak 300 PLUS

- EACH SaxPak INCLUDES THE FOLLOWING FOR MESSENGER OR NON-MESSENGER SYSTEMS:

SC02MF:	DROP CLAMP, MESSENGER CABLE
SC03E:	"ECONOSPAN" SPAN CLAMP
SC05-2:	7" CABLE SUPPORT STRAP
SC09:	SPLITTER RING NUT
SC10-2:	"S" CLIP
SC12DS81:	GRD BLOCK WITH F81 CONNECTOR
SC13-1:	6 1/2" COPPER GROUND STRAP
SC15-1:	"P" TYPE HOUSE HOOK
SC18-19:	"SAXXON" CABLE CLIP
SC19:	"U" CABLE CLIP
SC21:	"U" CLIP FOR GROUNDWIRE
SC22-6:	COPPER GROUND CONNECTOR
SC25-1:	FASTENING/MOUNTING SCREWS
SC26-1:	OMNI HOUSE HOOK
SC28-1:	IDENTIFICATION TAG
SC46D:	BRACKET, DUAL GROUND

SC02:	DROP CLAMP, NON MESSENGER
SC03-2:	SPAN CLAMP WITH 2 PIGTAIL HOOKS
SC05-2:	7" CABLE SUPPORT STRAP
SC09:	SPLITTER RING NUT
SC12DS81:	GRD BLOCK WITH F81 CONNECTOR
SC13-1:	6 1/2" COPPER GROUND STRAP
SC15-1:	"P" TYPE HOUSE HOOK
SC18-19:	"SAXXON" CABLE CLIP
SC19:	"U" CABLE CLIP
SC21:	"U" CLIP FOR GROUND WIRE
SC22-6:	COPPER GROUND CONNECTOR
SC25-1:	FASTENING/MOUNTING SCREWS
SC28-1	IDENTIFICATION TAG
SC46D:	BRACKET, DUAL GROUND

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For more information fill in and send the reader inquiry card enclosed in this issue or,
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FAX: **1-514-636-0794**

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Reader Service Number 15.

SACHS COMMUNICATIONS
30 West Service Road,
Champlain, N.Y. 12919-9703

IT INSTALLER TECHNICIAN

Name ____________________

Title ____________________

Company Name ____________________

Address ____________________

City ____________ State ____________ ZIP ____________

Phone Number (____) ____________________

FREE INFORMATION

Reader Service Card

September 1988 (Valid until November 1988).

Simply circle the number(s) below corresponding to products of interest!

1	16	31	46	61	76	91	106	121
2	17	32	47	62	77	92	107	122
3	18	33	48	63	78	93	108	123
4	19	34	49	64	79	94	109	124
5	20	35	50	65	80	95	110	125
6	21	36	51	66	81	96	111	126
7	22	37	52	67	82	97	112	127
8	23	38	53	68	83	98	113	128
9	24	39	54	69	84	99	114	129
10	25	40	55	70	85	100	115	130
11	26	41	56	71	86	101	116	131
12	27	42	57	72	87	102	117	132
13	28	43	58	73	88	103	118	133
14	29	44	59	74	89	104	119	134
15	30	45	60	75	90	105	120	135

IT 9/88

IT INSTALLER TECHNICIAN

IT INSTALLER TECHNICIAN

Installer/Technician magazine is distributed FREE each month to qualified cable TV personnel. Before you can qualify you MUST fill out this form completely. Incomplete forms will not be processed.

1) I wish to receive ***Installer/Technician*** FREE
- ☐ Yes ☐ No

Name ____________________ (please print or type)

Title ____________________

Company Name ____________________

Address ____________________

City ____________ **State** ____________ **ZIP** ____________

Signature ____________________ **Date** ____________

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2) Please check the category that best describes your firm's primary business (check only one)
- ☐ Independent Cable Operator
- ☐ MSO (two or more cable TV systems)
- ☐ Independent Contractor
- ☐ Microwave or Telephone Company
- ☐ SMATV or DBS Operator
- ☐ MDS, STV or LPTV Operator
- ☐ Government Agency
- ☐ Educational TV Station, School or Library
- ☐ Other ____________ (please describe)

3) In the performance of my job I authorize, specify or recommend products and/or services for purchase
- ☐ Yes ☐ No

4) Primarily my responsibilities involve
- ☐ Inside Plant (working within one specific office)
- ☐ Outside Plant (working outside of your company's office environment, i.e., in a mobile unit, at various locations on a daily basis)

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The *S.T.I.K. program...* see our ad in this issue

Date ____________

Title ____________

Phone ____________

Name ____________________

Company ____________________

Address ____________________

City ____________ State ____________ Zip ____________

- ☐ Please contact me immediately at the above number for more information on the S.T.I.K. program.
- ☐ Please send me literature immediately on the S.T.I.K. program.
- ☐ I am presently using the following Sachs products in my system :

SPECIAL INTRODUCTORY OFFER

(i) With every SaxPak 100 Plus ordered
Sachs will add 3 SC50 TOOLS at no extra charge
(ii) With every SaxPak 300 Plus ordered
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Decibels (Part 4)

By Ron Hranac
Jones Intercable Inc.

The power levels of RF signals carried on a cable system are quite small, especially when compared with other forms of RF communications. A CB radio for example transmits 4 watts, a local AM radio station about 5,000 watts and the two-way radio in your company vehicle about 35 watts. On the other hand, a headend processor output is 4.2 milliwatts (0.0042 watts or +55 dBmV) and a typical signal in a subscriber's home is 0.00004217 milliwatts (+5 dBmV).

Expressing cable system RF signal levels in watts can be cumbersome; once again, the magic of the decibel simplifies the mathematics of cable television. The following chart provides a conversion between dBmV and milliwatts (across a 75 ohm impedance). The formulas from which this chart was derived, along with examples of how to use them, are on the next page.

dBmV	milliwatts	dBmV	milliwatts
−20	0.0000001334	0	0.000013335
−19	0.0000001679	+ 1	0.000016788
−18	0.0000002113	+ 2	0.000021135
−17	0.0000002661	+ 3	0.000026607
−16	0.0000003350	+ 4	0.000033497
−15	0.0000004217	+ 5	0.000042170
−14	0.0000005309	+ 6	0.000053088
−13	0.0000006683	+ 7	0.000066834
−12	0.0000008414	+ 8	0.000084140
−11	0.0000010593	+ 9	0.000105925
−10	0.0000013335	+10	0.000133352
− 9	0.0000016788	+11	0.000167880
− 8	0.0000021135	+12	0.000211349
− 7	0.0000026607	+13	0.000266073
− 6	0.0000033497	+14	0.000334965
− 5	0.0000042170	+15	0.000421697
− 4	0.0000053088	+16	0.000530884
− 3	0.0000066834	+17	0.000668344
− 2	0.0000084140	+18	0.000841395
− 1	0.000010593	+19	0.001059254
		+20	0.001333521

To convert dBmV to milliwatts, use the formula

$$\text{milliwatts} = 10^{\left(\frac{\text{dBmV} - 48.75}{10}\right)}$$

To convert milliwatts to dBmV, use the formula

$$\text{dBmV} = 48.75 + [10\log_{10}(\text{milliwatts})]$$

Examples

Problem
The output of a line extender is +48 dBmV. What is that signal level in watts?

Solution
First, convert dBmV to milliwatts using the formula

$$\text{milliwatts} = 10^{\left(\frac{\text{dBmV} - 48.75}{10}\right)}$$

$$= 10^{\left(\frac{48 - 48.75}{10}\right)}$$

$$= 10^{\left(\frac{-0.75}{10}\right)}$$

$$= 10^{(-0.075)}$$

$$= 0.841395 \text{ mW}$$

Since 1 milliwatt is 0.001 watt, you must divide milliwatts by 1,000 to determine watts. Therefore, 0.841395 milliwatts/1,000 = 0.000841395 watts.

Problem
Convert 1 milliwatt to dBmV.

Solution
Use the formula

$$\text{dBmV} = 48.75 + [10\log_{10}(\text{milliwatt})]$$

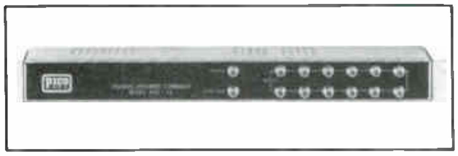
$$= 48.75 + [10\log_{10}(1)]$$

$$= 48.75 + [10(0)]$$

$$= 48.75 + [0]$$

$$= 48.75 \text{ dBmV}$$

Business Directory



Headend combiner

Pico Macom introduced the Model PHC-12 passive headend combiner, designed for applications requiring high isolation, non-amplified combining. It features 12 inputs, a maximum insertion loss of 16 dB and port-to-port isolation of 40 dB. It also is lightweight and rack mountable.

For further details, contact Pico Macom, 12500 Foothill Blvd., Lakeview Terrace, Calif. 91342, (818) 897-0028; or circle #133 on the reader service card.

Switcher

AM Communications' RTS-1 is a plug-in module for use in Jerrold JN or JX Series dual-cable trunk amplifiers. It is controlled by AM's TMC-8051 amplifier status monitor module and provides the capability to control signal flow for the inbound cable.

The signal path can be turned on, off or attenuated 6 dB under control of the LANguard system software. Two LED indicators on the top of the module show the current state of the switch. The module uses RF relays and the circuit is designed to fail safe so loss of control results in a default on state.

For additional information, contact AM Communications, 1900 AM Dr., P.O. Box 505, Quakertown, Pa. 18951, (215) 536-1354; or circle #131 on the reader service card.

Oscilloscope

Available from B&K-Precision, the Model 1541A 40 MHz oscilloscope has 1 mV sensitivity and V-mode operation. This allows two signals, unrelated in frequency, to be displayed in sync simultaneously for comparing signals from different timebase sources. The unit also has 5 mV full-bandwidth sensitivity, offering flat response over its entire range.

Additional features include 20 calibrated sweeps, a high brightness rectangular CRT with internal graticule and scale illumination video sync separators, x-y operation, z-axis input, sum and difference capability and Ch. 1 output.

For more details, contact B&K-Precision, Maxtec International, 6470 W. Cortland St., Chicago, Ill. 60635, (312) 889-1448; or circle #130 on the reader service card.

Demolition tool

Allied introduced the boom-mounted Concrete Cruncher for crushing concrete, cutting rebar and assisting in loading debris at the job site. It has 360° full rotating swing and twin rod cylinder power. According to the company, noise levels and dust are significantly minimized.

For further information, contact Allied, 5800 Harper Rd., Solon, Ohio 44139, (216) 248-2600; or circle #129 on the reader service card.

Calendar

September

Sept. 7-9: Eastern Show, Atlanta Merchandise Mart, Atlanta. Contact Nancy Horne, (404) 252-2454.

Sept. 8: SCTE Central California Meeting Group technical seminar on satellite technology. Contact Andrew Valles, (209) 453-7791; or Dick Jackson, (209) 384-2626.

Sept 9: SCTE Upstate New York Meeting Group technical seminar on fiber optics, The Lodge on the Green, Corning, N.Y. Contact Ed Pickett, (716) 325-1111.

Sept. 12-14: SCTE Technical Training Seminar, Harvey Hotel, Dallas. Contact (215) 363-6888.

Sept. 13: SCTE Central Illinois Meeting Group BCT/E review course on Category VI, Sheraton Inn, Normal, Ill. Contact Tony Lasher, (217) 784-8390.

Sept. 13-15: Magnavox CATV training seminar, Columbus, Ohio. Contact Amy Costello, (800) 448-5171.

Sept. 17: SCTE Inland Empire Meeting Group technical seminar. Contact Michael Lajko, (208) 263-4070.

Sept. 19-21: Siecor Corp. technical seminar on fiber-optic cable testing, Hickory, N.C. Contact (704) 327-5539.

Sept. 20-22: Magnavox CATV training seminar, Detroit. Contact Amy Costello, (800) 448-5171.

Sept. 20-22: C-COR Electronics technical seminar, Kansas City, Mo. Contact Shelley Parker, (800) 233-2267.

Sept. 21: SCTE North Central Texas Chapter technical seminar. Contact Vern Kahler, (817) 265-7766.

Sept. 21: SCTE North Jersey Chapter technical seminar on signal leakage. Contact Art Muschler, (201) 672-1397.

Sept. 26-29: Siecor Corp. technical seminar on fiber-optic installation and splicing for LANS, building and campus applications, Hickory, N.C. Contact (704) 327-5539.

Sept. 27: SCTE Satellite Tele-Seminar Program, "Standby power supply maintenance with automatic performance monitoring," 12-1 p.m. ET on Transponder 7 of Satcom F3R. Contact (215) 363-6888.

Sept. 27-29: Great Lakes Expo, Cobo Hall, Detroit. Contact Steve Smith, (517) 351-5800.

Sept. 27-29: SCTE Great Lakes Chapter technical seminar. Contact Daniel Leith, (313) 549-8288.

Sept. 27-29: Magnavox CATV training seminar, Chicago. Contact Amy Costello, (800) 448-5171.

Upcoming

Oct. 4-6: Atlantic Show, Convention Center, Atlantic City, N.J.

Oct. 18-20: Mid-America Show, Hyatt Regency, Kansas City, Mo.

Dec. 7-9: Western Show, Convention Center, Anaheim, Calif.

Feb. 22-24: Texas Show, Convention Center, San Antonio, Texas.

May 21-24: NCTA Show, Convention Center, Dallas.

Ad Index

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Reader Service Number 20.