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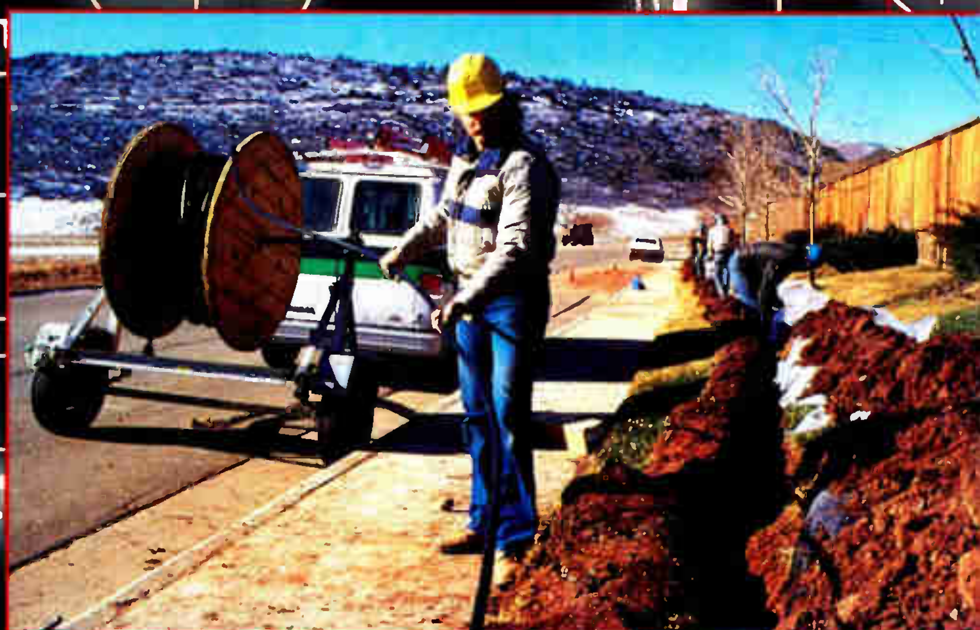
Official trade journal of the Society of Cable Television Engineers

Cable-Tec Expo registration

Designs on construction

Interdiction • Fiber



Troubleshooting tips

April 1991

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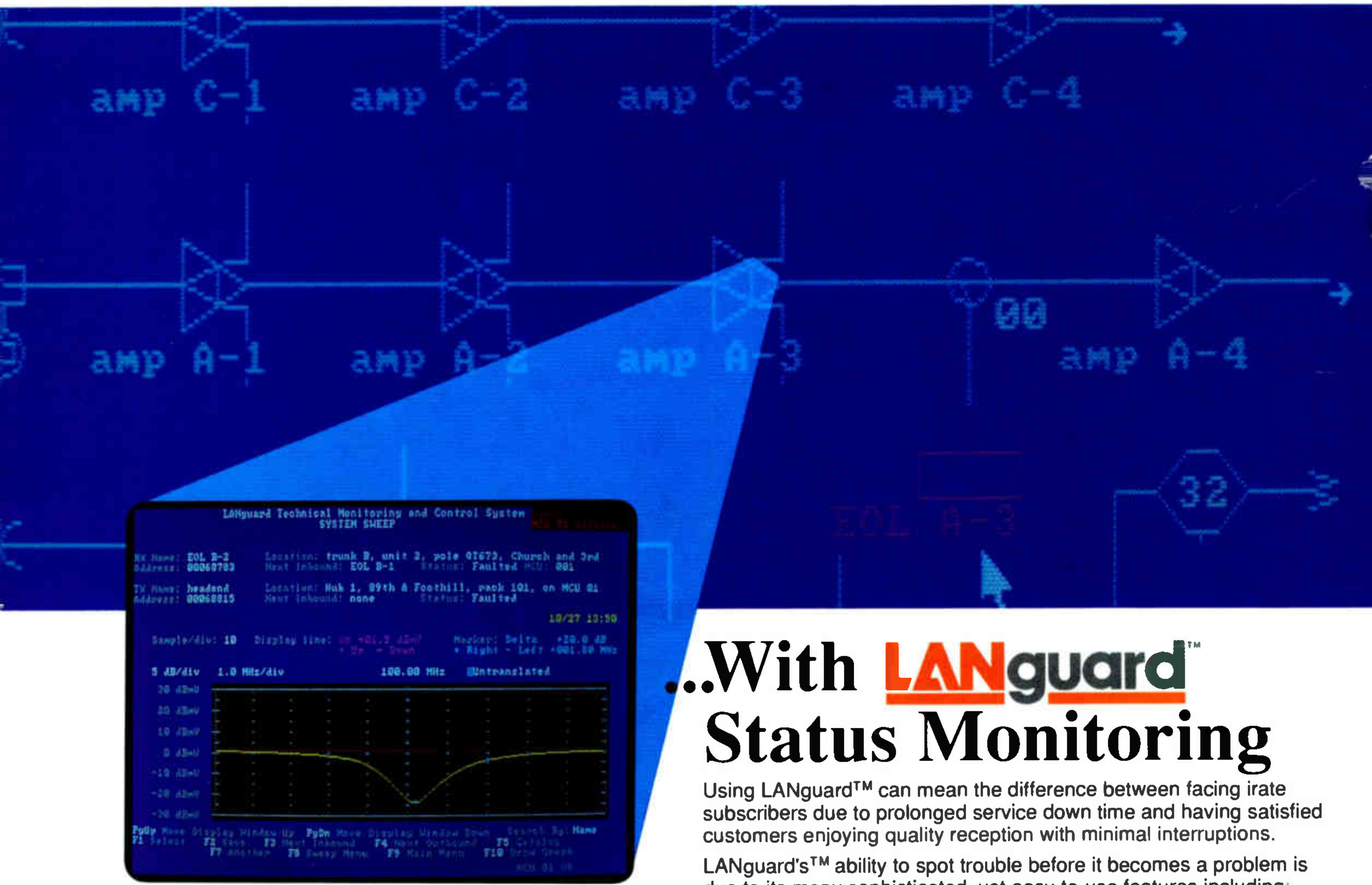

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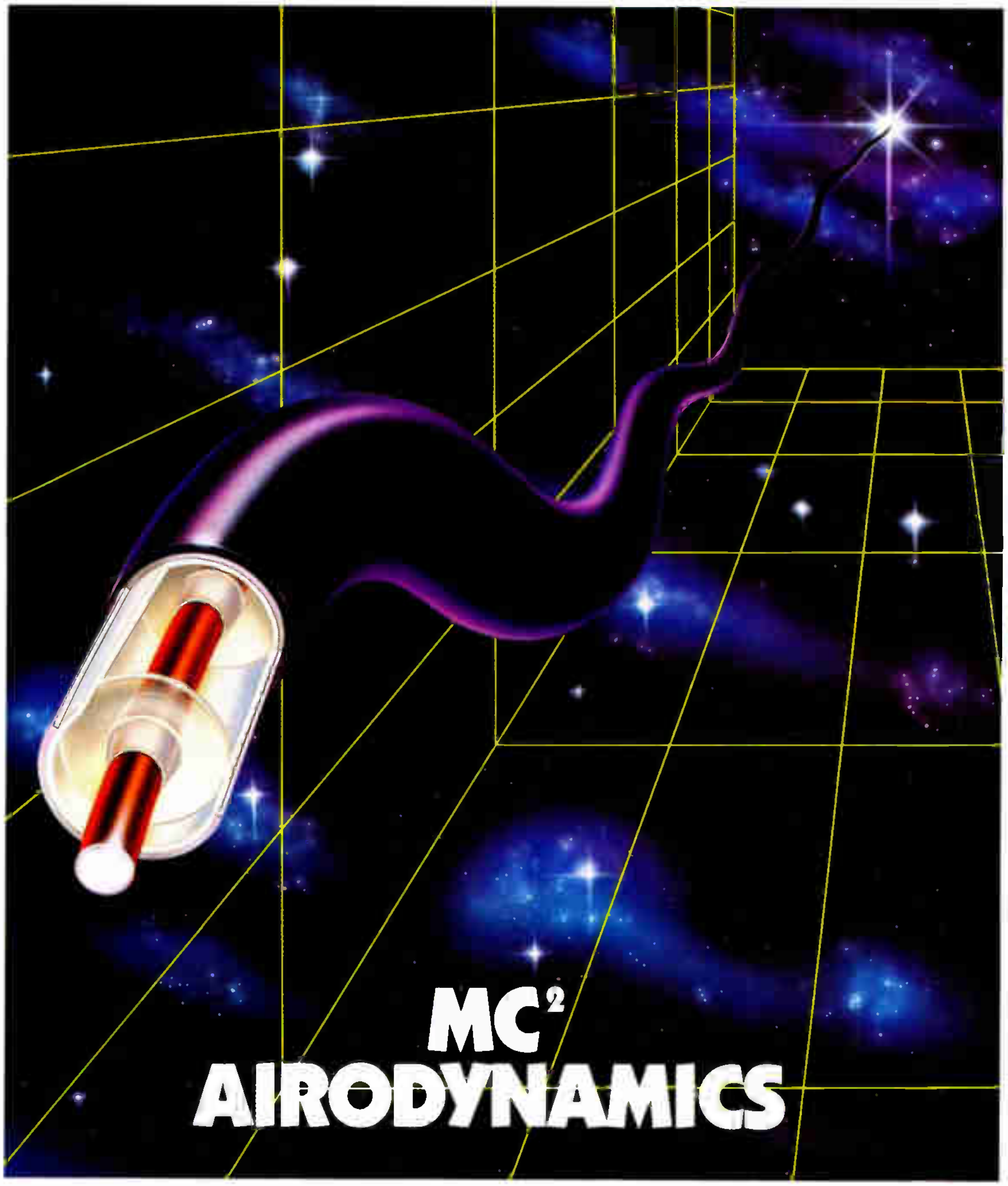

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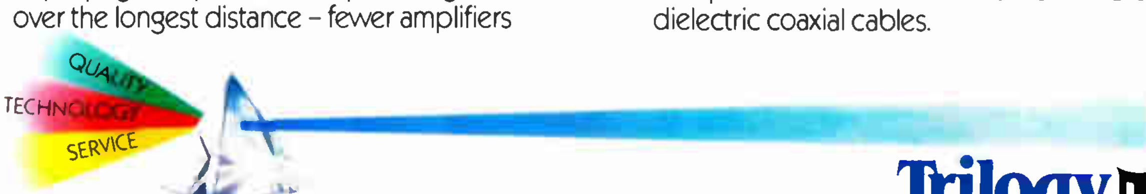

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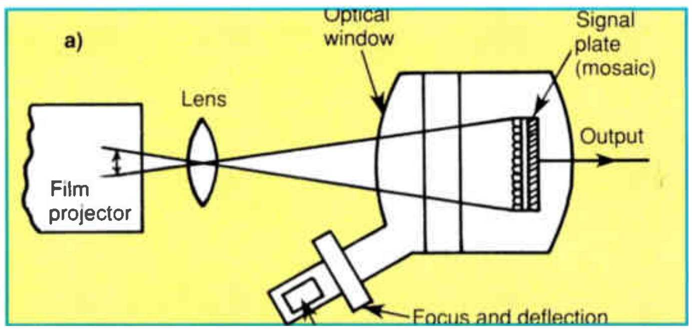

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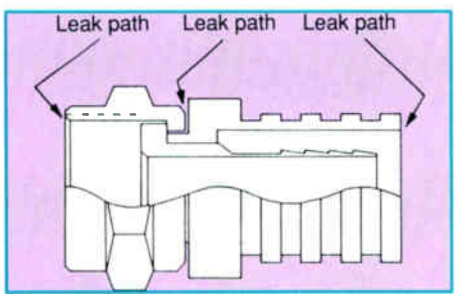

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Recession checklist

There is little question that the recession gripping our nation's economy also has taken its toll in the cable industry. While cable is generally considered to be at least recession resistant, we haven't gone without our share of bumps and bruises.

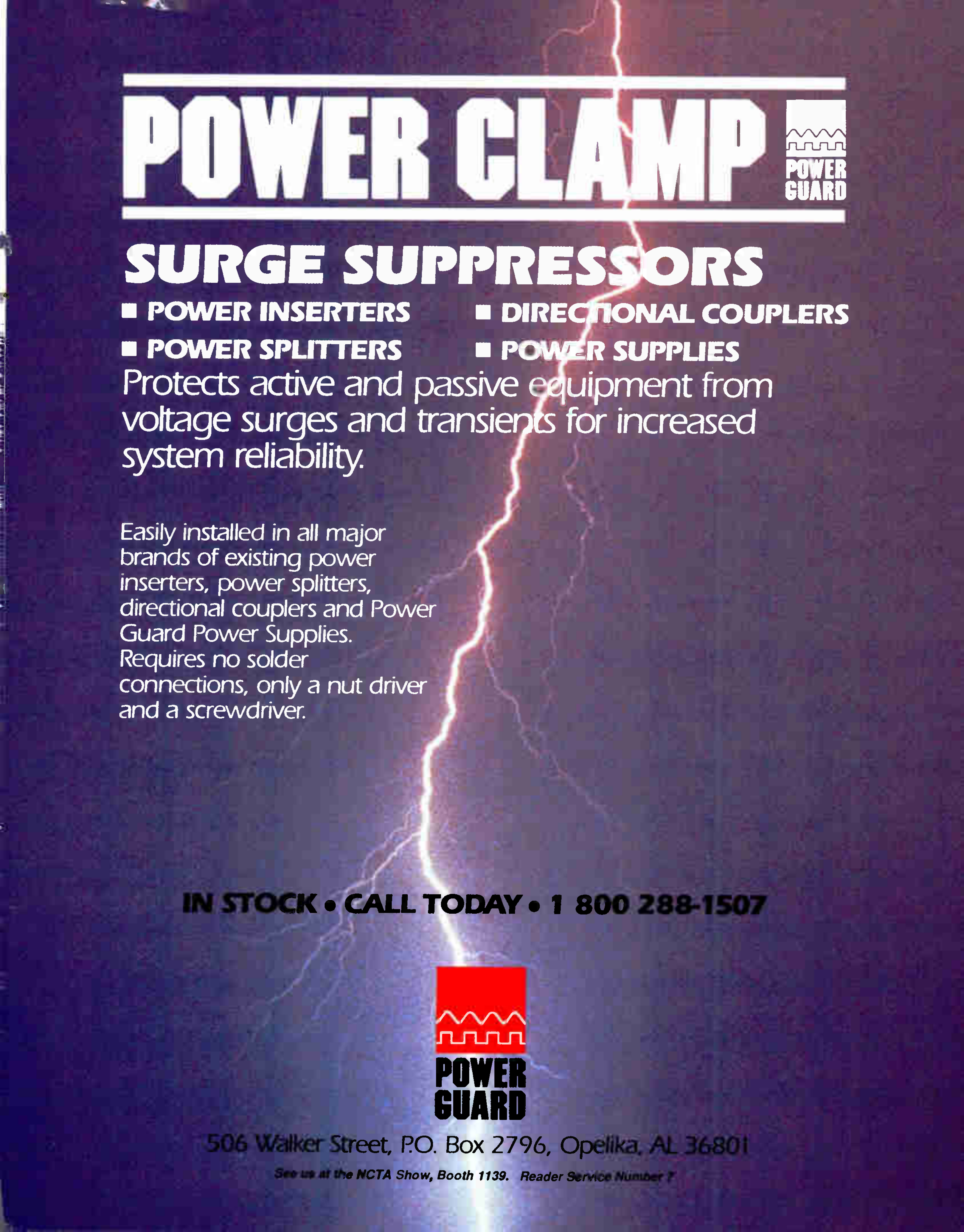
Several vendors have been forced to lay off personnel in the wake of reduced sales, many manufacturers have announced lower earnings, pay penetration is down, and operators have postponed or outright cancelled major builds, upgrades and rebuilds. Attendance at many shows by both operators and exhibitors is down. Even the publishing side of our business has been affected: *Cable Television Business*, *Cable Marketing* and *MSO* are among those that have felt the squeeze. The threat of reregulation and numerous over-leveraged cable financial deals have left Wall Street with second thoughts, too.

If things in your system have slowed down, what can you be doing until they pick up again? I've put together the following list, and while it is by no means complete, it does provide a place to start. You'll probably notice that most of the following can best be categorized as things we never seem to have time to do.

- Start a technical training program, and be sure to include time for at least one safety meeting each month. Good sources for training materials include SCTE and NCTI, and most of the major manufacturers can provide product-specific information that applies to equipment used in your system. Worthwhile goals include working to certify your staff in one or more of SCTE's certification programs, which are available for installers, technicians and engineers.
- Implement a preventive maintenance program! Here's a good opportunity to contribute to reduced service calls (less expense for the system) and improve overall system performance (happier subscribers). Numerous articles have been written about this subject; check your back issues of *CT* to gather information for the creation of a program for your system. SCTE also sells some good videotapes on this same subject.
- Finish your CLI early and beat the annual rush to get your paperwork sent in to the FCC.
- When was the last time you really swept your system? No, not just the trunk. I mean every active device in the system: trunk, bridger and line extender amplifiers.
- Peak your off-air antennas, align your satellite dishes to "bird in the box" and peak up your microwave paths.
- Of course, we all know that in cable the word *temporary* actually means forever. This may well be a good time to replace all of those temporary street crossings, the broken lashing wire, easement cables, the rope that is still holding the strand up where they did that pole changeout a couple years ago, etc.
- Bury all of those unburied drops. What? You don't have any? If you say so, but mine hasn't been buried now for four years!
- Update your system maps. You can do it yourself or hire an outside firm to provide fresh strand or as-built maps. It's a heck of a lot less costly than the rebuild that was postponed, and doing it now means you'll have the paperwork out of the way when corporate does give you the green light to actually start the rebuild.
- When was the last time you sent your test equipment in for calibration?
- Rewire those MDUs you've been putting off. It probably can be done with drop cable and new passives. Besides, TV pictures in hotels are often among the worst anywhere; why not work with their maintenance people and show them the correct ways to maintain their in-house systems? And if a particular MDU is not yet connected to your system, perhaps this show of goodwill on your part might just help convince them to become part of your network.

What can you add to this list?

Ronald J. Hranac
Senior Technical Editor



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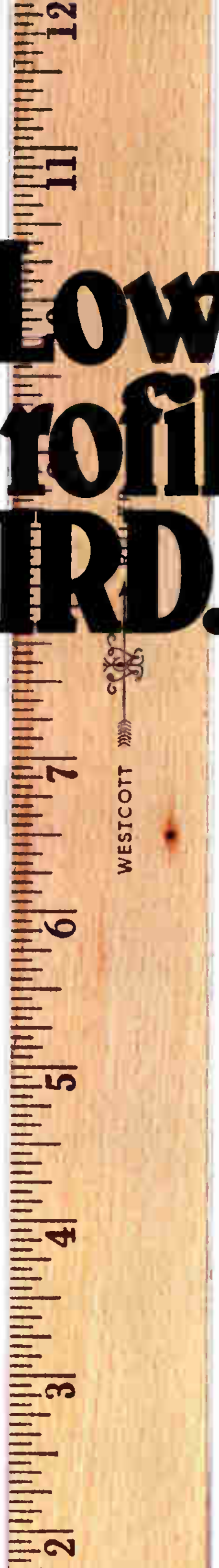

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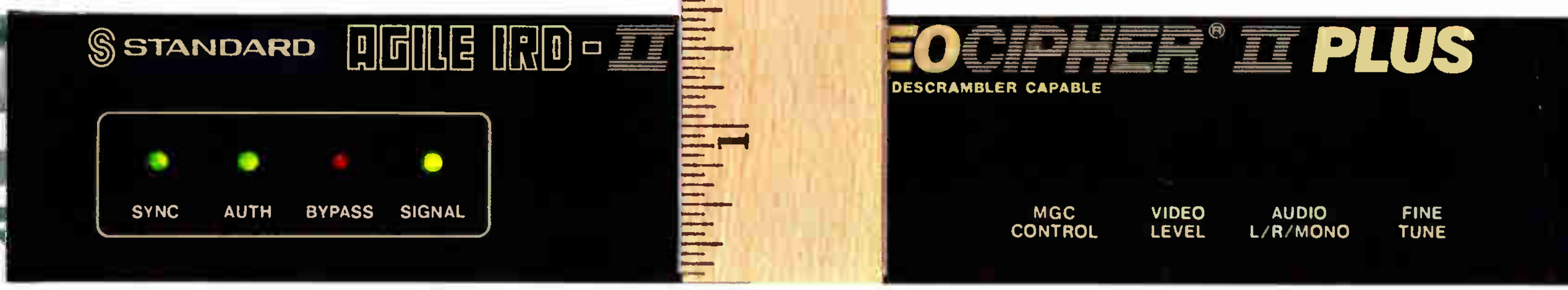

See us at the NCTA Show, Booth 1752. Reader Service Number 10

Jerrold introduces cable digital system; GI, MIT form alliance

HATBORO, Pa. — General Instrument's Jerrold Communications division recently unveiled Digicable, a digital compression and transmission system for cable TV. This system is part of a three-pronged development effort to digitally compress programming transmission for satellite and cable TV delivery systems.

Digicable takes GI's DigiCipher technology and adapts it for cable transmission. Using the system, an operator can compress as many as five movie channels or two standard NTSC channels into one 6 MHz bandwidth slot. "In addition, and most importantly, this is a gateway technology for the transmission of high definition signals," said Jerrold President Hal Krisbergh, "because you can also transmit one HDTV signal in this 6 MHz space."

In other news, General Instrument Corp. and Massachusetts Institute of Technology announced an agreement, to be known as the American Television Alliance, to jointly develop all-digital, simulcast high definition TV systems. Two resulting systems are to be submitted to the FCC for testing and consideration as the national HDTV standard for terrestrial broadcast TV.

Before the creation of the alliance, General Instrument and MIT competed as proponents for a national advanced TV standard. The agreement provides for equal representation, responsibilities and technology contributions. The resulting benefits will be shared equally by GI and MIT. The alliance will submit its systems for testing in slots previously assigned to GI and MIT; these slots occupy approximately two-month periods starting in September and March 1992.

Hams update list

DENVER — A group of Denver area ham radio operators is updating a list of radio amateurs in the CATV industry for publication in the June 1991 issue of *Communications Technology*. To date there are just over 350 hams on the list, and it has proved to be a valuable resource for sharing technical information, signal leakage complaints and solutions, and for solving interference problems. If you're not yet on the list, contact Steve Johnson, NOAYE, at ATC, 160 Inverness Drive West, Englewood, Colo. 80112, (303) 799-1200.

☛ **National Satellite Programming Network**, along with **Lifetime, E! Entertainment Television** and **J.C. Penney Shopping Network,** launched a campaign to promote programming on the new Satcom F1-R satellite. The F1-R, which replaced Satcom F3-R in January, provides stronger signals and a better footprint, enabling some systems to receive programming they did not previously have access to.

☛ **Viewsonics** moved its operations to 6454 E. Rogers Circle, Boca Raton, Fla. 33487; (407) 998-9594 (phone), (407) 998-3712 (FAX). The toll-free number will remain (800) 645-7600. The company began to phase out its operations in New York Feb. 4.

Texas Show sessions cover new technology

During this year's Texas Show sessions, which were coordinated by SCTE, attendees were invited to investigate current events, fiber optics and addressability via interdiction.

In the first seminar, "Technology: Current Events," John Wong (assistant chief of the FCC's cable TV branch) presented the latest news for CARS microwave band users and suggested that the CATV industry should work together for the establishment of industry-wide technical standards. But most of the seminar was devoted to signal leakage. He stated that of the 30,000 copies of Form 320 sent out for the 1990 filing, 900 community units had not been received. SCTE At-Large Director Tom Elliot (vice president of science and technology at CableLabs) then highlighted three recent transitions in the video industry: decoupling of the video with the transmission media, moving from analog to digital, and changing from NTSC to HDTV. Moderator Dan Pike, vice president of engineering at Prime Cable, concluded the session with a fascinating history of early TV technology and the coming of HDTV.

The second of three seminars ("Cable Operators Respond to Fiber Optics") began with an introduction to, and update of, SCTE events and programs by SCTE President Wendell Woody (director of fiber optics with Anixter Cable TV). He also addressed the work of the International SCTE Council and joint cooperation with CableLabs and the NCTA. The first talk on fiber was given by Richard Clevenger, vice president of service and technology for KBLCOM. He presented an overview of technology and industry structure, concentrating on competitive forces to CATV. Hugh Bramble, director of engineering for Columbia International, described fiber's use in preventing outages and increasing reliability. Finally, SCTE Treasurer and Region 4 Director Les Read (field service engineer with Sammons Communications) delivered a brief summary of his personal experience with a fiber-optic link in Dover, N.J.

The third session, moderated by ONI's fiber-optic project engineer, Lynn Watson, was titled "Off-Premises Addressability (Interdiction)." Gaylord Hart (director of engineering, Regal Technologies Ltd.) began with an overview of the basic technology of interdiction. Mike Hayashi, director of marketing for Scientific-Atlanta's Subscriber Systems Division, revealed to the largely technical audience the secrets of marketing with interdiction. Jack Bryant (director of product management, Jerrold Subscriber Systems Division) analyzed cost savings and implementation issues. He also discussed the pros and cons of powering by the cable plant and the home. Finally, Andy Shumway, Kingwood Cablevision's regional engineer, focused on his system's experiences with interdiction in a recent rebuild. Finally, he considered the designs concems of interdiction.

Two new chapters elevated at Texas Show

Two SCTE meeting groups were officially elevated to full chapter status at the 1991 Texas Cable Show in San Antonio. Region 8 Director Jack Trower presented chapter status to the former Ark-La-Tex Meeting Group, which serves SCTE members in Arkansas, Louisiana and Texas, and is based in Longview, Texas. The group's secretary, Robert Hagan II, accepted the chapter plaque on behalf of the chapter officers and members in attendance.

The Houston-based former Southeast Texas Meeting Group also was elevated to chapter status at the event. SCTE Treasurer and Region 4 Director Leslie Read presented the chapter plaque to the group's president, Tom Rowan. The Society currently has 48 chapters and 15 meeting groups for a total of 63 local groups

Two free SCTE memberships awarded

In further Texas Show news, two free one-year memberships in the SCTE were awarded in drawings held at the show's exhibit hall. Carl Savage, an engineering operations manager with Valco Inc. of Dallas was the winner of a membership donated by the Society in a drawing held at the SCTE booth, while Ed Allen, manager of United Artists Cable in Perryton, Texas, was the winner of a membership donated by Multilink in a drawing at the Multilink booth.

Technicians compete in first Cable-Tec Games

At the first annual SCTE Cable-Tec Games event, held in conjunction with the 1991 Texas Cable Show Feb. 27 in San Antonio, 16 CATV technical personnel competed for medals and a plaque in four events: RG-59 cable and connector preparation, .750 cable and connector preparation, "name that distortion" and a written test. The four teams were the Cable Contractors, Ark-La-Tex, Southeast Texas and Midwest CATV.

The winners for each event are as follows:

RG-59 — First: Pete Bingham (Cabletex/Cable Contractors team); second: Robert Hagan (WEHCO Video-Longview, Texas/Ark-La-Tex team); third: Fred Butler (Fred Butler Cable TV Construction/Cable Contractors team)

.750 — First: Robert Hagan; second: Chuck Spivey (Midwest CATV/Midwest CATV team); third: Pete Bingham

Distortion — First: Kelly Watson (Lakewood Cablevision of Montgomery, Texas/Southeast Texas team); second: Chuck Spivey; third: Doug Huston (Midwest CATV/Ark-La-Tex team)

Written test — First: Jimmy Smith (Lakewood Cablevision of Onalaska, Texas/Southeast Texas team); second: Kelly Watson; third: Tom Rowan (Warner Cable of Houston/Southeast Texas team)

In addition, the Southeast Texas team won a plaque for achieving the highest team aggregate score. Kelly Watson got a plaque for the highest individual score. Other participants in the games were Hughston Anderson (Lakewood Cablevision of Montgomery/Southeast Texas team); Mitch McGaughey, Jack Kennedy and Norm Vangon (Midwest CATV/Midwest CATV team); Joe Agostini and Darrell Eichelberger (ATC-Shreveport, La./Ark-La-Tex team); and Domingo Puente and Jimmy Gutierrez (TCI/Cable Contractors team).

The Cable-Tec Games were sponsored by Anixter Cable TV and *Communications Technology* magazine. The next games are scheduled for the Cable-Tec Expo in Reno, Nev., this June.

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Reader Service Number 13

Considerations, alternatives and designs for addressable interdiction

By John M. Cochran
Senior Applications Engineer
Subscriber Products Business Division
Scientific-Atlanta Inc.

Addressable interdiction offers the cable operator a new technology capable of providing a more friendly subscriber interface, higher security and increased reliability. New marketing and incremental revenue opportunities, increased operational control and reduced operating costs can also be realized. These benefits result from the change in the architecture and security method of existing systems to that of interdiction.

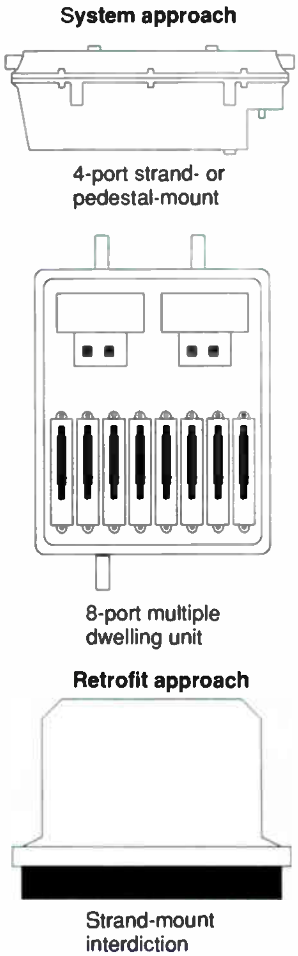
Interdiction is a system architecture that is equally applicable to new-builds, rebuilds and upgrades of cable systems. Changing existing system security and architecture from positive traps, negative traps or video scrambling to interdiction requires planning.

Operational considerations

• *Billing control and system operations.* Interdiction poses some new and unique marketing and incremental revenue opportunities. Over time, all homes can become connected to the CATV distribution system, assuring growth. Proactive marketing campaigns to non-subscribing homes will be easier when all the cable services are provided, literally, with the push of a button. Creative revenue producing cable services such as weekend-only cable, cable on demand and pay-per-view to non-subscribers are possible. All of this capability does not come without the need for some changes in the traditional billing system and CATV system internal operations.

• *Tracking of the interdiction unit.* Traditional billing tracks a set-top terminal through the warehouse, to the installer and to a subscriber at a billing address. A home is connected to the CATV system when a drop cable is connected between a port on the feeder tap and the ground block on the home. Interdiction units (IUs) come in multiple drop port versions in which each drop port has its own unique digital address. Physical separation of the individual ports is impossible.

Figure 1: Addressable interdiction product family



For example, a four-port unit cannot have one port in warehouse status while another is in truck status or yet another is in installed status. Also, multiple subscribers are controlled from one interdiction unit. Traditional billing systems must evolve to allow interdiction's inseparable ports, synonymous with multiple set-top terminals, to be tracked as a single contiguous block and not allow the block to be broken under any circumstances.

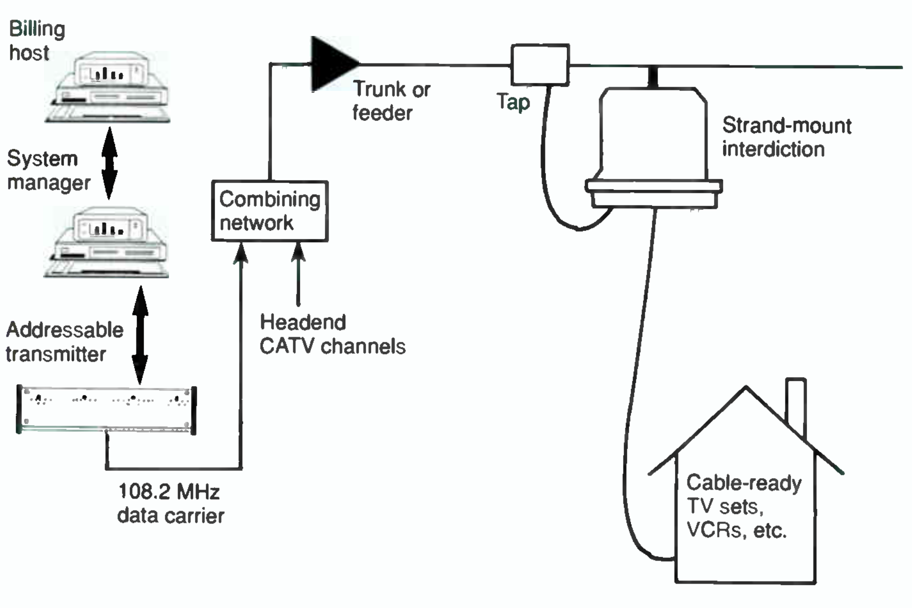
The billing system will not only need to maintain a block of subscriber ports as one, but will also have to display, at any time, all the home addresses connected to the one interdiction unit.

• *Home-to-IU connection.* Another billing issue is the correlation of a billing address and addressable port. Traditional billing ties a set-top converter to a person and, likewise, a person to a home. The missing connection is the home-to-converter, which is not seen as permanent in a set-top terminal tracking scenario and rightly so. For interdiction, this home-to-unit connection is a constant and a permanent record is essential.

For example, John Jones has service at 1 Main St. and decides to disconnect service. In the current scheme, Jones and his billing address must be purged from the billing system so that a bill will not continue to go to his address. Also, if a set-top converter is being used by Jones, a work order for the recovery of the unit is issued and the home/converter connection is eliminated. Once the interdiction unit is installed, it is permanently connected to a specific home and the port cannot be recovered. Billing systems must evolve to allow an IU's port to be tied permanently to a home address regardless of a change in the subscriber status. A home address also must be allowed to have multiple drops, if necessary.

Operationally, the multiple port IU replaces the tap in the feeder system. The change in operations is related to the connection between a port on the tap and a specific subscriber's home. With interdiction, each port has a digital address that is unique in the system. The procedure of connecting just any tap port to the home is not possible. The home must be connected to the "correct" port. The correct port is the one that the billing system associates with the house address. It also is the port that will receive the proper service level for the subscriber at that house address. Installations must be handled carefully so that an accurate record of the home-to-interdiction drop port exists to control service level for the proper subscriber.

Figure 2: Overall system architecture (retrofit case)



The IU's subscriber modules are dedicated on a per subscriber basis. At initial install, the choice can be made to not populate the subscriber module for non-subscribing homes. For a subsequent install, the billing system will have to display whether or not the service can be turned on immediately by indicating the subscriber module and drop status. A technician may have to install a module and/or a drop at the location. The billing system must track the subscriber module status of each IU's drops. Also for those with a module in place, billing should track inactivity of subscriber modules so that they may be recovered after an operator-specified period of inactivity.

Interdiction provides a means to allow the drop cable to become a permanent connection to the home. The remote connect and disconnect feature is built into the IU and is controlled from the headend. The drop cable does not have to be removed for a disconnect operation. This offers the opportunity to improve the drop installation techniques in the areas of coaxial wire quality and environmental protection. The result may be an overall improvement in the cumulative leakage index (CLI) of the system.

• *Marketing, services and non-subscriber purchases*. Interdiction allows the drop to be connected and disconnected at any time by addressable command. The opportunities for proactive telemarketing and special service provisions are enhanced. Equipped non-subscribers can be connected temporarily at any time and can make purchases such as PPV events. Operators will have the capability to offer new types of service packages such as pay-per-day and pay-per-weekend. To allow this extra revenue process, the billing systems will have to make provisions to allow non-subscribers to be credit-approved for random purchase of services and to be billed for their purchases. Non-subscribers will have to be able to receive and be billed for services other than on a per month basis.

In general, interdiction has new features and poses new operational considerations. The billing system must provide the new transactions for allowing control of an IU's features and the operational controls necessary for efficient and consistent day-to-day operations.

Deployment alternatives

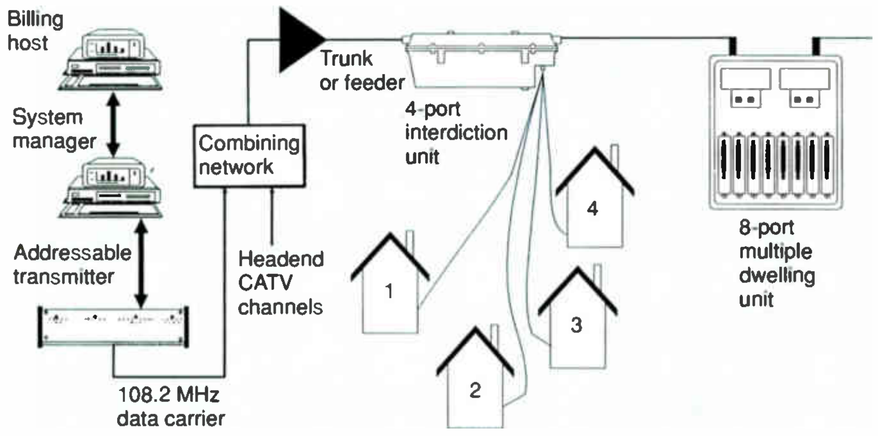
Addressable interdiction is a family of products that provides two methods of moving the addressable control and security electronics outside the subscriber's home. (See Figure1.) The first method is on a system retrofit basis. Strand-mount interdiction (SMI) provides the cable operator with a deployment alternative that is compatible with existing tap architecture as shown in Figure 2. The SMI is inserted in existing drops between the tap and the subscriber's entertainment device and receives power from the home. Since SMI receives cable service from the tap, it is built with an operational range consistent with the level and tilt scenarios particular to the drop path. SMI is an evolutionary approach and does not necessitate rebuild or hard-line coax splicing to implement.

The second method is distribution-system oriented. The four- and eight-port IUs become integral with the coax network by replacing the tap as shown in Figure 3. The units are spliced into the hard-line coax of the distribution trunk or feeder and are powered from the cable system or from the subscriber's home. The four- and eight-port interdiction approach is seen as the final evolution of the retrofit approach discussed first. Design is a critical step in implementing the system approach, distribution-oriented interdiction system.

• *Existing securities*. The security that exists today can be grouped into two categories: denial security and scrambling security. Denial securities are characterized by clear signals through the distribution plant with permanent extraction or alteration of the channel content just outside the subscriber's home. Scrambling securities are characterized by transformation of the video and/or audio signal at the headend before distribution to the subscriber. Signal reconstruction, "descrambling," takes place at the subscriber's home.

• *Interdiction security*. Interdiction is classified as a denial security. Interdic-

Figure 3: Overall system-approach architecture



tion provides signal security by inserting jamming carriers into the channel spectrum of unauthorized channels. The jamming carriers are generated within the IU by voltage-controlled oscillators (VCOs). The VCOs are agile, allowing each individual VCO to secure multiple channels. The jamming carrier permanently obliterates the video of the secured channels and causes an annoying buzz in the audio. Multiple channels can be secured with various levels of video obliteration. The jamming scheme has characteristics that make it impossible to defeat (short of completely bypassing the IU), assuring the maximum security available even at the lowest level of video obliteration.

The interdiction technology does not require scrambling of the secured channels at the headend. Channel programming is distributed in the clear and is secured within the IU by insertion of the jamming carrier. Picture quality is better because an interdiction-authorized channel is never scrambled and, therefore, will not contain any scrambling-related artifacts.

Addressable interdiction remotely controls the channel authorizations. Authorized channels are passed unjammed while unauthorized channels are secured by jamming. Channels are authorized by an addressable command that suspends the jamming on the appropriate authorized channel. A PPV purchase through CSR, ANI or ARU is handled as a temporary authorization of that channel.

- *Interdiction replacement of negative traps*. Changeover from negative traps to interdiction offers one of the easiest, most straightforward scenarios. Interdiction and negative traps are the same security type, denial. The existing taps and negative traps are replaced by the interdiction unit. Instead of attenuating or removing the signals with the negative traps, the interdiction system is instructed to place jamming carriers on the proper channels. The jamming carriers can be turned on any time after each IU installation. Each drop is defined in the billing computer and is given the proper service codes to authorize service for that subscriber.

- *Interdiction replacement of positive traps*. Changeover from positive traps to interdiction requires the IU to be used essentially as a passive tap while the rebuild is progressing. For the positively trapped channel, the IU is instructed to pass the signal in the clear allowing the positive trap to unscramble the positive encoding. Once the system, headend or feeder is fully populated with interdiction, the positive encoding is turned off; interdiction jamming is turned on and the positive traps are recovered as convenient. For those subscribers not purchasing the positive-trapped channel, the IU places jamming on top of the positive encoding for guaranteed security and prevention of unauthorized positive trap decoding in the home.

"The operational cost savings, incremental revenue opportunities and marketing flexibility available (with interdiction) are the ultimate enhancements necessary for cable TV's growth."

- *Interdiction replacement of scrambling*. The changeover from electronic scrambling to interdiction is similar to the scenario with positive traps. The IU is instructed to pass the scrambled channels as though they are in the clear so that descrambling can be done by the set-top terminal in the home. The IU will function as a passive tap until the entire system, headend or feeder area can have the scrambling security turned off. Once the scrambling is turned off, the channels are secured by interdiction. For those subscribers not purchasing the scrambled channel, the IU can place jamming on top of the scrambling for guaranteed security and prevention of unauthorized descrambling in the home.

- *Pocket deployment*. Segmenting or "pocketing" the overall distribution system by headend, feeder or other geographical points offers an enhanced solution to the changeover from existing security methods to interdiction. The overall system is segmented into smaller areas that are rebuilt one at a time. The segmented area is populated with interdiction then fed by a modified headend channel lineup consisting of separately modulated clear premium channels. Negative traps, positive traps and set-tops from the area can be recovered immediately after the security change and be used to satisfy requirements in other segments of the system that are awaiting changeover.

Some methods of system pocketing are inherent to existing system architectures. Some upgrade or rebuild scopes create a possible mode of segmentation. For example, a system that has many headends or multiple trunks per headend has natural segmentation built in. An upgrade or rebuild that involves new or overlashed trunks and/or feeders can be segmented by a dedicated trunk run with interdiction changeover by feeder. Fiber noding in the rebuild is a natural system evolution toward segmentation where interdiction is populated and a fiber to the

(Continued cn page 34)

The fiber build from start to finish

By James P. Ludington
Regional Manager, American Television and Communications Construction Division

Articles on the construction of fiber in a cable TV system have not been a rarity in trade magazines of late. Each contains important information on a section of the process. What follows is a general discussion of the major tasks in fiber construction procedures, written for operating system personnel as an aid in the proper planning, management and completion of a fiber-optic cabling project.

Whether the chosen architecture is FTF, backbone, CAN, supertrunk or any variation of each, the exercise is similar. The one comment that cannot be expressed too emphatically is that precise planning and preparation is the absolute key to the short- and long-term success of the fiber-optic project. Short-term success is the completion of the project as budgeted, scheduled and designed. Long-term success is attaining the desired reliability, maintainability and expandability of the fiber network.

The future of the CATV system technically (capacity and performance) as well as physically (plant expansion) must be forecasted as part of the fiber design. This exercise can be as difficult as predicting where technology may yet lead us.

Trade-offs between the cost of construction vs. future maintainability must be weighed. By adding a splice at a strategic location (future split or node), both current and future construction costs can be reduced. This will require some real brainstorming by the engineering department as well as upper management. It may require a "crystal ball" approach, but if the operation plans to endure tomorrow's competition the future is now!

The best route

The shortest distance between two points is not always the best way. By routing your fiber away from obstructions, high traffic, road widenings, utility maintenance, etc., when possible, you can limit the short- and long-term costs of the fiber placement and maintenance. Consider all routes even if it entails new strand or conduit placement. Cost out each possible route during the selection process.

When selecting the most viable route, knowledge of each particular method of fiber cable placement is necessary. The route, or link, is comprised of the individual runs between transmitters, splice points and receivers. While riding out each run, the method of construction should be pictured in your mind. How will this run be placed? That decision must be made *before* the fiber is ordered. Complete familiarity with the aerial placement methods of backpull and drive-off, critical tension forecasting, and intermediate assist methods via figure-eight or assist winch for aerial and underground is a must for the planning of each run.

Lengths of each run are dependent on the applicable method of construction, the cable tension predicted at a given location, the ability and equipment of the labor force, and the total splice loss available in the link. First, determine how many splices the power budget allows in this link. Then devise the construction plan for each individual run by meticulous route inspections. It is advisable to have a representative of the labor crew present during the rideouts. In suburban and rural aerial situations where drive-off is practical, lengths of 12,000-20,000+ feet are possible if the crews can handle a reel of that size and weight! If backpull is the means, practical lengths should be limited to less than 12,000 feet. Longer lengths are achievable, though at an incrementally higher cost.

The planning effort magnifies when underground is involved. When placing new conduit, use a critical tension forecasting method to determine intermediate assist point locations before the digging begins. The use of an inner duct is recommended for the fiber cable. Budget plenty of time and energy when retrofitting an existing duct system for use with fiber. Clogged, crushed, full and separated pipes are a nightmare when pulling in cables. Assure complete continuity in the duct system prior to attempting a cable pull.

Critical issues

The two most critical issues in fiber placement are pulling tension and minimum bend radius. The manufacturer's specifications must be strictly monitored in all phases of construction and storage after completion.

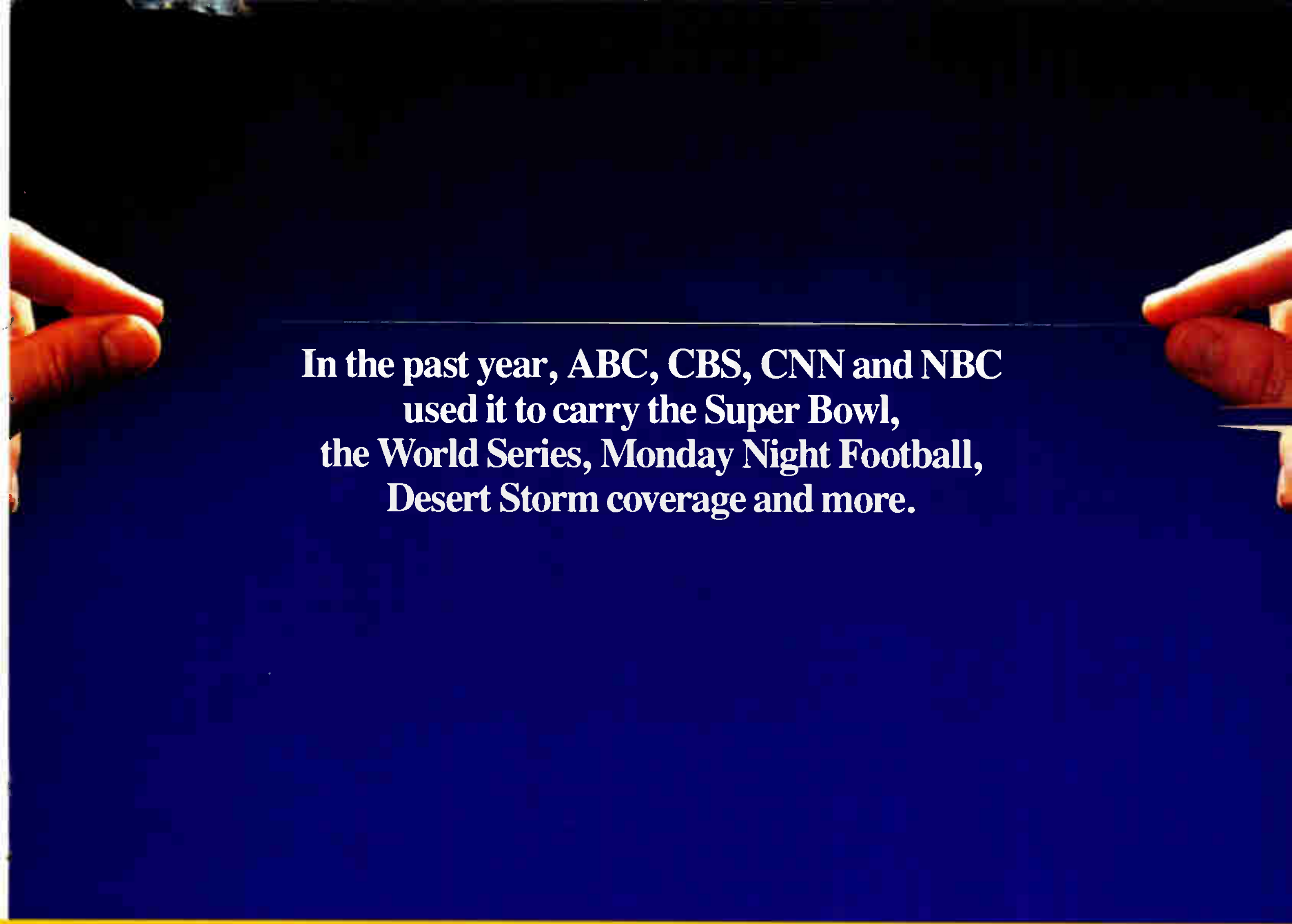
The splice location is typically a function of construction practices combined with future plans. Place the splice at a point that divides differing construction methods (aerial/underground transition, drive-off to backpull, etc.) when feasible, or at a point of high difficulty (obstacles, crossings, easements, etc.). Plan the splice near a probable future split location if there is a plan for future extension, additional cascade reduction via supplemental nodes, redundancy, alternate business opportunities, etc. Locate the splice enclosure in a limited traffic area, be it aerial or underground, with enough isolation and space to accommodate the splicing vehicle for an extended period.

Each run must be specifically planned with the construction method, location of setup and assist points, splice locations, and any special considerations noted on a set of field prints to be used during the construction process. The labor force should be carefully chosen using previous experience, condition of tools and equipment, and price as the main criteria.

Material orders

Now that each run is determined and the construction process blueprinted, the fiber and materials are ordered. Verify 100 percent of the strand/duct footages along the routes. Add the total footage for each run, then additional footage for each splice tail (+50 feet), slack point (+150 feet), sag percentage (2-3 percent), risers and offsets (exact), and the headend/hub building (exact) along each individual run. A slack point is a length of excess cable planned at strategic points along the link to account for unplanned splices, reroutes, etc. Once the fiber count for the run is defined, a single reel of this length is ordered. Remember to order the

(Continued on page 38)



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Reader Service Number 15

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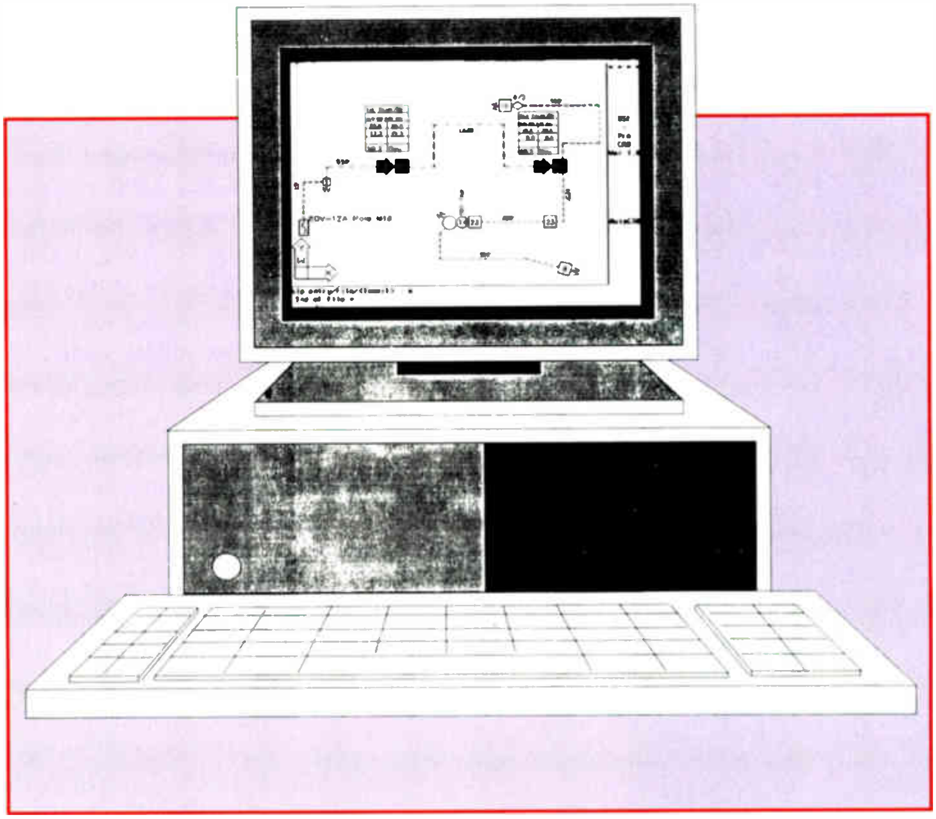
Sorting out CATV CAD: Part 3

This is the third and final installment in a series on CATV CAD. In Part 1 (October 1990) we took a look at how computer-aided drafting (CAD) for CATV evolved, and how the management and technical issues for CAD interacted. In Part 2 (January 1991), we examined the hardware requirements for CAD along with requirements for developing a good PC program.



By John Gutierrez
President, ComNet Co.

The following is a list of the most often asked questions and answers about features that should be considered when evaluating cable design software. You may consider these questions as part of your evaluation procedure and weigh them in your order of preference.

√ *Can you understand the screen interface? Is it user-intuitive?*

The way the screen information is presented to you will determine how well you're going to get along with the program. A cryptic screen is hard to follow and of little use, no matter how powerful the program. Some program screens may have a "spreadsheet" appearance and require tons of code that you have to interpret to explain the design to someone. An ideal user interface should have organized windowed locations for design entries, level analysis, current status and, optionally, the current time of day. Additional information should be available through dialogue or pop-up boxes. The use of pull-down menus is a desirable feature.

√ *What is the range of design frequencies?*

There is little value in buying a program that allows an upper design frequency of 600 MHz, and then finding out that your system has been authorized for 860 MHz. Some programs have the capability to design up to 2 GHz with user-defined splits. A program should be capable of designing reverse simultaneously. If you're not going to design for reverse, the program should have a method to disable the reverse design. You also should be able to take an existing forward design file and perform reverse design without re-entering all the data. Programs that allocate choices of fixed frequencies should be avoided.

√ *Can frequencies be changed in mid-design?*

You should be able to change frequencies in mid-design. This is important for rebuild applications or doing "what ifs." If you do a 300 MHz design, will it allow you to change to 550 MHz easily and do a global recalculation? Some programs require that you change cable insertion losses for the higher frequency, but you'll still see 300 MHz on the screen.

√ *Can trunk and feeder design be linked together?*

Some programs use a menu access screen to run an individual design module program for trunk and another for feeder or tap distribution. These programs are not always interactive, and trunk and feeder designs must be done independent of each other. For this program type, you would first design the trunk and save it as a file name. Then you would exit the trunk module and enter into the feeder module program. You'd begin with a bridger output level, enter a feeder-maker (some force you to use line splitters or directional couplers) then add cable, taps and so on. Then you save the bridger/feeder distribution as another file name. Look for a design program that has the ability to design trunk and feeder within the same design and also be able to switch from trunk to bridger distribution using a simple key press command.

√ *Can the program do AC powering within the design?*

When amplifiers began using switching power supplies, calculating AC powering received greater design attention. Anytime an amplifier power supply receives a lower voltage it wants more current to maintain its regulation. The problem occurs when the

(Continued on page 40)

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Reader Service Number 17

CONTEC
INTERNATIONAL

Testing cable, taps and splitters with a TDR

By Marshall Borchert
President, Riser-Bond Instruments

The question most commonly asked by CATV technicians regarding the use of a time domain reflectometer is, "Can I test through taps and splitters and, if so, what will the waveform look like?"

The following information will answer this question and, in addition, help you better understand the time domain reflectometer and how to interpret the waveforms you encounter.

All tests were performed using Riser-Bond Instruments' TDRs and standard, off-the-shelf taps and splitters. Test results may vary slightly with the type of TDR used and the brand and type of taps and splitters tested. Splices, taps and splitters vary from manufacturer to manufacturer and give widely varying amplitudes of reflection. Some are good and some are not.

Review

TDRs have been around for many years. The concept of a TDR is rather simple: a pulse of energy is transmitted down a piece of two-conductor cable. If the far end of the cable *is* terminated in its characteristic impedance, no energy will be reflected. If the far end of the cable *is not* terminated in its characteristic impedance, some or all of the en-ergy will be reflected back up through the cable.

The two extremes from the characteristic impedance are a complete open and a dead short. Partial faults fall within these two extremes. The amount of reflection from a fault is expressed as decibels of return loss (dBRL). The formula for finding return loss is:

$$dBRL = 20 \text{ Log } V_t/V_r$$

Where:
V_t is the voltage of the transmitted pulse
V_r is the voltage of the reflected pulse

A complete open or short reflects all the energy back toward the TDR and therefore will have a 0 dBRL (as measured at the point of the fault). Reflections caused by less than complete opens or shorts will have a dBRL value larger than zero. The larger the dBRL value, the smaller the reflection.

As an example: RG-6 is a coaxial cable containing two conductors (the sheath and the center conductor). RG-6 has a characteristic impedance of 75 ohms. If the far end of the cable is terminated in 75 ohms and the near end is connected to a TDR, no energy will be reflected back from the far end; the terminator absorbs all the pulse energy. (Editor's note: In practice, the impedance of coaxial cable is seldom exactly 75 ohms and creating a termination with a constant impedance over a wide bandwidth is very difficult. Consequently, there will almost always be some signal energy reflected back toward the TDR.) If the far end is a complete open or short, then all the pulse energy will be reflected back toward the TDR.

Note when testing a cable you know is open or shorted at the far end, the reflected pulse is lower amplitude than the transmitted pulse. Why? Cable has loss.

As the pulse travels down the cable, it loses signal amplitude. At the end of the cable all the remaining energy is reflected back. It loses energy again as it travels back up the cable to the TDR. That is why the amplitude of the reflected pulse is less than the amplitude of the transmitted pulse. →

Figure 1: Waveform of 340 feet of .625 trunk cable with TDR's vertical gain increased

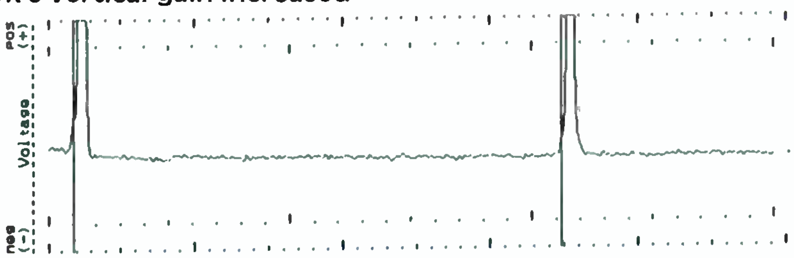


Figure 2: Waveform of 340 feet of .625 trunk cable with sheath damage in the middle

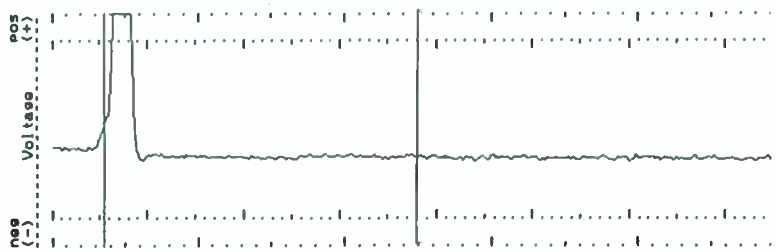
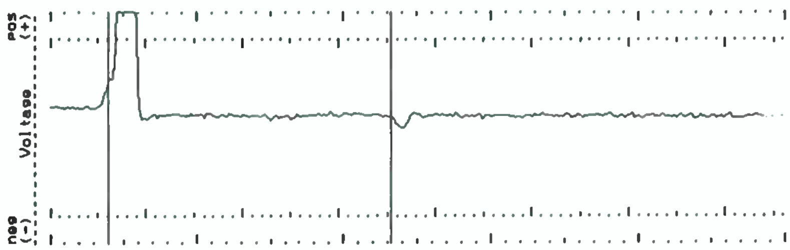


Figure 3: Waveform of 340 feet of .625 damaged trunk cable in saltwater



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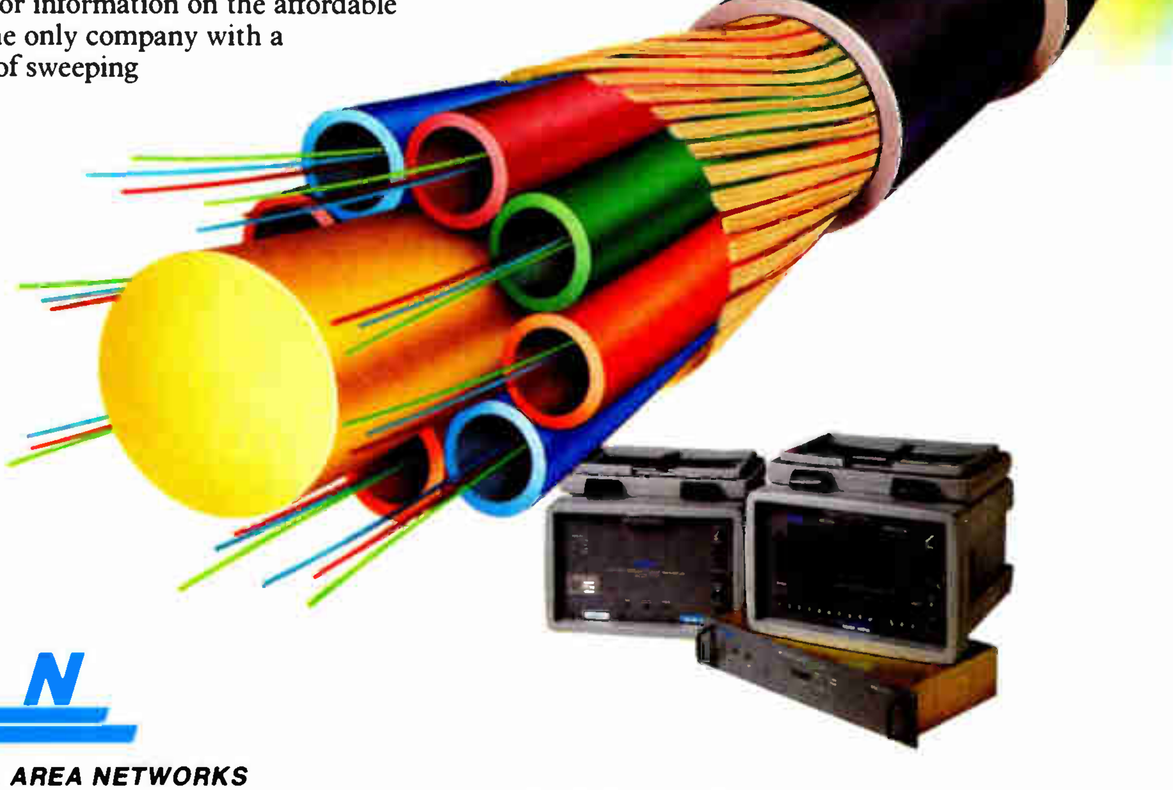

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Figure 4: Waveform of 340 feet of .625 trunk cable with a good splice

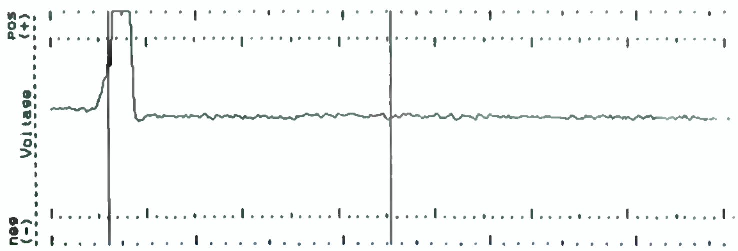


Figure 5: Waveform of 340 feet of .625 trunk cable with a wet, contaminated splice

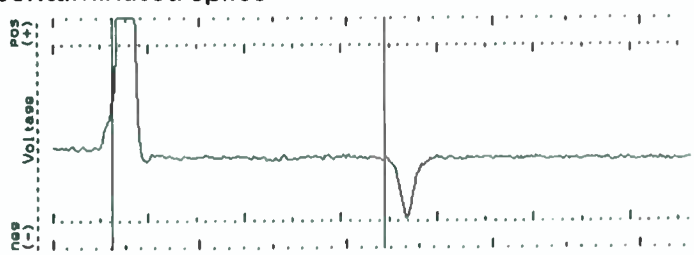
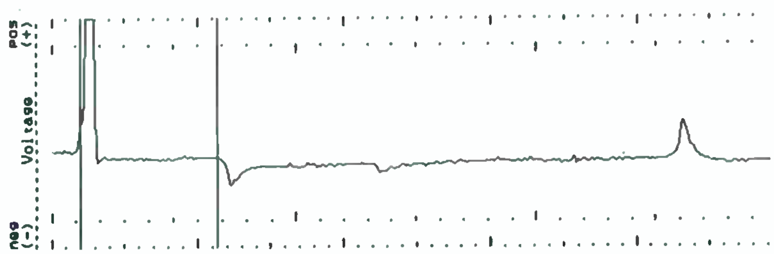


Figure 6: Waveform of a 400-foot cable containing three taps with values of 10, 12 and 17 dB at 100-foot intervals



Cable tests

In order to determine a reference point in the taps and splitters tests, a cable was first examined without hardware components. The following example is for .625 trunk cable, but is equally applicable for any similar type of cable.

The first test involved 340 feet of new .625 cable. Figure 1 shows the waveform of the cable with the TDR at maximum vertical gain. Look at the quality of the cable. The flatness of the base line gives an indication of cable quality.

The unevenness of the base line should not necessarily be interpreted as structural return loss. In some ways it is, in others it is not. It is return loss at the frequency of the TDR's pulse. To measure actual structural return loss, a sweep generator should be used to measure the return loss at the worst frequency. The TDR does not generate all frequencies and therefore should not be used to measure structural return loss.

Next, the cable sheath was damaged by cutting a two-inch segment along the length of the cable. The sheath was separated exposing 90 percent of the dielectric material. The damage was created halfway down the length of the cable so as to not let the reflection caused by the end of the cable affect the "damage" reflection. Figure 2 shows the resulting waveform.

You would expect such a severe sheath fault to show easily on the TDR display; why then, doesn't it clearly show in this example? Is the TDR not sensitive enough?

If your cable had damage like that in the field, it certainly would be causing problems in the transmission of the cable signal. You need to be able to see it in order to fix it. Right? Right!

The reason the fault in this example did not show clearly on the display is precisely why TDRs are sometimes misinterpreted or misunderstood in a laboratory test environment. In this case, there were no contaminants such as water, earth chemicals or salts to affect the impedance. This point needs to be stressed: When evaluating a new piece of test equipment or training new employees, be certain you simulate "a field environment" as close to the real thing as possible. If you don't, you can discredit a perfectly good piece of test equipment because your lab test did not accurately simulate the real world.

Through extensive testing, it was concluded that cable damage by itself does not always change the cable's characteristic impedance even though a point impedance discontinuity may exist as a result of the damage. The impedance is changed when contamination infiltrates the cable dielectric.

In a cable system, you probably would not know the sheath had been damaged until water or other contaminants had penetrated the cable and caused signal problems.

The best field trial is exactly that: a trial in the field. When a field trial needs to be conducted in the lab, be sure your test accurately models the actual field environment.

In order to simulate the real world, the damaged cable was immersed in water to see how the characteristics of the faulty cable would change. In order to speed up the contamination process, we added table salt to the water. Figure 3 shows the resulting waveform.

This test shows the damaged sheath may not necessarily be the problem. The problem is the contamination the moisture brings with it!

Next, the cable was cut and a barrel splice installed. (You may want to install several splices to see the wide range of quality of the splices.) What does the quality of the splice look like? (See Figure 4.)

Next, the splice was immersed in saltwater to see what a contaminated splice would look like. (See Figure 5.)

Sheath damage can be frequency sensitive and definitely is susceptible to ingress of moisture and contamination. A properly installed splice would not exhibit either of these problems.

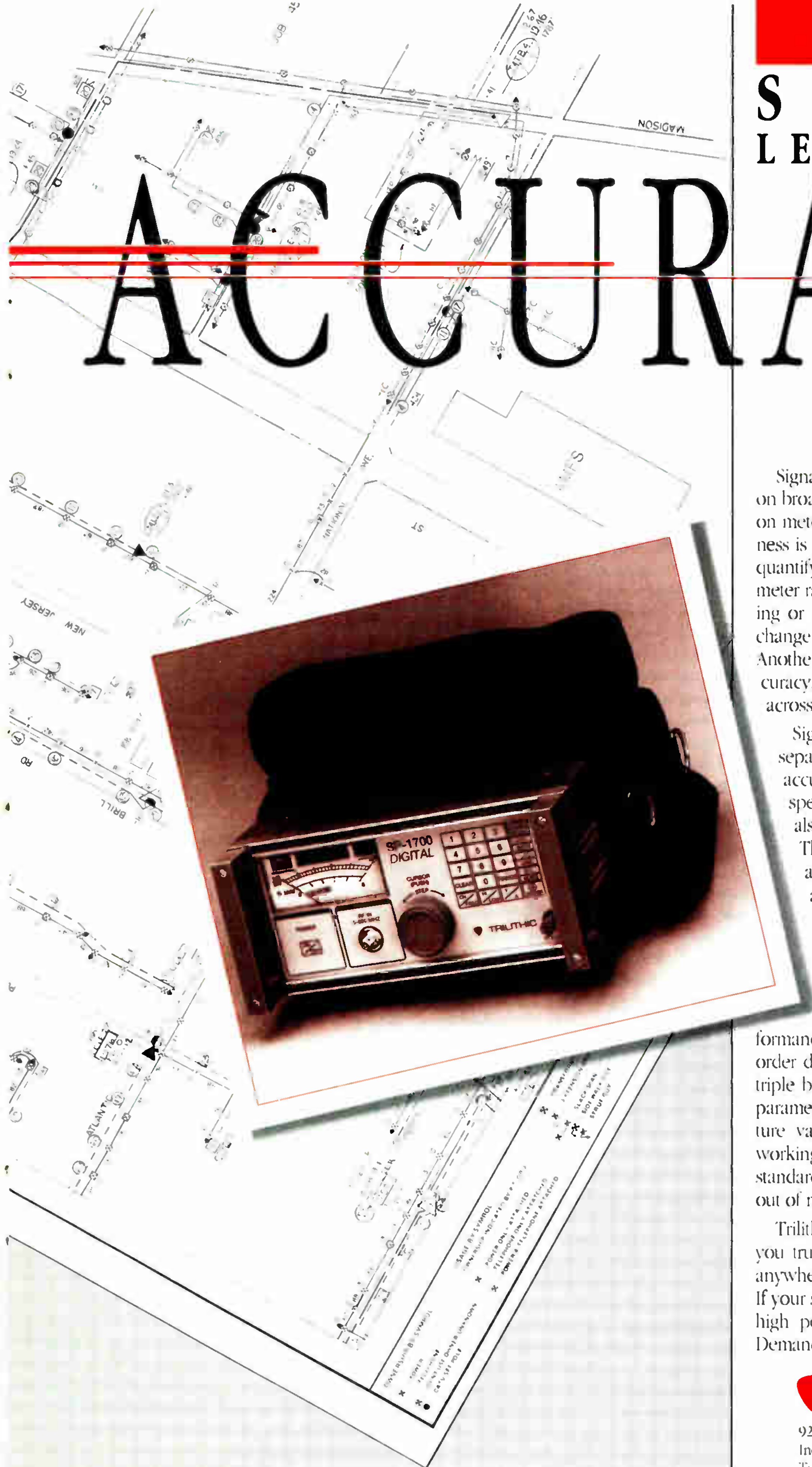
The information gained from these tests brings up other questions.

•When looking at minor cable problems, just how sensitive does the time

(Continued on page 52)

SIGNAL LEVEL METER

ACCURACY



VS.

Plant Performance

Signal level meter accuracy has profound effects on broadband (CATV) performance. Specifications on meter accuracy, however, can be unclear. Flatness is not an overall accuracy measure. It doesn't quantify the instrument's abilities at different levels, meter ranges or temperatures. Meter scaling, tracking or linearity is the ability to accurately track a change in input level at a given attenuator setting. Another specification is attenuator step-to-step accuracy, which is the ability to display correct levels across differing attenuator settings.

Signal level meter specifications can be listed separately, then added for overall accuracy. The accuracy stated may not give a true picture if specifications are omitted. Some manufacturers also specify accuracy by listing *overall* accuracy. The overall accuracy specification takes the above mentioned inaccuracies into account and provides one reliable number.

What does this mean to your system performance? For example, the meter used for system alignment has an overall accuracy specification of +/-3 dB, the carrier-to-noise and second order distortion performance will have a total window of 6 dB. The third order distortions (cross-modulation and composite triple beat) will have a window of 12 dB. These parameters may be further aggravated by temperature variations and channel loading. A system working well with 20 channels may produce substandard pictures with 30 channels. So the big rollout of new channels turns into a service nightmare.

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Reader Service Number 38

Circle sweeping using a fiber medium

By Dewayne Lipp
Consulting Engineer, CaLan Inc.

The phrase "circle sweeping" comes from a technique being utilized to its fullest extent in Orlando, Fla. The concept of circle sweeping actually has existed since sweeping became a reality. In the past, however, traditional thinking has always been to sweep and align each amplifier in the cascade in a serial sequence until you reach the end point and hope that nothing changes behind you. Constant change is what the real world of cable is all about. It's this change that requires experienced technicians to routinely look for and correct faults whether they be in an amplifier, cable, connector, tap, etc. So, circle sweeping (by design) is a technique in which these changes are detected and corrected. The ultimate result is a better quality picture with minimum subscriber interruption. It's an exciting concept.

Figure 1: Main headend

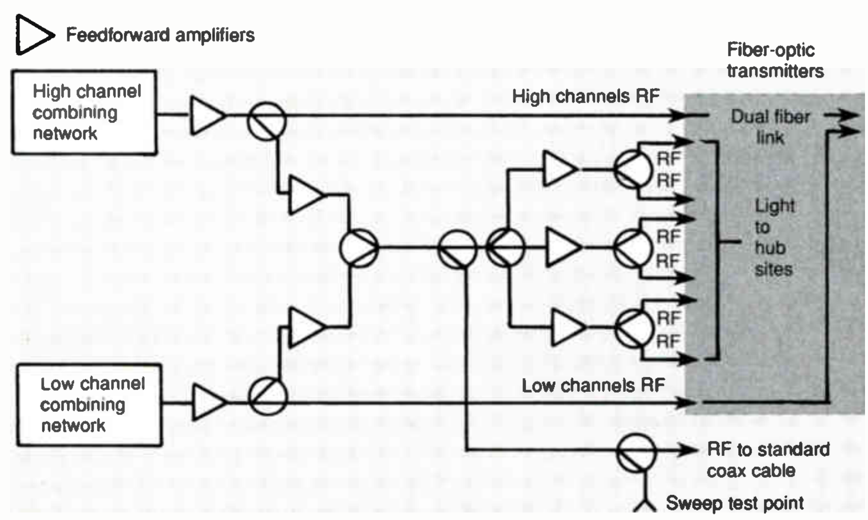
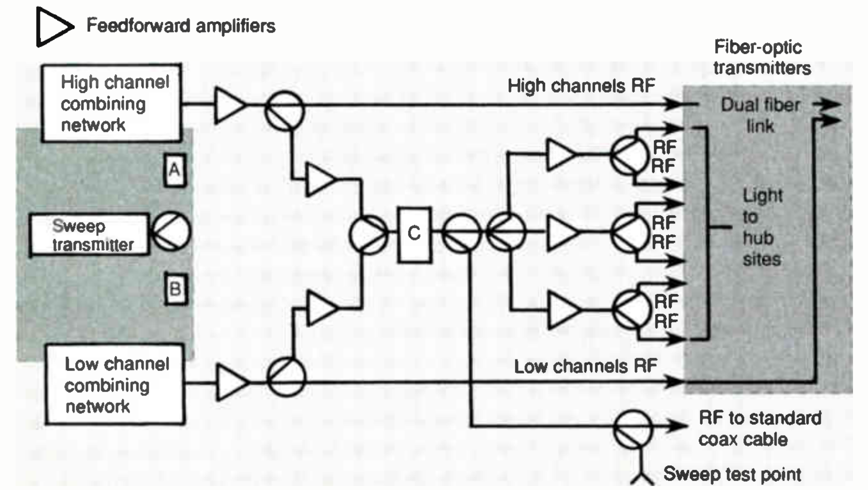


Figure 2: Main headend



Installing the sweep transmitter

All sweeping starts at the headend. Then the question is, how do you insert a single sweep transmitter in a main headend that serves 180,000+ subs, 2,843 main trunk stations, seven fiber-optic links and standard coaxial cable? In looking at Figure 1 the most obvious point of sweep insertion would be to split the signal from the sweep transmitter (see Figure 2) and insert it into the high and low channel combining networks. However, when extracting the signal from the sweep test point, the response was less than desirable.

Upon review, it became apparent that if you split a signal and recombine it at Point C (in Figure 2) both signals must reach the combining point at exactly the same time or phase cancellation occurs causing suckouts. To make this sweep insertion point work, it was necessary to trim Cable A (since it was physically the longer of the two cables) in 1/4-inch increments until the response became acceptable. This worked as a temporary means but obviously was not the best solution since changing anything in the RF path between "A" to "C" or "B" to "C" would change the characteristics of the sweep signal.

The more effective method of installing the single transmitter for this configuration is to split the signal three ways (see Figure 3) and install amplifiers in Path A and C. The amplifiers provide sweep isolation between the high channel RF and low channel RF. Once the RF sweep signal is turned into light, transported through the fiber-optic cable and recovered at the receiver site, it will have undergone a slight response change.

According to Steve McConnell, system support engineer for Scientific-Atlanta, the fiber link sweep response has a response flatness specification of 1.5 dB maximum. In sweeping from RF to light to RF, we found that our result was very close to the specification (Figure 4).

Circle sweeping from the hub

The hub site receives the sweep signal through the fiber-optic cable along with all channels on the system and converts these signals to RF before feeding them into a launch amplifier. At the output of the launch amplifier the technician measures the sweep signal (see Figure 5) and then stores it in internal memory as a reference sweep signal.

The technician then proceeds to sweep the first amplifier in Cascade A normalized to the reference as depicted in Figure 6. After aligning the amplifier with the sweep, he then stores and identifies the normalized response into one of the receiver's 80 internal memory slots. He proceeds to Amplifier 2 and repeats the same procedure storing each trace as he progresses along the cascade.

Upon completion of the third amplifier he starts at the first amplifier in the next cascade from the same hub. He repeats this procedure for as many cascades as there are in the system. Once he has completed this, he returns to the original third amplifier in Cascade A and compares the new response to the old response recalled from the internal memory. If he determines that the change of the sweep response is significantly different, he proceeds to identify the cause of the change and adjust or repair the amplifier accordingly. If the sweep signal in his judgment is reasonably stable, he proceeds to sweep another three amplifiers in the same manner storing each trace.

An important item to remember is that the trace reference at each location will definitely change. It is the degree of this change that provides immediate detection of any problem and determines whether the technician needs to backtrack and make necessary repairs or continue sweeping the next two or three amplifiers in that cascade.

(Continued on page 54)

Figure 3: Main headend

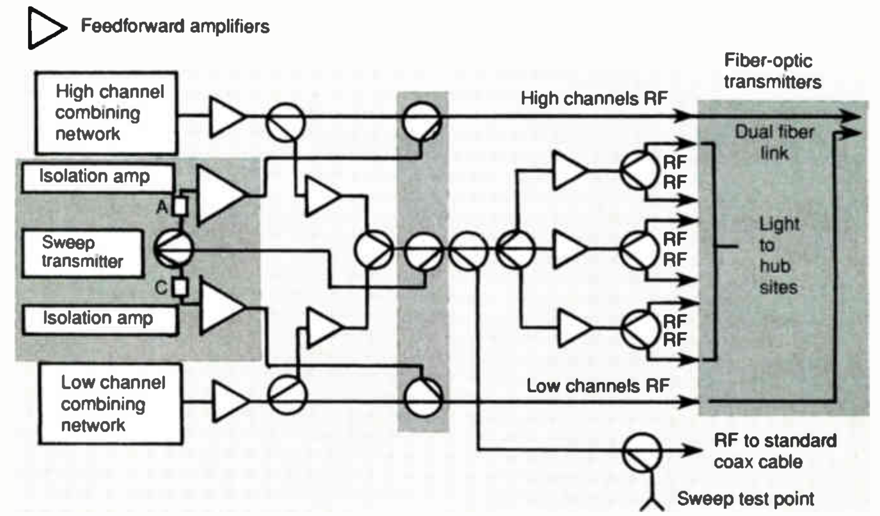


Figure 5: Node/hub receive site

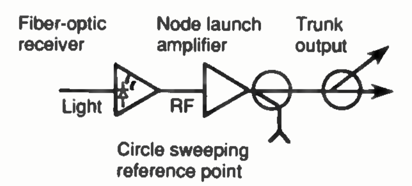
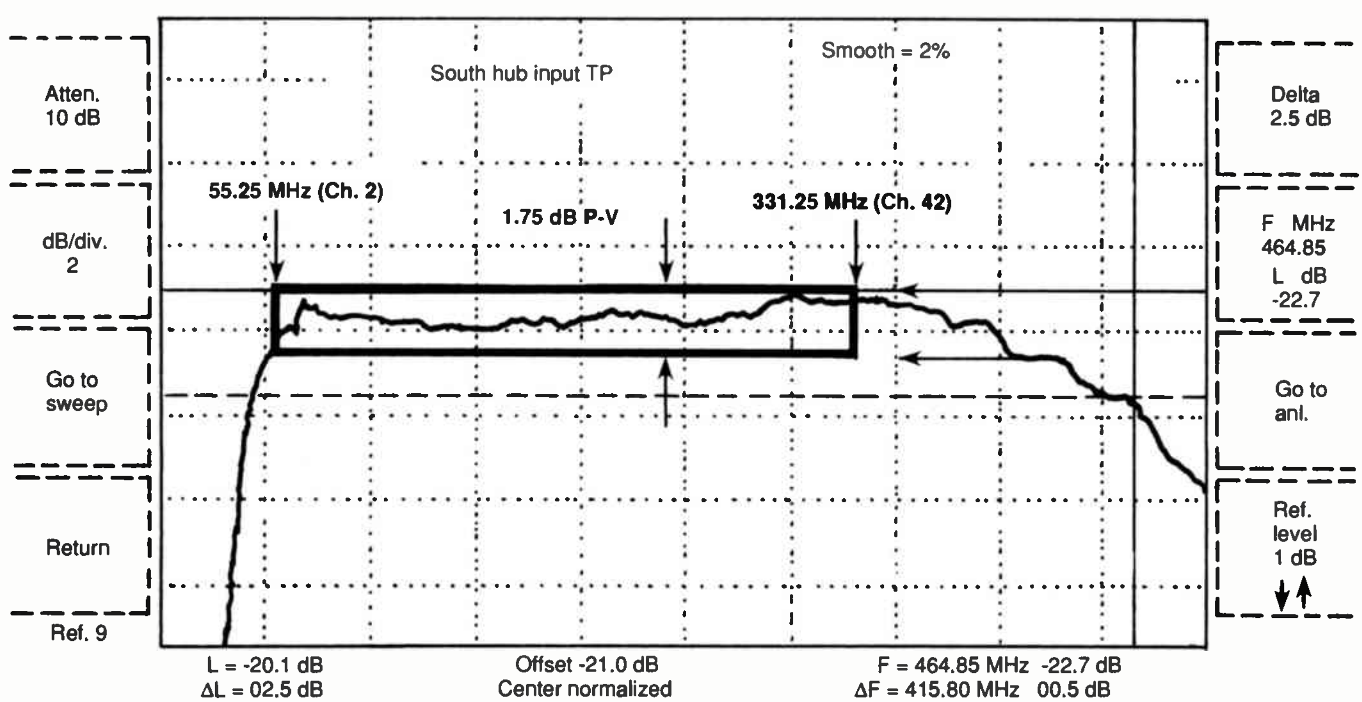


Figure 4: Fiber link frequency response (RF-to-light-to-RF)



Microwave performance margin maintenance

By Tom Straus
Chief Scientist

And Dane Walker
Senior System Specialist
Hughes Microwave Communication Products

There is a wide variation of signal quality available in existing AML microwave systems. In most localities the microwave link is highly reliable and supplies superior quality pictures throughout the year. At the other extreme, CARS band AM systems can suffer chronic rain or multipath fades and even during clear weather the signal characteristics may not be as good as potentially possible.

A number of factors contribute to this wide diversity of performance experience. These factors include local weather patterns, initial system design plus subsequent expansions and upgrades, tower design, microwave path clearance and, very importantly, maintenance. In many cases maintenance alone is the key to good results. In other instances the problem cannot fully be overcome without modification of the existing design to achieve improved fade margin. The importance of adequate fade margins, particularly in the light of increased stress on signal quality, is underscored.

Understanding fade margin

For the purposes of AML system availability calculations, fade margin is the number of decibels by which the path attenuation between the microwave transmitter and receiver can increase, relative to normal clear weather conditions, before the microwave system C/N is degraded to 35 dB. The choice of 35 dB NCTA C/N (equivalent to approximately 36 dB S/N[1]) is somewhat arbitrary since TV pictures are still watchable well below this point. This is particularly true with AM microwave systems that do not have a sharp threshold as with FM microwave, which is typically specified down to 33 dB S/N. On the other hand the picture is certainly noticeably noisy and possibly objectionable at such a low C/N, so only the fact that operation at this level is contemplated for at most a tiny fraction of the year (typically a few hours or less), justifies the choice of the 35 dB criterion.

It is perhaps obvious that fade margin is increased by larger transmit output power and by greater receiver sensitivity. The latter is obtained by lowering the noise figure. What may not be as obvious is the fact the microwave system C/N is not necessarily synonymous with the C/N experienced by the proverbial "last subscriber." Under clear weather conditions the C/N contribution of the rest of the CATV system will dominate and the microwave usually will be "transparent." For instance, if the microwave portion of the C/N is 53 dB and the cable plant contribution is 47 dB, power addition of the two C/N ratios gives an overall 46 dB. On the other hand during a deep microwave path fade, the 35 dB of the microwave system is the dominant source of noise and the above cable plant's "last subscriber" *should* be looking at a 34.7 dB picture.

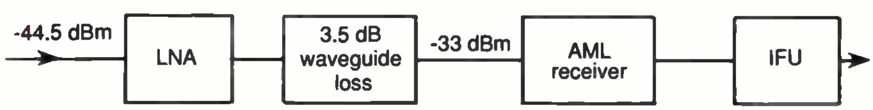
The word "should" is emphasized because some form of AGC is required to assure this picture quality is not substantially worse. In AML systems this is the primary function of the interface unit (IFU), or in 550 MHz receivers, of the VHF AGC module. Both provide a minimum of 12 dB of additional AGC after the available microwave AGC range is used up. In this way the carrier level input to the cable plant remains constant, and therefore the C/N contribution of the cable plant remains constant while the microwave contribution is degraded during the fade. These points are illustrated through Figures 1 and 2.

The simplest case is illustrated by deleting the LNA and IFU in Figure 1. The clear weather input to the receiver would be -48 dBm, well below the AGC threshold (even the "normal" threshold of -45 dBm). Figure 2 shows the worst-case C/N experienced by the last subscriber if there were no AGC in the system. In most cases there is always some AGC in the trunk amplifiers, which will tend to maintain constant carrier level but will increase the end of line noise contribution of the cable plant. The net result is to extend the fade margin a few dB beyond the 10.4 dB shown for this case.

Next, add the LNA at the top of the tower. This time there is 7 dB of AGC margin before the signal level to the trunk starts to drop. Again, the trunk

(Continued on page 56)

Figure 1: Typical receive site with tower-mounted LNA



Assumptions: Clear weather carrier levels as indicated
LNA: gain = 15 dB
noise figure = 3.5 dB
Receiver: AGC threshold = -40 dBm
noise figure = 10 dB

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Addressable interdiction

(Continued from page 16)

feeder provides the clear channel lineup for the area.

• *Duplicate premium channels.* Duplication of premium channels during the changeover from positive traps and scrambling to interdiction alleviates the need for concurrent positive traps and descrambling set-top terminals in the rebuild area. Each of the premium channels is duplicated in the clear on another channel for the rebuild duration. The advantage to duplication is that subscribers do not need a positive trap or a set-top terminal to receive the service. The requirements for positive traps and descrambling converters during the rebuild decrease, and as the rebuild progresses, recovered hardware can be used to satisfy requirements in other parts of the system. However, the clear duplicate channels are accessible to all subscribers during the rebuild.

System design

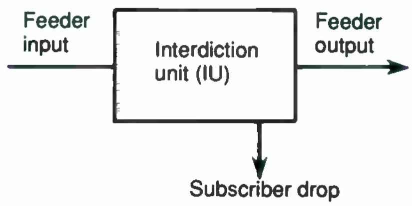
System-approach interdiction requires the level and tilt input to be within a specified range so that the jamming security has a consistent effect on all channels. An internal AGC compensates for feeder level changes after the level and tilt input specifications are met. The four- and eight-port IUs are balanced at each location by selection of a directional coupler and equalizer based upon the feeder levels. This balancing is very similar to the procedure for balancing amplifiers with pads and equalizers. The directional coupler determines the tap value and insertion loss of each installation. The equalizer is in the tap leg and equalizes the drop path for proper cable system tilt relative to the jamming security. The interdiction equalizer affects the drop path and not the overall trunk or feeder path.

The equalizer in each unit poses a new operation for the design phase. Prediction of an equalizer in each tap location must be performed by adapting the traditional design techniques and computer-aided design (CAD). A complexity arises in design as a result of the combination of characteristics of the directional coupler and equalizer in the drop path.

• *Feeder design with interdiction.* The design of the RF feeder system with interdiction parallels design with taps. With interdiction, the tap value is determined unit-by-unit with a plug-in directional coupler. Selection of the directional coupler is a similar process as selecting a face plate value in traditional tap systems.

The main design difference is the requirement of an equalizer at each installation. Typically an in-line equalizer will be used to compensate drops toward the end of a feeder. A recognizable benefit from the internal equalization in each IU is that no in-line equal-

Figure 4: Interdiction drop output specification



Nominal drop output:
14/10 dBmV for a 330 MHz system
15/10 dBmV for a 400 MHz system
15/10 dBmV for a 450 MHz system
16/10 dBmV for a 550 MHz system
Directional coupler and equalizer required

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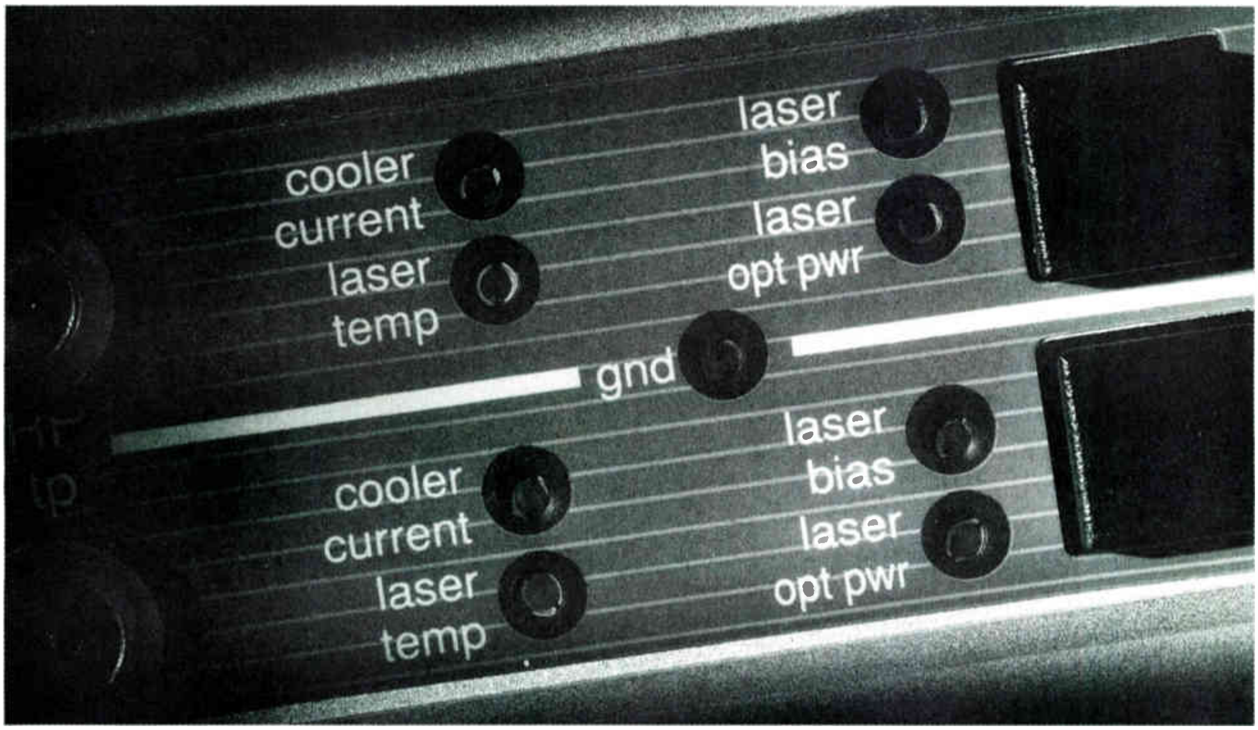

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ization is required in the feeder. Once installed and balanced, each drop is automatically compensated for changing feeder levels, which assures a secured, high video quality drop to every subscriber in the franchise.

The directional couplers have inherent tilt that affects the equalization at each location. The higher values of directional couplers have "up-tilt," which essentially reduces the equalization required. The lower values of directional couplers have "down-tilt," which increases the equalization required. The interaction of the directional couplers and equalizers in this respect is fairly simple to predict.

The inverse equalizer case is not so simple to predict. At tap locations near the line amplifier, the up-tilt of the amplifier may be more than the specified range for the IU. For this case, an inverse equalizer is used to simulate the down tilt of cable and to set the tilt properly. The inverse equalizer has loss at the high channel frequency, which effectively reduces the directional coupler value required. The interaction between the directional coupler and equalizer must be accounted for in the design so the design values and resulting bill of materials are close to the as-built.

The interdiction drop level is constant due to the need to maintain jamming effectiveness. The interdiction drop level is not adjustable. A lower directional coupler (tap) value does not and cannot result in a "hot tap" because the jamming effectiveness would be degraded. The IU's nominal drop output levels are illustrated in Figure 4.

• *Directional coupler and equalizer selection guide.* The interactive characteristics of the directional coupler and equalizer are taken into account in producing a guide. By using the guide, feeder input calculations as well as actual installed system measurements are used to directly select a directional coupler and equalizer without the calculation process. A look-up table of these values will allow a computerized design program to automatically select the directional coupler and equalizer based upon the calculated feeder levels. An excerpt from the guide is shown in the accompanying table. The feeder input levels are derived from the combined characteristics of the directional coupler and equalizer. The feeder levels are those required to match each respective combination. The level derivations may not reflect realistic system levels in all cases of combination.

Excerpt from the directional coupler, equalizer selection guide (550 MHz equalization tables, Model 9504)

Feeder input 550 MHz (dBmV)	Feeder input 54 MHz (dBmV)	Directional coupler	Equalizer value
31	22	5.0	-3.0
31	20	3.0	-6.0
31	19	1.0	-7.5
30	38	6.0	19.5
30	37	6.0	18.0
30	36	6.0	16.5
30	35	6.0	15.0
30	34	6.0	13.5
30	33	6.0	12.0
30	32	6.0	10.5
30	31	6.0	9.0
30	30	6.0	7.5
30	28	6.0	6.0
30	27	6.0	4.5
30	26	6.0	3.0
30	25	6.0	1.5
30	24	7.5	0.0
30	23	6.0	0.0
30	21	4.0	-3.0
30	20	2.0	-6.0
30	19	0.0	-7.5

Summary

Interdiction is a major advance in delivery of cable TV services. The operational cost savings, incremental revenue opportunities and marketing flexibility are the ultimate enhancements necessary for cable's growth. **CT**

CATV CAD

(Continued from page 24)

AC voltage is lowered; the power supply wants more current. With this, there is a corresponding increase in current across a cable span ahead of it causing a higher IR voltage drop and decreasing the voltage input even more. Well, this process could continue until there's no voltage left! Fortunately, in a well-designed system, this does not occur.

A program should be able to calculate "true" AC powering in the scenario described previously. In addition, the program should be able to calculate AC powering within the design. The design program also should allow you to move the power inserter to optimize powering. For designing a system with interdiction, AC powering will be an important part of the feeder design element. BSE-Pro is the only known program that calculates AC powering within the design and claims <±1 volt accuracy. Avoid using spreadsheet programs for AC powering. They cannot simulate the previous situation.

Programs that cannot link trunk to feeder within the design cannot hope to calculate powering in real time. To overcome this limitation some programs offer a special powering utility program to recreate the cable layout per power supply. This means that you must re-enter the same cable footages all over again to do the AC powering. Why do data entering twice?

√ *Does the program offer noise and distortion calculations?*

Distortions and carrier-to-noise (C/N) calculations have long been done with BASIC programs. They were simple, but were of limited use if you had mixed amplifiers, mixed levels and so on. Distortion calculations usually ran on the designer's intuition and a factor of safety was ensured if you didn't exceed the cascade length. Opinions seem to differ over the need to have distortions and C/N calculated. In the broadband LAN industry, IEEE 802.7 sets strict standards for distortions and noise. FCC proof-of-performance is served best by having distortion and noise calculations for field technicians to observe and compare. Furthermore, it makes for good system design documentation.

A program should be able to calculate C/N, second order, cross-mod and composite triple beat, and do it in real time. That is, after an amplifier is added, you should be able to observe the C/N and distortions via a dialogue pop-up box. With amplifiers using switch-regulated power supplies, hum is no longer a design issue, except if the current rating of the passive device is exceeded. A design program may offer interstage padding. This trades input padding for the interstage and improves C/N calculations, but make sure the program takes into the effect rises in distortion when overloading the pre-amp input. As in AC powering, BSE-Pro is the only known cable design software program having this real time AC powering capability.

√ *Are in-line equalizers placed automatically?*

Few designers seem to find this an important feature, but if the program offers this feature make sure that you can override it. At first blush, this feature appears needed, but eventually you'll find out that the computer can make poor design decisions. A good designer *always* should have control of the design, not the computer. (Remem-

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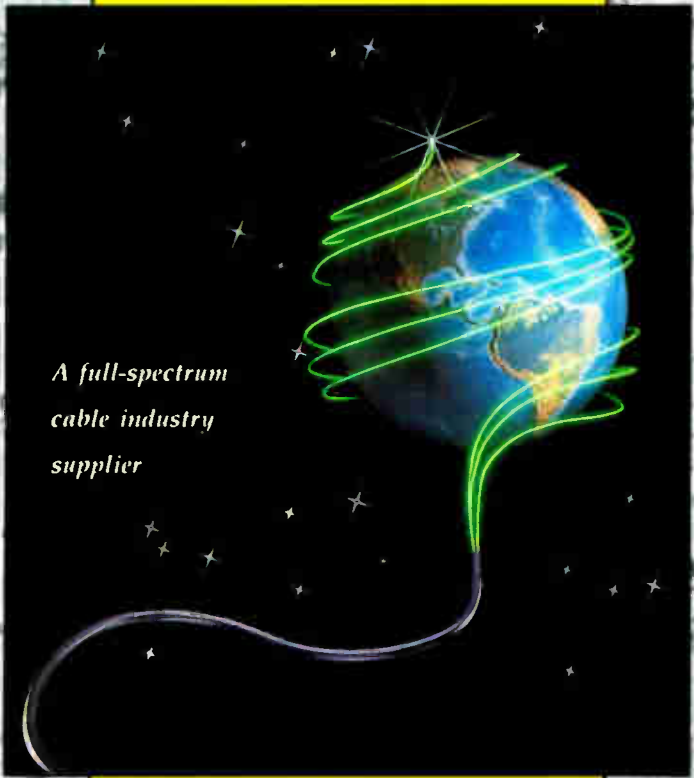

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ber HAL?) A program should have a warning indicator when you've exceeded the cable spacing or maximum tilt. When the warning occurs, it should be easy to back up to the previous entry to modify the last cable footage or take corrective action until the warning goes away. The common problem with automatic placement of equalizers (EQs) is that they are generally placed where they shouldn't be — preceding the cable feeding into the tap — instead of adjacent to the input of the tap. If you try to delete the misplaced EQ the program immediately replaces it, until you override it.

√ *Does the program show true EQ and pad values?*

A program that only gives you band edge tilt compensation is of no value. The amplifier EQ should be calculated as if it were cable itself, and should be a true value. Look for a program that gives interstage pad options.

√ *Does the program use feeder-makers?*

Many programs require that you use standard line splitters and DC passives for bridger feeder-makers. Most line passives exert higher insertion losses than feeder-makers and will result in lower than expected RF levels. In addition, "building" a feeder-maker using this process means you cannot issue a correct BOM report. Look for a program that specifically addresses user-defined feeder-maker configurations.

√ *Are RF levels displayed in real time?*

A program should keep on-screen updates on the current levels at all band edges, tilt deviation and accumulated losses from the last amplifier or starting point. Current system level analysis always should be displayed and automatically updated as devices are added to the design or as you browse the design. Although you are designing in a forward direction, you constantly should be aware of the system levels and status.

√ *Does the program design in the reverse direction?*

Some programs operate on a "build" method, by doing design calculations after you've entered a series of devices. In this case, you would first design your feeder distribution (cable, tap, cable, tap, passive, etc.). From the end of line, the program is told to calculate the design to its bridger or line extender. What you get is the program's design interpretation. If you don't like what it designed, you can override and redesign the way you want it. These programs may not offer real time signal analysis, because true levels can't be known until after the calculations are finished. The notion that reverse designing optimizes amplifier placement is moot if a program has real time RF level analysis for forward and reverse.

√ *Does the program allow continued design after a terminating tap?*

Some programs refuse to allow you to continue to design following a terminated tap until an amplifier is inserted ahead of the terminated tap. A design program should let you continue the design effort allowing you to enter as many devices as needed until the last pole is reached (though they will have a zero port and value). Then it should allow you to go back and insert a line extender (LE) within the design. Following the LE insertion, the program should recalculate the zeroed taps for their respective design values. In a

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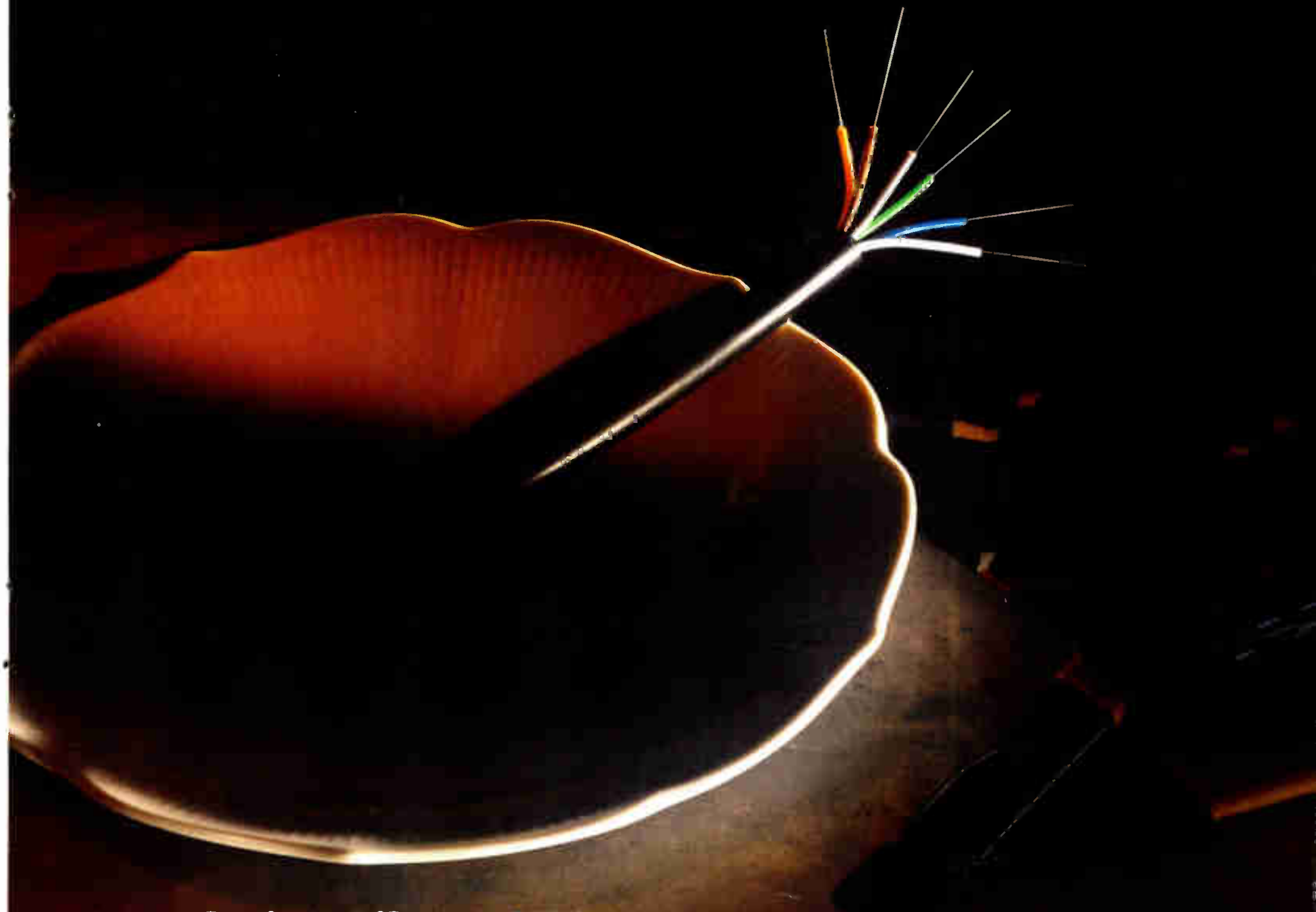

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similar situation, the design program should allow you to enter any device despite the fact that you may be violating spacing, tilt or RF levels. The concept is that you are able to take corrective action without being restricted to design protocols.

√ *Does the program automatically insert amplifiers?*

Just as in automatic placement of EQs, similar problems occur with trusting a design program to automatically place amplifiers. This is true for feeder distribution, where a program of this type will automatically insert an amplifier adjacent to a tap's through port rather than at its input. A good design should not have a tap precede an amplifier's input. This can result in lower than expected C/Ns, especially noticeable at the end of the longest cascades.

Another problem is that the program selects a pole span interval that is crowded or is not easily accessible. If this information is known while designing, the automatic function will be disabled. Eventually, the automatic functions of this kind of program can become a hindrance to design productivity and the feature becomes questionable. It is supposed that this type of feature is good for novice designers who may not know all the ins and outs of CATV design, and the program is considered both designer and teacher. This is a backwards approach to good design practices and indicates that personalized design training should be reinforced.

"Look for a design program that has the ability to design trunk and feeder within the same design and also be able to switch from trunk to bridger distribution using a simple key press command."

√ *Can you assign hot taps?*

Most programs provide this feature, but ensure that hot taps can be device-locked so that they won't change to a new value in the event input levels change. Also, you should be able to change any tap for a new value by changing the output level, instead of replacing the tap with a new value.

√ *Can you device-lock design entries?*

The design program should have the capability to keep selected devices from recalculating. A device-locking feature is important to keep taps from changing their values, particularly if they were hot taps. You can device-lock all taps in a feeder branch and then see the drop level effects when upgrading to a higher frequency. When device-locking an amplifier, the pads and EQs are kept frozen despite the changing of frequencies, temperature or input levels.

√ *How does the program determine tap values?*

A program should select tap values based on either tap port or cable drop output specifications based on a specified cable length and any cable size. Ensure that you can specify the mini-

 Reader Service Number 31

mum RF drop band edge levels. Also, look for a program that can display the forward/reverse levels and loop loss for dual-cable LANs. This should be done easily, without entering complex programing codes. You should be able to change the tap value by specifying another port or drop output level.

√ *Can you define the number of ports on a tap in the data base, etc.?*

Some programs are limited to two, four and eight ports. Look for a program that offers user-defined taps from one to 99 ports. You also should have the ability to define up to as many as 20 frequency insertion points across the bandwidth. A program should have the ability to use tap values in tenths of a dB for the 1.5 incremental tap values.

√ *Can you define insertion loss points for passives, EQs, pads?*

The program data base passive editor should allow you to define 10 to 20 frequency insertion loss points of your choosing. This allows you to define special insertion loss values for sub-, mid- or high-split components. You also can define any special type of EQ or pad for a specific in-line application, especially for local area networks.

√ *Can the data base be modified while in the design?*

There are times, in the middle of a design, you will want to modify or create a new component in the program's data base file for your next device entry. Look for a program that can access the data base files from within the design. It should act like a memory resident program using speed keys or through a pull-down menu. After creating or modifying the device, you should be able to have immediate access to this device. This is a great time saver.

√ *Can you specify different design temperatures?*

All CATV designs are based at 68°F, because that's the way cable manufacturers spec their losses. You should strive to design for the annual median temperature. This program feature may be nice for those designing in areas of extreme temperatures. This feature also serves as a "what if" for getting accurate amplifier input levels at different temperatures, especially long cable spans. If you change your design temperature to -20°F, you should see the tap values changed by the recalculation and restored when you return to a normal temperature.

√ *Can it design in metric?*

This is important for international users. Designs should automatically convert from metric to the U.S. equivalent and vice versa without re-entering design data.

√ *How easy is it to edit devices?*

Can you change the cable length, size, type or manufacturer without having to delete the device in the design? Can you change a two-way splitter to a three-way unbalanced and then change port assignments to alternate branches? Can you move a directional coupler (DC) and its down leg components to another location and then have the taps automatically recalculate for updated values? Can you "tweak" the amplifier output levels? Can you change an amplifier to another manufacture type? Regardless of the program you choose, you are going to spend time optimizing your design. Therefore, look for a program that will give you the flexibility to make changes as you see them. Remember, you should always be in control of your design!

√ Can you design with mixed manufacturers?

In just about every case you'll design a system that might have a variety of cable types. In addition, not everybody makes a three-way balanced or a DC-20 line passive. You may even have to use different brands of amplifiers or special types. A design program should give you the opportunity to select the kind of device you want before placing it into the design. You also should be able to substitute devices for another brand.

√ Can you easily mix amplifiers of different gains?

This is an important consideration if you are rebuilding a system. Some systems use a mix of standard and power-doubling or feedforward amplifiers. You should be able to select or switch between amplifiers of different gains. The more arduous this task is, the more prone to errors it will become.

√ Can you specify a derated amplifier?

This too should be an easy operation. Some systems have several orders of derated amplifiers. You should at least have one derated level. If you need more you should have the ability to change the amplifier output levels for a higher order of deration.

√ Can you add descriptive text notations?

You should be able to add and edit notations to an entered device. Can you describe a device with text information such as an address, an amplifier number or a unique name?

√ Can you do a search?

Designs can get quite large and branch in every direction. Finding a particular amplifier or a specific point is very time-consuming and frustrating. A design program should have a search feature that will look for the text string of any device. In addition, the program should be able to offer a total count of device occurrences within the design.

√ What kind of reports does the design program generate?

First, a design program should be able to generate a BOM with material and cost information. It should have both a net and list price. Cost per mile and usage per mile also should be available. You should be able to format the report in the order you wish it to print. The program should have an ability to print a partial design BOM, such as a new extension. The BOM should be able to tell you the kind and estimated number of cable connectors and splice blocks used in the design. Splice blocks only should be specified whenever unlike cables are joined. Don't expect a BOM to count 90° connectors, nuts and bolts, #6 copper wire, ground rods, shrink tubing, sealants, lashing wire or anything that's not part of the design.

Second, a design program should be able to print a signal level analysis. The program should have the ability to allow you to "pick and choose" what design parameters or device kinds you want to see. It should have the ability to print RF levels, pad and EQ values, distortion, AC powering, cable types and footages, etc. The report should give a device connectivity report. This is important if you want to find how devices are connected to other components.

Most programs will do an ASCII print to disk. This allows you to merge the printout to a word processor. A good program allows you to write your printer driver, if you have your printer book. Avoid programs that use the DOS "print screen" command.

√ *How is the program copy-protected?*

You can expect some form of software protection for all cable design programs. Protection schemes are of two varieties: hardware lock and software encryption. Of the two, hardware lock is better. The hardware lock allows you to make as many disk backups you want, but you can only operate the program using a hardware "key" placed on the printer port. Software protection does not allow you to make disk backups nor hard disk backups. If your hard disk crashes or you decide to reformat the hard disk without first uninstalling, the program is gone forever, even though a hard disk backup was done. If the hardware lock key fails, a very small fee will replace it upon exchange. If the master encrypted disk has exhausted its authorized installation count(s) and you suffer a hard disk crash, you may not get any compassion from the vendor and consequently be forced to repurchase the program. Software protection for CAD is rare.

√ *Can the program link to drafting software?*

Very few cable design programs link to drafting software. Of those that do, they link only to AutoCAD. In the LAN industry this was an expected feature. While drafting software is making its way into the CATV industry, a program that can link its design to drafting software should not be dismissed. The ability to link cable design software to drafting software comes by way of developing a translator program that runs within the CAD software. The translator program interprets a file created by the design program and builds a symbol script file from a symbol table. The symbol script file knows the logical order of all designed devices and all the operator has to do is "paste" the design symbols over the strand map. The CAD translator should be easy to use and you should have the ability to create your own cable symbols.

√ *Can the program design within a graphics environment?*

There is no known cable design program that can, in real time, interpret design requirements from a drafting program. It would be very ideal to have a drafting program intelligently know the value of the tap at the end of a scaled cable span and then insert a tap in accordance to drop specifications. This kind of program requires "artificial intelligence" programming and to date no cable design program of this type has been developed. However, it soon may be possible. Using DDE in a special language design software with a binding CAD program could make this possible, but we're just a little bit ahead of our time.

Several design programs have the ability to do design within the CAD drawing. However, they are not accomplished as described above, but instead do the design after the base map is completed. One of them, however, is not PC-based and comes with the largest price tag. It is a powerful drafting program and uses very sophisticated computer hardware and monitors. Its cable design is accessed through a menu option. The program designs by following a designated path or a marked routing. When you insert an amplifier at some point upstream, the program goes into a series of automatic calculations through the selected paths. As it does this, you see a moving marker, as if visible electrons were flowing into a device. The calculations will examine pole counts to determine the port value required and then will issue a tap value respective of the pole house count. The program determines splitter and DC values and continues design calculations automatically until all ends of lines are completed.

If an end of line cannot be completed, you are alerted of the potential problem and to take corrective action. At your option, the program can force the design by adding an amplifier or ask you if it's OK to change the drop specs to meet an end of line tap, but this is considered "fudging." As an alternative, you have the option to relocate the amplifier a pole or two closer to the end of line path and recalculate the path(s) all over again until it's done right. Though the program designs very intelligently, you may have to go through a series of time-consuming trial runs to get the optimum design. Powering is basically done in the same manner, but the design must be done first.

Another drafting program having cable design capabilities is PC-based. The program uses Microstation drafting software. It is a ready made CATV drawing program with management capabilities and uses a similar variation for marking the ends lines for ends of lines. However, the total design is limited to a fenced poly line drawn around a given area. The program assumes a given minimum output level at the end points and calculates backwards until it finds a suitable location for an amplifier. The cable design is saved as a file and only one amplifier per file can exist. These files cannot link with each other to do AC powering, C/N and distortions in real time.

√ *Does the vendor offer a demo disk?*

Most cable design software vendors provide a demo version of their program. However, these demo disks generally turn out to be a simple "slide show" depicting different screens of the program along with some animated explanations of what you're seeing. Others may offer a "working" trial version that is limited in the number of design entries and program functions. The working trial version will let you get a good feel of the program for most aspects of its features, and is infinitely better than just looking at pictures of screens you cannot access, change or see in use. Expect a working trial disk to be sold for a small fee, up to about $25, which is usually applied toward your future purchase. Simple demo disks should always given away at no charge.

For those vendors who do not have a demonstration disk, you'll have to arrange for full demonstration at your facility, at their office or at a trade show. One of the best ways to evaluate a program is to talk to people who use the software. Ask the vendor for references, and give them a call. With any luck, they have evaluated most of the packages you are considering and may be able to pass along valuable insight on the reasons behind their choice.

CAD training

When a design department embarks into a CAD environment, the issue of training should be considered. The learning curve of a cable CAD program depends on various factors: user-friendliness of the program, compre-

hendible documentation and the designer's ability to adapt to the CAD environment.

In another observation, computer literacy of cable designers affects the level of CAD interest altogether. If members of a design department have never used a computer before, then they will have little or no interest for the benefits of CAD. In this case a CAD vendor is uniquely challenged. Interestingly, engineering management desires CAD, but the hurdle of computerizing a design department's traditional ways can seem impossible. Within this observation, many CAD vendors focus on their products without solving the total computerization training issues that the designer or management might have.

The more complex a program becomes, the longer the learning curve will be. Designers, who are unfamiliar with drafting or if the program is very complex, should take advantage of any training offered by the vendor. Despite the best software documentation, training always will substantially shorten the learning curve. Nobody likes to read operating manuals, but every effort must be avoided to use the trial and error process for learning a new program to cut costs. This mental approach to save money can seriously impair design productivity in the short term and raise serious questions about the validity to automate the design department.

Of course, the level of training is dependent upon the complexities of the CAD program. At the high end of the spectrum, a very complex drafting and design program can take a designer up to six months before he is really productive. A designer trained on a highly specialized CAD program is an asset that a system will want to retain. Other affordable CAD programs can be powerful and yet not require any special intensive training, thus minimizing the recurrent costs of training and productivity losses in the event of employee turnover.

The CAD advantages

Whether you're a major MSO, an independent system operator or a cable design contractor, a good cable CAD program is going to offer consistent system designs, regardless of who is doing them. The old guild system can be replaced by intelligent design procedures. Conformance to CAD design standards are adopted easily. For large system designs or rebuilds, a system operator can insist that third-party designers use specific CAD programs that also are used internally. In this manner, the system operator is ensured that computer design disk files are part of the final submittals. This provides the system with the original computer records used for the design. Having the CAD files can be handy for future expansions, system maintenance or for protecting the original documentation in case the contract design company goes out of business or a falling out occurs.

Computer-aided design and drafting is here to stay. The drafting table is rapidly being replaced by CAD in every industry. Cable design PC software has become sophisticated and meritorious for design productivity. However, the managerial and technical issues of CAD are broad and complex, and no single answer exists. But a decision must be made in this world of moving modern technology — and the decision may very well rest in your lap.

"To CAD or not to CAD?" — that is the question. **CT**


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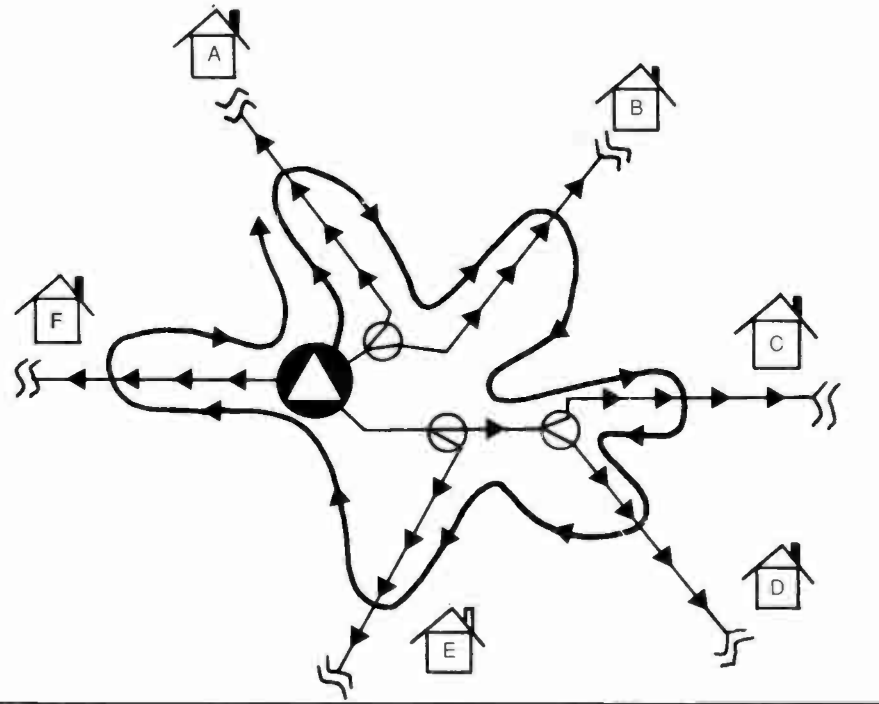
Figure 6: Typical distribution off node/hub



Circle sweeping

(Continued from page 31)

Key to success

The key to the success in this type of sweeping is that it is long-term and methodical. The true value of this system lies in the fact that it becomes a "preventive maintenance" procedure ultimately utilizing less time than the typical "putting out fires" approach to system maintenance. **CT**

Author's note: Special thanks to personnel of CableVision of Central Florida in Orlando.

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Reader Service Number 45

Microwave performance

(Continued from page 32)

contribution to C/N is assumed to be 47 dB and no VHF AGC is included. The fade margin for this case is 17.9 dB.

Finally, an additional 12 dB of AGC is supplied by the IFU or equivalent. The fade margin is then extended to 23 dB. If one were to consider only the microwave system fade margin for this case, it would be 23.8 dB. In actuality the trunk AGC will probably boost the total system fade margin very close to this number. Note the AML transmitter's contribution to C/N does not affect the fade margin since this component of overall system noise is attenuated along with the carrier during a path fade.

Receiver input level

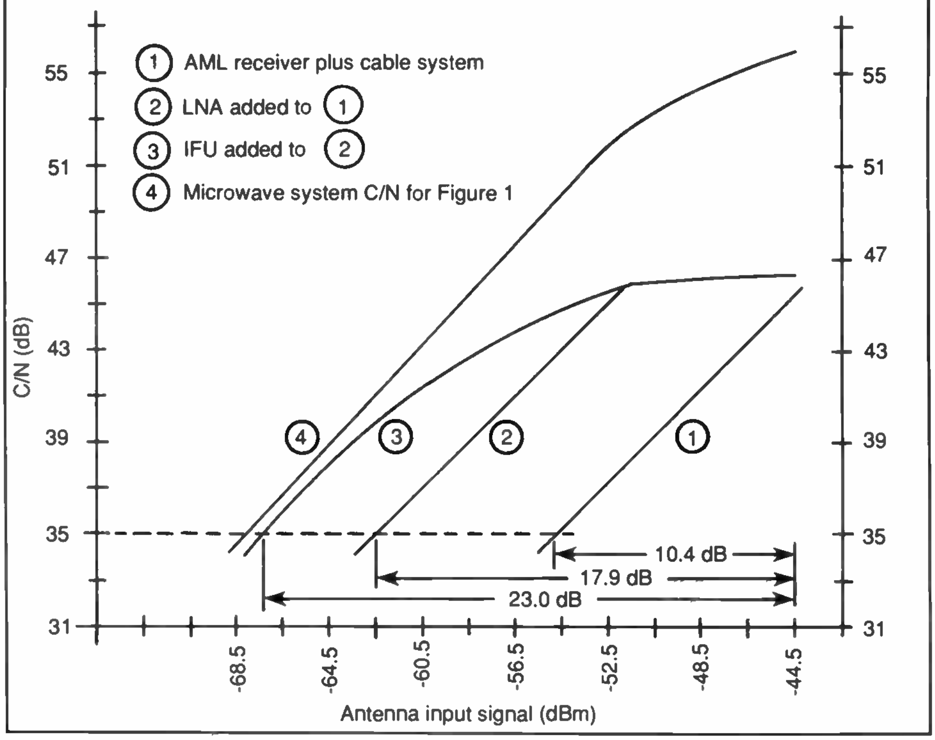
In any case it is necessary to compute the received carrier level at the input of the receiver. The formula at 13 GHz in the absence of an LNA is

$$P_R = P_T - L_T + G_T - 118.7 - 20*\log(D) + G_R - L_R$$

where P_T is the transmit power in dBm, L_T and L_R are the waveguide losses at the transmit and receive sites, G_T and G_R are antenna gain figures, and D is the distance in miles between the transmitter and the receiver. Elliptical and circular waveguide loss is approximately 3.6 dB and 1.3 dB, respectively, per 100 feet. Antenna gain is typically 48.8 dB for 10-foot, 47.6 dB for 8-foot, 45.1 dB for 6-foot, and 41.6 dB for 4-foot diameter dishes. A 2 or 3 dB field factor accounts for miscellaneous additional loss at waveguide flange interfaces and small imperfections in antenna alignment.

The expected received power must be compared to the actual received power to determine if there is an implementation discrepancy. The measurement must be performed during clear weather and at a time when multipath effects are least likely to affect the measured result. Multipath usually can be recognized by the rapid fluctuation of received signal strength ranging from a few dB above nominal level to many dB below normal. If one assumes an accurate knowledge of the receiver AGC threshold setting, one need only temporarily disable this AGC and measure the increase in signal level at the receiver test point. In a 550 MHz receiver it is necessary to first set the VHF AGC to MGC position before disabling the microwave AGC. The microwave carrier level at the receiver input is then equal to the microwave

Figure 2: C/N vs. microwave input level



AGC threshold plus the observed signal increase when the AGC is disabled.

Finding the missing decibels

If a sizable discrepancy exists between theory and the measurement, a serious attempt should be made to find the missing decibels. Although measurement accuracy and calibration assumptions always must be checked and double-checked, it is important to recognize that every missing decibel is worth going after. Even if the picture quality is high during clear weather, the results of poor maintenance show up as excess time of degraded quality during path fades. A periodic check of received signal level, along with prompt corrective action if required, will pay off in better signal quality when the path fade does occur.

One caution before beginning the search if this is the first time. Do not assume the as-built configuration is necessarily the same as the original design, which may be recovered from a dusty file. Waveguide lengths may be substantially longer (or shorter) than originally planned. Multiplexing losses could have increased with the addition of channel modules, thus reducing the nominal transmitter output power. Single-stage LNAs may have been retrofitted into receivers to improve noise figure and additional couplers installed atop the transmit waveguide run to service additional receive sites. Check everything before concluding what the theoretical fade margin should be. If you find that a 6 dB waveguide coupler has been installed backwards, apportioning the lion's share of the power to the shorter path, it would not be the first time for such an occurrence.

If there is only one microwave receiver the logical place to begin the search for missing decibels is at the transmitter. Measure the transmitter output carrier level through the transmit monitor and compare it to the value in the transmitter log book. First deal with those items that are easily checked or do not require taking the system down. If there are multiple receivers serviced by the same transmitter and some of the received signal levels are very close to predicted, it may be more efficient to start with the receive site. Since the receiver is suspect one cannot assume its gain calibration to still be accurate. There are two choices: either measure the received carrier level with a separate instrument or insert a known microwave signal into the receiver in order to recalibrate it. The most accurate method requires that all but the pilot tone signal be turned off at the transmitter and a high sensitivity power meter be substituted for the receiver. The use of a microwave spectrum analyzer avoids this requirement.

Table 1: Fade margin maintenance checklist

- As-built design
- Receiver gain
- LNA gain
- Waveguide loss
- Antenna feed
- Transmitter output
- Receiver AGC threshold
- Waveguide pressurization
- Antenna alignment
- Path clearance

Table 2: Fade margin design upgrade possibilities

- Receive LNA
- Multiplex optimization
- Repeater to cut long hops
- Space combining
- High power broadband
- Upgrade to higher power

Alternatively, the AML MTS-60 microwave test set could be utilized along with an ordinary VHF signal level meter. The battery-operated test set is in essence a calibrated microwave receiver equipped with waveguide-to-coax adapters and precision microwave cable to facilitate connection to a microwave test point. The test set also can operate as a calibrated microwave pilot generator. When so configured it can be used to check the AML receiver gain and/or microwave AGC threshold setting. Either way the measurement determines if the AML receiver is operating as expected. Even if a tower-mounted LNA is part of the receive site installation, the easy portability of the test set permits verification of LNA gain. The precision coaxial attenuators provided with the test set ensure the LNA and receiver will not be driven into saturation when this measurement is made.

Since waveguide loss enters into the calculation of received signal strength, one should inspect the waveguide for any obvious physical damage. Excess loss can be due to water in the waveguide (increased signal level when the temperature drops below freezing is a good indicator), physical damage, or poorly installed connectors at the end of the elliptical waveguide. In the case of a bad connection, you can reuse the old connector but remember to use the correct reattachment kit corresponding to the connector model number. If the problem is a crack in the elliptical guide, a splice is often a faster and more cost-effective way of repair than replacing the entire waveguide run. Reroute some of the waveguide to pick up an approximate 3-inch surplus used up by the splice.

Moisture in the waveguide is bad not only because water attenuates the microwave signal, but also because it can cause internal corrosion, which further increases attenuation. The pressurization should be in the range of 3-8 psi and the desiccant should be a deep blue.

One particularly onerous form of corrosion has been a problem with a particular antenna feed design. Over a period of time the corrosion gradually builds up pressure, which squeezes in on the waveguide forming a taper section with only small loss. If this process continues, the waveguide eventually collapses and a very large loss of signal suddenly occurs. The damage cannot be spotted from outside and therefore requires disconnecting the input to the feed and a visual inspection of the inside using a flashlight. Check with the antenna manufacturer to determine if your antenna is susceptible to this disease.

If some decibels are still missing, check the receive antenna alignment. If the AML receiver at the base of the tower is being utilized to monitor relative signal level during this procedure, make certain the microwave AGC is disabled and the VHF AGC module is set to MGC position. Peak the signal through azimuth and elevation realignment. Make certain the level doesn't degrade as these adjustments are tightly locked down.

It may also be worthwhile to sight along the path through a pair of binoculars. The transmit antenna should be clearly visible and any objects within 1/20th of a degree of the line-of-sight may be viewed with suspicion. It is beyond the scope of this article to go into the formulas that determine proper Fresnel zone clearance. It is sufficient to be aware that tree growth or new building construction can degrade a path that was previously clear. This

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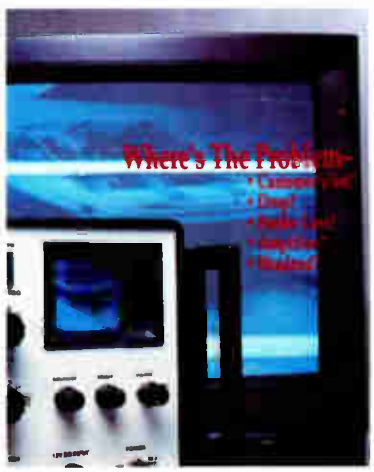

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and the preceding paragraphs are summarized by Table 1. (Editor's note: If the loss of signal is still a problem, check for antenna warpage. Inadvertent adjustment of an antenna's azimuth without first loosening the main support U-bolts can cause severe enough warpage to result in several decibels of signal loss on a path.)

Importance of fade margin

The fade margin has a very strong influence on path performance. This is particularly true for longer paths (>20 miles) where multipath almost always dominates the fade predictions. In this case an additional 10 dB in fade margin will cut the predicted time below 35 dB C/N by a factor of 10. Even when rain fades dominate, 10 dB additional fade margin will, on average, cut the predicted time by a factor of four. For example, suppose a given path is experiencing path fades below 35 dB C/N 0.1 percent of the time (8.8 hours/year). If the fade margin can be improved by 5 dB one would expect the time to be halved to 4.4 hours if rain is the cause. Only 3 dB increased fade margin is required to effect the same change if multipath dominates.

The equations that predict multipath and rain fading are the result of years of intense study by the international community. Nevertheless for a given locale a great deal of uncertainty exists. Even paths of the same length but in different directions from the transmitter could experience widely varying results due to influences of terrain or prevailing weather patterns. Moreover, the fades are not evenly distributed throughout the year, and one year could be quite different from the next. One can only speak in terms of averages. In that sense, the relative predictions for a given path as a function of fade margin should be fairly accurate. Therefore if a substantial path fade problem exists despite the fact that any "missing decibels" have been retrieved through vigilant maintenance, it behooves the microwave system designer to consider how the design might be altered to further improve the fade margin.

Ideas for improving fade margin

One of the most cost-effective ways of improving fade margin is to increase the sensitivity of the receive site. Referring again to Figure 2, consider the fade margin if the LNA were not present. Only 15 dB of microwave fade margin is available in contrast to the 23.8 dB that was available with the LNA present. The difference can be attributed not only to the improved noise figure of the receive system but also to the fact that the LNA is mounted at a point 3.5 dB upstream of the receiver. The gain of the LNA is not an important factor other than that it serves to establish the LNA generated noise (and thus its C/N contribution) as predominant relative to the receiver generated noise. In fact, too much LNA gain is decidedly not a good thing. This is because too strong an LNA output signal could result in excessive C/CTB. Thus if the expected clear weather signal in Figure 1 were 10 dB larger than indicated, an LNA should not be installed in this manner. One option is to install the LNA at the bottom of the tower in which case the fade margin improvement is only 6 dB but the C/CTB might be acceptable. If not, a lower gain (7 dB) LNA can be incorporated within the receiver AGC loop where it is protected from overload by high level signals. The fade margin improvement is then just equal to the improvement in receiver noise figure of approximately 3 dB.

"The microwave system C/N is not necessarily synonymous with the C/N experienced by the proverbial 'last subscriber.'"

Another way of picking up 3 dB in fade margin applies in the case when a channelized transmitter is not fully utilized due to the paucity of receive sites. Since a surplus of outputs is available, a channel combining magic tee can be removed from the final multiplexing layer and the two former magic tee inputs can be connected to separate antennas, both of which point at the same distant receive site. This form of multiplexing is referred to as "space combining" and requires only the one additional transmit antenna per path requiring upgrade.

If space combining is not possible due to tower wind loading considerations, reoptimization of the circulator and magic tee multiplexing network could be investigated. In the case of an AML MTX-132 transmitter, 1 dB of increased output power (and fade margin) may be possible by sacrificing unused outputs.

Another option for increasing the output of an underutilized AML MTX-132 is to carry half the channels in a HIBT-118 transmitter. The output from this high power broadband transmitter is then multiplexed into a modified remainder of the original MTX-132 network[2] and results in 2 dB additional fade margin. The recent technology advances in broadband microwave can also be applied through the utilization of an IBBR-124 repeater to improve the path availability on a long path. More than a factor of four reduction in the number of hours below 35 dB C/N is predicted for a typical 25-mile path[3].

Increasing transmitter output power is one of the more obvious ways of increasing fade margin. With the lowest power broadband transmitters the upgrades can be quite simple and improvements of 5 or 10 dB can be realized. Upgrade of a channelized high power STX-141 array is also possible. Conversion of the solid-state sources to high power solid-state sources adds 3 dB additional output capability. Table 2 summarizes these ideas.

Summary

The microwave system fade margin is defined as relative to 35 dB C/N but sufficient VHF AGC must be provided to ensure that the CATV system does not deliver a substantially worse C/N. The actual fade margin should be compared to the theoretical fade margin and any missing decibels should be recovered through maintenance troubleshooting procedures. A factor of two reduction in the number of hours below 35 dB C/N is possible with 3 dB or 5 dB fade margin increase, respectively, for multipath and rain fades. Several design upgrades are possible for improving fade margin. **CT**

References

1 T.M. Straus, "Defining S/N," *CED*, February 1986.

2 T.M. Straus, R.T. Hsu and L.A. Kaufman, "Impact of Microwave Technology Developments on CATV System Design," *1991 NCTA Technical Papers*.

3 T.M. Straus, R.T. Hsu and L.A. Kaufman, "New Microwave and Fiber-Optic Supertrunking System Configurations," *1990 NCTA Technical Papers*.

A Message from the Executive Vice President

Dear SCTE Member,

Enclosed is everything you need to register for our fifteenth Annual Engineering Conference and ninth annual Cable-Tec Expo. I hope this information will convince both you and your management of the valuable benefits to be gained through your attendance this year.

The entire program has been designed to be the most cost-effective means of obtaining the maximum technical training for all levels of technicians and engineers working in the field of Broadband Communications. Registration fees for Cable-Tec Expo remain unchanged for the last five years.

The Engineering Conference, while geared toward engineers, will contain topics of interest to all levels of our membership. Engineers from the FCC, NCTA and technical advisory committees will discuss current issues that will impact future directions taken by our industry.

The Expo itself will offer a total of ten workshops, which are listed on the following pages. No other activities will be scheduled during workshop periods in order to maximize attendance and participation. Exhibitors have been encouraged to gear their booth presentations toward "hands-on" demonstrations, and a Technical Training Center will feature additional equipment demonstrations.

We invite you to join us in Reno for Expo '91. If you cannot attend, I hope to see you at Chapter meetings or future SCTE technical seminars during the coming year.

Best regards,

Bill

William W. Riker

THE FACTS ABOUT CABLE-TEC EXPO® '91

dates

Annual Engineering Conference, June 13, 1991
Cable-Tec Expo, June 14-16, 1991

location

Reno-Sparks Convention Center and Bally's Reno Hotel
Reno, Nevada

history

Cable-Tec Expo '91 is the ninth annual convention/tradeshow sponsored by the Society of Cable Television Engineers, Inc., combining a wide variety of technical programs, hands-on training and breakout technical workshops with instructional hardware exhibits. The Annual Engineering Conference will be SCTE's fifteenth yearly conference dedicated to current engineering issues, FCC compliance and technical management. In addition, the Society has presented more than 60 national technical programs in cities across the United States over the past twenty years, attended by more than 15,000 engineering and technical personnel from the broadband communications industries.

attendance

Attendance is open to individuals within the CATV industry as well as anyone involved in broadband communications. Over 1,500 registered attendees are expected from all levels of the cable television and related businesses, including all levels of non-technical personnel.

program

The Annual Engineering Conference will be packed with six hours of technical and management papers presented by many of the industry's engineering leaders. The annual membership meeting, held at the conclusion of the conference, will afford attendees the opportunity to meet members of SCTE's national Board of Directors.

The 2 1/2 day Cable-Tec Expo follows the Annual Engineering Conference and combines practical workshops with "hands-on" technical training and hardware displays. The program features many schoolroom style workshops to choose from. No other activities are scheduled during workshop sessions in order to guarantee maximum attendance and participation.

A new addition to this year's Expo will be a separate series of workshops dealing with topics of interest to local origination engineers and technicians.

As with all SCTE activities, the main purpose of Cable-Tec Expo '91 is to provide the maximum amount of training opportunities for the lowest possible cost. The event has been coordinated to fulfill this purpose, as it offers a wide variety of informative, up-to-date technical training programs. Additionally, Expo '91 will give attendees the opportunity to prepare for and participate in the Society's Broadband Communications Technician/Engineer (BCT/E) and Installer Certification Programs, gaining valuable knowledge and practical skills in the process.

exhibits

The exhibit floor has a focus on education, with many industry suppliers presenting live technical demonstrations of their products.

Over 150 hardware exhibitors are expected to reserve space on the Expo '91 Exhibit Floor. Exhibits will include all types of products, supplies, services and equipment used in the design, construction, installation, repair, maintenance and operation of cable television systems. The exhibit floor will also feature a Technical Training Center for further equipment demonstrations.

special events

The Arrival Night Reception on Wednesday, June 12 will be sponsored by Wavetek. A Welcome Reception to be held Thursday, June 13, and the Expo Evening scheduled for Friday, June 14, will be co-sponsored by Anixter, AT&T, Comm/Scope, Jerrold Communications, Raychem and Scientific-Atlanta. Scheduled for Sunday, June 16, is SCTE's first national Golf Tournament, co-sponsored by SCTE and Midwest CATV.

CABLE-TEC EXPO '91 SCHEDULE OF EVENTS

	Wednesday June 12	Thursday June 13	Friday June 14	Saturday June 15	Sunday June 16
Attendee Registration	4 - 8 p.m.	7:30 a.m. - 3 p.m.	7:30 a.m. - 3 p.m.	7:30 a.m. - 3 p.m.	8:30 - 10 a.m.
Engineering Conference		8:30 a.m. - 4:30 p.m.			
Expo Workshops			8 a.m. - 12:15 p.m.	8 a.m. - 12:15 p.m.	
Exhibit Hall Open			12 noon - 6 p.m.	12 noon - 5 p.m.	
BCT/E and Installer Certification Testing			8:30 a.m. - 12 noon	8:30 a.m. - 12 noon	8:30 a.m. - 12 noon
Special Events	NCTA Engineering Subcommittee Meetings 1 - 5 p.m. Arrival Night Reception 6 - 8 p.m.	SCTE Annual Membership Meeting 4:30 - 5:30 p.m. Welcome Reception 6 - 8 p.m.	Expo Evening featuring the First National Cable-Tec Games 6 - 8:30 p.m.	Ham Radio Operators' Reception 5 - 7 p.m. House of Delegates Meeting 5 - 7 p.m.	National Golf Tournament 8 a.m. - 12 noon

PRELIMINARY PROGRAM

Engineering Conference

—**Session A: A Look Back - The Birth of Broadband Communications** *with Ed Allen, InterMedia Partners (Moderator); Len Ecker, Jerrold Communications; Ken Simons, consultant; Strat Smith, Pennsylvania State University; and Archer Taylor, Malarkey Taylor*

—**Session B: Exploring Fiber Optic Architectures** *with Ed Callahan, Anixter (Moderator); Earl Langenburg, US West; Bob Luff, Jones Intercable; Jay Vaughn, ATC; and Dave Willis, TCI*

—**Session C: Interdiction and Other Signal Security Techniques** *with Terry Mast, Continental (Moderator); Jim Allen, C.O.S.T.; Leonard Falter, Continental; and Paul Harr, Scientific-Atlanta*

—**Session D: A Look Ahead - The Future of Broadband Communications** *with Gary Kim, Multichannel News (Moderator); Robert Rast, Videocypher; and Archer Taylor, Malarkey Taylor*

Plus: Invited Keynote Speaker Ron Parver, Chief, Cable Branch, FCC

Expo Workshops

Theme: "Back to Basics"

—**Fiber Optic Trunk Restoration** *with Gene Bray, ONI; Ron Causey, AT&T; and Dave Johnson, Siecor*

—**Maximizing Benefits from Basic Test Equipment** *with Paul Beeman, TVN Entertainment Corp.; and Ron Hranac, Coaxial International*

—**OSHA Regulations: Safety in the Workplace** *with Ralph Haimowitz, SCTE; and Roger Keith, NCTI*

—**Painless Technical Speaking** *with Doug Ceballos, NCTI; and Rikki Lee, consultant*

—**Practical Technical Calculations Made Easy** *with Richard Covell, Texscan*

—**Satellite Proof-of-Performance Measurements** *with Doyle Catlett, Superior Satellite Engineering; Scott Grone, Antenna Technology Corp.; and John Vartanian, HBO*

—**Signal Leakage Issues One Year After Form 320** *with Les Read, Sammons Communications; and John Wong, FCC*

—**System Maintenance and Troubleshooting** *with John Cecil, Hewlett-Packard; and Steve Windle, Wavetek (with working amplifier cascade)*

—**System Sweep Techniques** *with John Neilson, Tektronix; and Warren Reihs, Calan (with working amplifier cascade)*

—**Tap to TV: Strengthening the Weakest Link** *with Larry Nelson, Comm/Scope; and Pam Nobles, Jones Intercable*

ALSO: Full program of sessions especially for local origination (L.O.) engineers and technicians including an evaluation of different video formats, basic quality control engineering and future trends in audio/ video production

Plus: BCT/E and Installer Certification Testing during all six workshop periods and Sunday morning

CABLE-TEC EXPO '91 REGISTRATION FEES
(UNCHANGED SINCE 1986)

	Until May 13, 1991		On-Site	
	Member	Non-Member	Member	Non-Member
Engineering Conference and Expo*	$195.00	$350.00	$235.00	$390.00
EXPO only	$145.00	$250.00	$185.00	$290.00
Engineering Conference only*	$120.00	$200.00	$160.00	$240.00
Spouse Registration*	$95.00	$95.00	$95.00	$95.00

* Includes ticket to the Awards Luncheon on June 13. Additional luncheon tickets are available at $20.00 each.

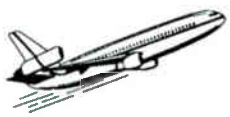
admission

Admission to all events will be through color coded badges to be picked up at the registration desk upon arrival.

lodging

The Bally's Reno Hotel has been designated headquarters hotel for Expo '91. It will also be the site of the Annual Engineering Conference, BCT/E examinations and several hospitality events. Room rates at Bally's are $76 for a single or double room. Reservations can be made by calling the hotel directly at **1 (800) 648-5080**. Please **make hotel reservations early** to guarantee a room at the hotel.

transportation



SCTE has designated American Airlines and US Air as the Expo's official air travel carriers. Supersaver and discounted coach air fares have been arranged and Hertz Car Rentals is offering special rates to attendees (see information below). Transportation from the Reno Airport to the hotel can be economically arranged through Bally's Shuttle Service or by taxi.

American Airlines: 1 (800) 433-1790 (U.S. and Canada)—Refer to Star #S12618G

US Air: 1 (800) 334-8644; in Canada: 1 (800) 428-4322—Refer to Gold File #233520

Hertz: 1 (800) 654-2240—Refer to Meeting #8227

entertainment

The Bally's Reno Hotel lobby features a tour desk with brochures covering area attractions, dining, nightlife and sightseeing activities. The discounted hotel rates are in effect for Expo attendees wishing to stay in Reno for three days before or after the conference.

event sponsor

Society of Cable Television Engineers
669 Exton Commons, Exton, PA 19341
(215) 363-6888; FAX: (215) 363-5898

MEMBERSHIP APPLICATION

Make check payable to SCTE.
Mail To:

SCTE®

SCTE
669 Exton Commons
Exton, PA 19341

☐ I hereby apply for membership in the Society of Cable Television Engineers, Inc., and agree to abide by its bylaws. Additional member material will be mailed to me within 45 days. Payment in U.S. funds is enclosed. I understand dues are billed annually.

☐ Please send me further information on the Society of Cable Television Engineers

SCTE is a 501 (c) (6) non-profit professional membership organization. Your dues may be tax deductible. Consult your local IRS office or your tax advisor.

APPLYING FOR: ☐ INDIVIDUAL @ $40 ☐ SUSTAINING @ $250

Please print or type information. Data will be used exactly as it is submitted here.

☐ MR. ☐ MRS. ☐ MS. TITLE:__________

NAME:__________ TEL. #:__________
First Initial Last Area Code-Number

EMPLOYER:__________ FAX #:__________
Company Name Area Code-Number

CO. ADDRESS:__________
Street/PO City State Zip

USE HOME ADDRESS?__________
Street/PO City State Zip

YOUR SIGNATURE:__________ DATE:__________

Complete the information. Enclose full payment or charge to MasterCard/VISA shown below.

NAME ON CARD:__________ EXP.:__________

MASTERCARD NO.:__________

VISA NO.:__________

SIGNATURE FOR CHARGE AUTHORITY:__________

Applications without payment will be returned. Applications from outside U.S., enclose additional $20 (U.S.) to cover mailing expenses.

CABLE-TEC EXPO '91 EXHIBITORS

(as of Feburary 1, 1991)

A.D.S. Inc.
Advanced Communications International
Alpha Technologies
AM Communications
American Lightwave Systems
AML Specialities
Anixter Cable TV
Anritsu America Inc.
Antenna Technology Corp.
Applied Instruments Inc.
Arcom/Northern CATV
Amco Corp.
Augat Communications Group
Authorized Parts Co.
Belden Wire & Cable
Ben Hughes Communications
Blonder-Tongue Laboratories
BUDCO
C-COR Electronics Inc.
Cable Connector Corp.
Cable Constructors Inc.
Cable Converter Service Corp.
Cable Exchange
Cable Innovations Inc.
Cable Link Inc.
Cable Security/Power Guard
Cable Services Co.
Cable Technologies International
Cableready
CABLETEK Center Products Inc.
CADCO Inc.
CALAN Inc.
Canusa-EMI
Carolina Galvanizing Corp.
Catel Telecommunications Inc.
CATV Services Inc.
CED
Channel Master
Channell Commercial Corp.
CHANNELMATIC Inc.
Comm/Scope
Commercial Electronics Inc.
ComNet Co.
ComSonics Inc.
ConTec International
Converter Parts Inc.
Corning Inc.
CT Publications Corp.
Diamond Comm/Coastal Engineered
Digitrace Inc.
Diversified Fastening Systems
DX Communications Inc.
Eagle Comtronics Inc.
Eastern International
Electroline Equipment
Fitel General Inc.
FM Systems Inc.
Foresight Products Inc.
Gilbert Engineering
Hewlett-Packard Co.
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ISS Engineering Inc.
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Jerry Conn Associates Inc.
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Lyn-Lad Truck Equipment
Magnavox CATV
Main Line Equipment Inc.
Mega Hertz
Microwave Radio Corp.
Midwest Cable Services
Midwest CATV
Midwest Communications Corp.
Monroe Electronics
Moore Diversified Products
Multilink Inc.
Murray International Inc.
NaCom
National Cable TV Center and Museum
NCS Industries
NCTI
Nexus Engineering Corp.
Optical Cable Corp.
Optical Networks International
Orchard Communications
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Reliance Comm/Tec
Ripley Co. Inc.
Riser-Bond
RMS Electronics Inc.
RMT Engineering
Rohde & Schwarz
RS&I
RTK Corp.
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Trilogy Communications Inc.
Triple Crown Electronics
TSB Inc.
TVC Inc.
U.S. Cable Inc.
US Electronics
Videomedia
Viewsonics Inc.
Wavetek
Wegener Communications
Westec Communications
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INSTRUCTIONS

1. **Deadline:** Cable-Tec Expo '91 Registration Forms must be received by SCTE National Headquarters on or before May 13, 1991. Forms received after that date cannot be processed and will be returned to the sender. If you do not preregister for the Cable-Tec Expo in advance, you must register on-site in Reno.

☞ Use a separate form for each individual (forms may be copied)

☞ Appropriate registration and activity fees must be enclosed for this form to be processed.

☞ Hotel reservations must be made directly with the hotel before May 13, 1991.

2. **Registration Cancellations:** All cancellations must be received in writing by SCTE National Headquarters on or before May 28, 1991. A $50 cancellation charge is applicable to all registrations cancelled after May 13, 1991. Substitutions will be accepted until June 4, 1991. **NO REFUNDS WILL BE GRANTED AFTER MAY 28, 1991.**

3. Telephone requests for cancellations and substitutions will not be accepted. All requests for cancellations must be submitted in writing and be received before May 28, 1991 and all requests for substitutions must be received before June 4, 1991. (SCTE FAX #: 215-363-5898)

4. Return the Cable-Tec Expo 1991 Registration Form with the appropriate fees to:

SCTE
669 Exton Commons
Exton, PA 19341
Attention: Anna Riker

5. Please make flight reservations through American Airlines, US Air or your local travel agent using the special discount numbers listed on the previous page. Rental car reservations may be made through Hertz.

6. All correspondence concerning hotel reservations should be made directly with Bally's Reno Hotel.

PLEASE NOTE DEADLINES

CABLE-TEC EXPO REGISTRATION

Everyone must register. ID badges must be worn and visible at all times in workshops and on the EXPO floor. To avoid delay, fill in all information requested. Full and complete payment must be sent with this registration form. Make all sleeping room arrangements directly with the appropriate hotel.

Registration Fee includes technical workshops, exhibit hall and hospitality/entertainment events. SCTE Active, Senior and Charter Members must provide Member ID Number. New Members applying at this time must include SCTE Member Application and dues payment.

If you wish to register more than one person, please make copies of this form.

✱ PLEASE PRINT OR TYPE ❑ Mr. ❑ Mrs. ❑ Ms.

YOUR NAME: ______________________________

First M.I. Last

NICKNAME: ______________________________

TITLE: ____________ COMPANY: ____________

ADDRESS: ______________________________

Street/P.O. Box

____

City State Zip

TELEPHONE: (____) ________ SCTE MEMBER #: ____________

FAX #: (____) ________ AMATEUR RADIO CALL SIGN: ____________

✱ REGISTRATION FEES (until May 13, 1991) (Please check the appropriate box)

	Member	Non-Member	
Engineering Conference and Expo	❑ $195.00	❑ $350.00	
Expo only	❑ $145.00	❑ $250.00	
Engineering Conference	❑ $120.00	❑ $200.00	
Spouse - First Name: ________	❑ $95.00	❑ $95.00	$ ________

(Spouse registration includes: All Sessions, Exhibit Floor and Awards Luncheon)

#______ Additional Awards Luncheon tickets @ $20.00 $ ________

TOTAL AMOUNT ENCLOSED: $ ________

❑ I plan to take BCT/E Certification Examinations on Sunday, June 16, 1991, from 8:30 a.m. to 12 noon.

✱ PRE-REGISTRATION FORM - must be received **BEFORE MAY 13, 1991.**

✱ Cancellation Policy - A $50 cancellation charge is applicable to all registrations cancelled after May 13, 1991. NO refunds given after MAY 28, 1991.

✱ METHOD OF PAYMENT

❑ Check (Checks to be made payable to SCTE) ❑ MasterCard ❑ Visa

CHARGE CARD INFORMATION - Complete for MasterCard/Visa shown below:

NAME ON CARD: ______________ EXP. DATE: ________

MASTER CARD NO.: ______________ VISA NO.: ______________

SIGNATURE FOR CHARGE AUTHORITY: ______________________________

NOTE: There are no further discounts available. SCTE Sustaining Membership qualifies only ONE (1) person to register at SCTE Member rate. Additional personnel must be registered at Non-Member fee or submit individual application for membership with full payment.

April 1991

Focus on installation

BACK TO BASICS

The training and educational supplement to Communications Technology magazine.

Geri Saye

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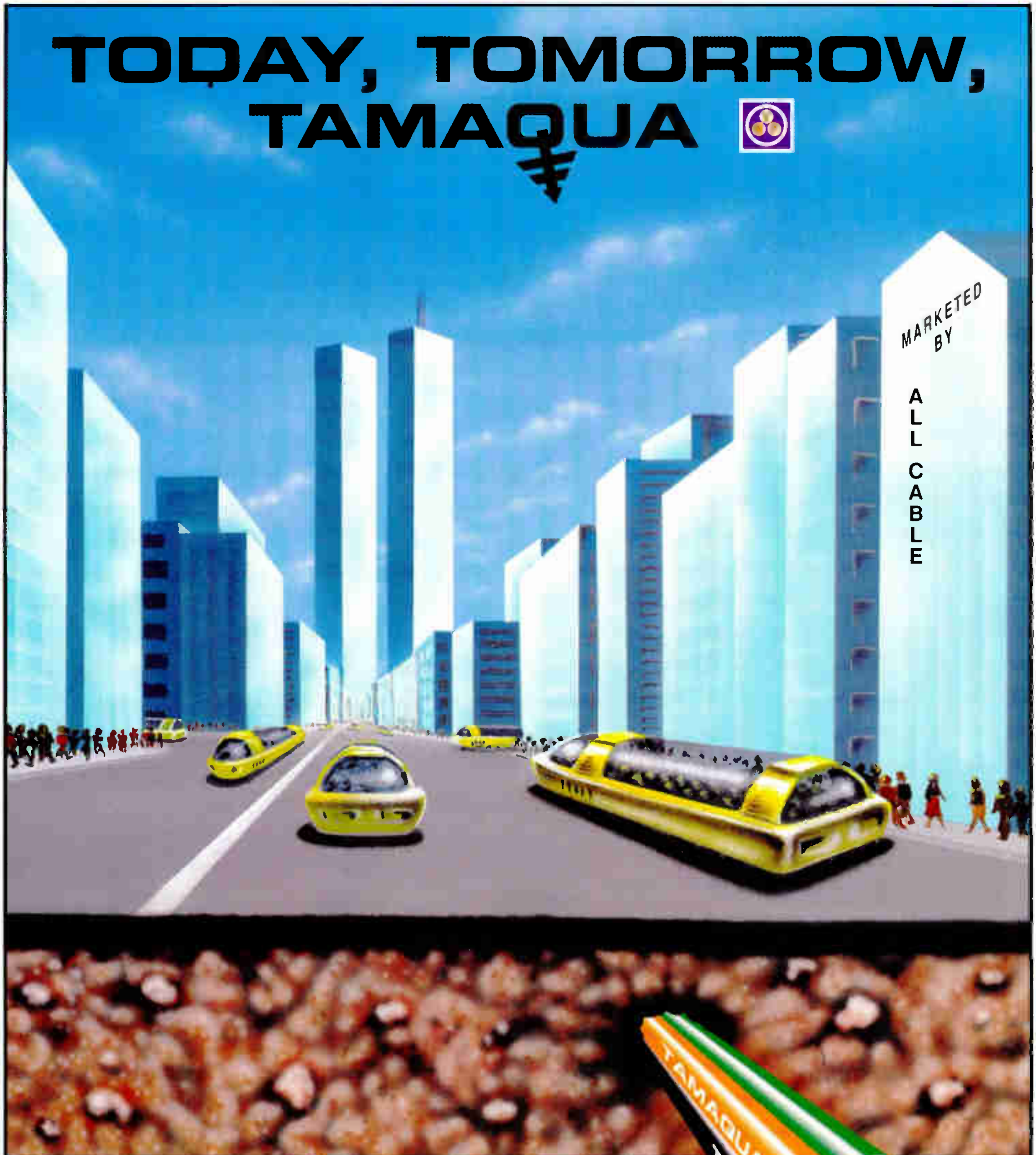
Formerly Installer/Technician


TODAY, TOMORROW,
TAMAQUA
MARKETED BY
ALL CABLE
TAMAQUA
TAMAQUA

Training for quality installations

By John Schonewill
National Sales Manager, Sachs Communications Inc.

Since the cable TV industry has become increasingly more technical, it is important for manufacturers to provide operators with a training system in drop and construction areas. With fiber optics, the potential for 600 MHz to 1 GHz is on the horizon. At these frequencies, it is critical that the impedance of the network be maintained properly to ensure maximum performance of the system. So, the ordinary drop hardware and today's method of installation will not suffice in the near future.

Training for profit

When installation training is combined with innovative products that meet today's challenges with performance, the cable system will profit — mainly through the reduction of service calls. Proper installation also can reduce negative occurrences such as when a customer decides to disconnect or downgrade because of poor signal quality caused by an improper installation.

Similar problems occur when the drop is installed by poorly trained technicians. So, it's essential to provide classroom or field training to make sure the install is performed right the first time. However, systems (or contractors hired to do the work) may rely on faulty on-the-job experience to teach installers. Hence, some procedures not conducive to the life span of a drop part are perpetrated.

Lack of training causes more headaches when the employee must fill a daily quota of installations or service calls. Jobs done in a hurry often are done poorly and workers tend to slack in performance if they're already behind schedule. When shortcuts are taken, mistakes happen and safety practices are ignored. We must consider what's more important these days — one's full paycheck and work orders completed on time (but perhaps done poorly), or jobs well-done and an excellent safety record.

So what's the real secret to saving money at the drop? Experts in installation procedures agree: Get it right the first time. And there's no better way to get it right than to *learn* how to do it right. This usually means conducting a seminar that gives technicians some hands-on training with the types of equipment they will be using on the job.

Various options exist for installation training today and many are excellent. These training programs can succeed but only up to a point. For example, installation practices common to many systems can be demonstrated, but perhaps with hardware not needed in your system. So this training is not as system-specific as individual training could be.

Yet, keep in mind the cost of ongoing system-specific installation training can be nominal. Here's where the manufacturer comes in. If the company that sells the products also provides the training, it can go a long way to ensure that the drop product will be used in exactly the way it was designed.

With that philosophy, Sachs has provided training in installation techniques for over 16 years (as long as we've been in business). Our drop training specialists regularly travel the United States and Canada to help our customers' field workers use our products properly and productively. Over the past two years we've opened training centers in Montreal, Toronto and Denver. This year a new center will be opened to serve the New York/New Jersey area and a facility in Atlanta is presently in the planning stages.

What's the seminar like?

A typical training session begins with a slide presentation and discussion of the costs of drop-related service calls. Take a 50,000-subscriber system and a 7 percent service call ratio per month (3,500 calls/month at $30 per call). If half the calls are drop-related, which is probably an underestimation, the system spends $52,500 fixing drops. By reducing these calls by one-fourth, the operator saves $13,000 per month.

The trainer and students then explore the relationship between plant mile costs and the drop. Quality workmanship at the drop can help produce higher completion ratios, improve customer relations, reduce service calls and generate less overtime. Higher productivity from better training also can keep labor costs down and employee morale up. In addition to explaining these points, the trainer discusses the importance of the installer and service tech to the cable industry and subs.

Then the installers are taken through demonstrations of a series of common installations. An actual mock-up of strand clamp, etc., is set up and hands-on practice begins. Since the class size is small (five to 15 students), everyone is given a chance to work with all the hardware used from the pole to the house. This often can include between 20 and 25 of the most common drop products. During this time, any questions or problems about proper use of materials can be addressed and solved.

At our customer's request, trainers go with field workers to help do installations with products. We often find that field personnel are confused when they don't have an application procedure and can't see how the work should be done. They may use the product in an unrecommended way with satisfactory results — that is, satisfactory for a while. It might take them longer or they may not use the best technique to achieve the longest life.

Safety is another important factor covered in the class. It's true that all employees are responsible for their own safety. However, training in the use of equipment goes a long way toward improving safety consciousness. If installers know beforehand how to work with their drop hardware, it makes for an easier job. Therefore, workers don't get frustrated. They're also more careful and less hurried. Without being rushed, accidents and injuries are prevented.

Finding the time

For their part, MSOs have been eager for training classes on products and applications, although finding enough time to train is perhaps the biggest problem. It isn't easy to interrupt even a few installers or service techs from their routes. The solution to this is that field supervisors are often present at our seminars to help train personnel who may be in the field. The trainer returns to the system a few months later for follow-up instruction. Industry turnover of installers and contractors makes continual training even more important for a system that wishes to continue to provide its subscribers

(Continued on page 71)

Installer certification: Meeting the industry's needs

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

The SCTE Installer Certification Program is currently recognized as one of the most popular and respected training programs on cable installation and beginner's technology. Over 700 people have joined the Society at the installer level of membership. The training manual for candidates in the program has sold out four printings and is currently going into its fifth.

The popularity of this program confirms the contention of Robert Luff of the SCTE board of directors that there was real need for a program for the frequently overlooked and under-trained installers and installer/technicians who play such a vital part in our industry.

Luff suggested the development of a certification program for installers at a 1987 board meeting, articulating a need that has been a concern of the cable TV industry throughout its existence. The installer, the person who makes final provisions for a customer to receive cable service (and in many cases the sole person the subscriber comes in contact with), deserves as much attention, preparation and technical training as any other cable employee.

Program objectives

Upon Luff's recommendation, an installer certification program committee was formed, consisting of Richard Covell (chairman), Ron Cotten, Allen Kirby, Dave Pangrac, Roy Tartaglia and Dave Willis. The committee's goals were to establish minimum skill requirements for the industry's installers and installer/techs by developing a program for the certification of installers that would follow a procedure similar to the Society's Broadband Communications Technician/Engineer (BCT/E) Program, which had enjoyed success since its introduction in 1985.

It was determined the installer certification program would combine a written examination (modeled after the seven exams utilized in the BCT/E certification) with a series of practical examinations to provide a means of measuring as comprehensively as possible installers' skill and expertise in the execution of their job duties.

One important objective of the program determined by the committee is the education of installers in matters besides technical practices. Customer relations is a vital part of an installer or installer/tech's job duties that is frequently overlooked in initial training. It was decided early in the evolution of the program that it would delve into this often neglected but highly significant discipline.

Installer manual

While a good deal of source material exists for BCT/E candidates to use as study resources, the installer program committee felt the more job-specific installer program required a comprehensive manual (especially for candidates seeking certification).

It was decided this manual would offer recommended practices for drop cable installation. It would have a consistent viewpoint based on the committee's findings and practical knowledge. Classroom-style and hands-on training would be conducted by the Society's more than 60 local chapters and meeting groups using the manual. Besides functioning as a study guide for the certification program, the manual would offer the industry a complete training guide for this historically neglected job category.

Committee Chairman Covell, who also serves as the Society's western vice president and is an at-large director on its national board, took on the responsibility of assembling the manual. After two years of intensive research and discussion, he provided a finished version of the manual in 1989. Since its publication in that year, the manual has sold nearly 2,000 copies, confirming the industry's endorsement of the program as an acceptable approach to installation. The manual is automatically provided to all participants enrolled in the program but copies of the manual as a stand-alone product are available to any interested party for $15.

Testing one, two, three

The other product of the committee's efforts, the actual certification program, officially premiered at Cable-Tec Expo '89 in Orlando, Fla. By this point the program had evolved to consist of three parts: a written examination and two practical examinations (cable preparation and fittings plus signal level meter reading). Although practical exams on pole climbing and ladder safety were considered in the early stages of the program's development, they were eliminated from the program due to the potential safety and insurance risks of such activities.

Since the practical exams are administered at the local level through the Society's chapters and meeting groups, only the written examination was introduced at Expo '89. Although done with little fanfare, it was an important event in cable TV history since it marked the Society's recognition of the industry's need to train people at each of its levels. For the first time, installers and installer/techs could be recognized for the skills they developed while having the opportunity to develop these skills further.

Special installer membership

Since the program's introduction, candidates for certification have been able to join the Society at the installer member level for a $25 fee that entitles the applicant to one full year's installer membership, as well as covering the

"The installer ... deserves as much attention, preparation and technical training as any other cable employee."

cost of the installer manual and the initial certification examination fees.

Installer membership in the Society entitles the individual to all discounts offered to SCTE members at conferences, meetings and seminars, as well as discounted prices on all SCTE products, publications, materials and videotapes sold by the Society. Installer members do not have voting privileges within the Society, may not hold an office in the Society at the national or local level, and are not eligible for insurance coverage or any other benefits of active membership requiring an expenditure of SCTE funds. A special membership card is issued for installer members.

Presidents of local chapters and meeting groups are authorized to proctor installer certification examinations. By applying to the certification committee, other members of local groups may receive approval to act as proctors.

Final certification

Candidates for certification in the program will receive a certificate listing the three areas of certification. When each area is successfully completed, the candidate will be sent special seals to be attached to the certificate. Upon the successful completion of all three exams, the candidate will receive the proper recognition through the local chapter. Installer certification by the Society is valid for a period of three years. The triannual recertification process is currently under development and will be announced at a later date.

The Society hopes to convince state cable TV associations and system managers that every installer and installer/tech working within their jurisdiction, including in-house installers and contractor personnel, should be certified in this important and respected program. SCTE created the installer certification program to satisfy an important need in the industry. It is now up to the industry to recognize that need, and satisfy it through the training the program has to offer. **CT**

Installation training

(Continued from page 69)

with high quality installations on a regular basis.

A class like the one described here usually takes an average of two hours or it can be expanded to a half or full day. Whether training is performed on-site, at a center or in the field, the facts are undeniable: training in the use of products improves productivity, cost-efficiency, safety, personnel motivation and system image, which allows the system operators to meet their customer service commitment. Everybody wins.

With as many pressures as our industry faces now, the importance of training backed with quality products cannot be overemphasized. It is every system's objective to give total customer responsiveness by optimizing on their day-to-day installations. This kind of value-added service to the industry benefits the subs, the system and the vendor. So everybody wins. **CT**

The author acknowledges the invaluable assistance of Rikki Lee in the preparation of this article.

Before you sweep...

By Tod D. Dean
Chief Technician, Alert Cable TV

We are about to begin sweeping our cable system. It has been over a year since we completed the last pass. The monthly extremity reports show signs that the cascades need attention.

One thing we learned last year is even though subs understand we are working to maintain our equipment and improve their reception, they don't want to see the interference caused by our high-level sweep system any longer than they have to. (And heaven forbid you forget to turn it off when you go home one night.)

Due to the areas we serve, sweeping during the night and early morning hours would cause as many problems as it would solve, so we have no choice but to do it during business hours. For these reasons and others, such as limited manpower and financial resources, we were looking for ways to reduce the number of days it takes.

Last time we tried to go to each amplifier location and adjust the existing amp module for correct levels and maximum flatness. We found that we spent a lot of time trying to flatten out the response at locations where there turned out to be problems that needed to be tracked down and repaired. We also had amp modules that wouldn't handle the higher frequencies in our system. We had upgraded from a 220 MHz system to 300 MHz and still had some of the old equipment in the field.

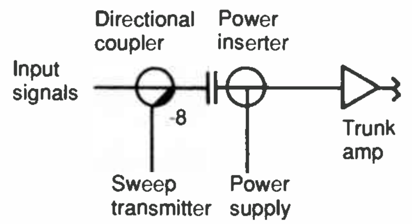
Most equipment manufacturers recommend that you align your amp modules on a test bench, then take them out and install them in the field. This works fine on new plant, but what about existing systems?

Making a swap

We found that by taking 10 spare modules, aligning them on the test bench and swapping them for existing modules in the system, we could duplicate the original procedure. By properly aligning the modules on the test bench, we verified that they met the required response specs. We then installed those modules in the first 10 amps out of the headend and took the 10 we just removed back to the test bench and aligned them. We repeated the process over and over until we had replaced the modules in every location.

By sweeping the modules on the bench, the subscribers were not seeing the interference caused by the sweep. (Editor's note: The "customer irritation" tradeoff between interference caused by a high level sweep and the periodic brief signal interruptions when swapping modules should be considered when using this technique.) We also found that setting up the modules on the test bench went faster than alignment in the field. Once in the field (by using modules they knew had the proper output response), the technicians could quickly tell by looking at the output test point whether or not there was a system problem needing repair. Major response variations indicated system problems, while minor variations were compensated for using the adjustments on the amp module.

Figure 1



(Connect sweep receiver to output test point or use test probe.)

Our system doesn't have bench sweep equipment. We found our Wavetek 1855/1865 system to be an extremely flexible piece of equipment on the test bench as well as in the field. We've used it to test sample pieces of system electronics (taps, splitters and directional couplers, as well as trunk amps and line extenders) to see if they would work for our system upgrade.

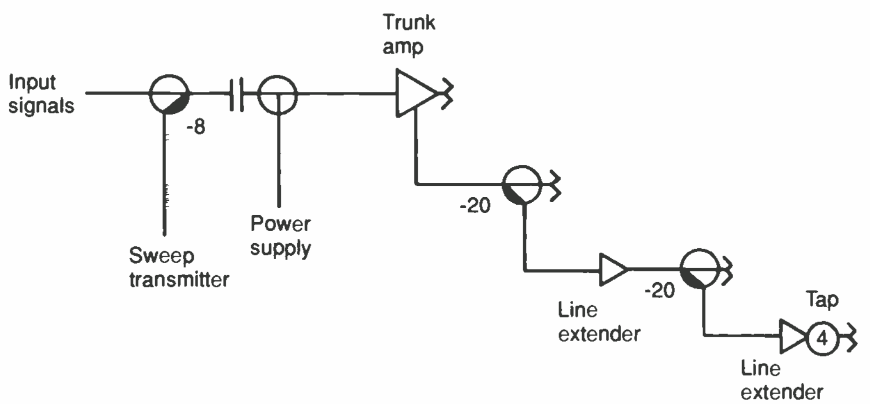
Signal level roll-off at higher frequencies becomes noticeable at a glance. We tested pieces of all cable sizes and verified signal losses between amps in the system. We also used the Wavetek sweep system as a bench sweep for the alignment procedure described earlier.

Using the test setup shown in Figure 1 we can align trunk modules using the sweep signals and verify AGC operation using system signals. By adding a bridger module and two line extenders to the test setup, as shown in Figure 2, we also can test those components before putting them into the system.

A feature of this setup is that any module brought from the system with a suspected problem can be put on the bench; response can be checked with the sweep, levels can be verified with the sweep or a signal level meter, and performance can quickly be checked by connecting a TV set to the output.

Now those modules can be checked before they are sent away for repair, only to return with the dreaded "No problem found" sticker. For additional ideas on how to use your sweep equipment, consult your owner's manual. **CT**

Figure 2



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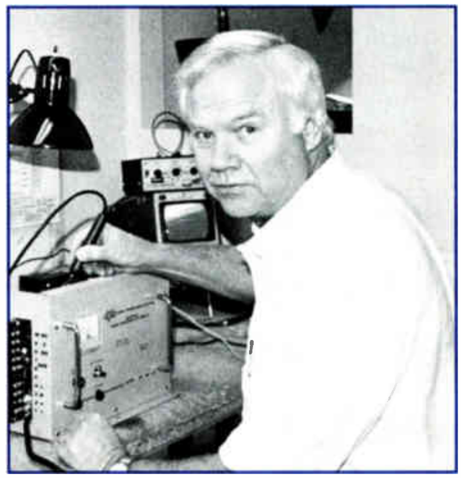
Troubleshooting Lectro standby power supplies, Part 3

This is the last of three articles dealing with Lectro Versatile standby power supplies. Last month we described methods for troubleshooting the time delay section of the battery charger module. This article describes a step-by-step troubleshooting procedure for the inverter card and suggests some ways to improve reliability.

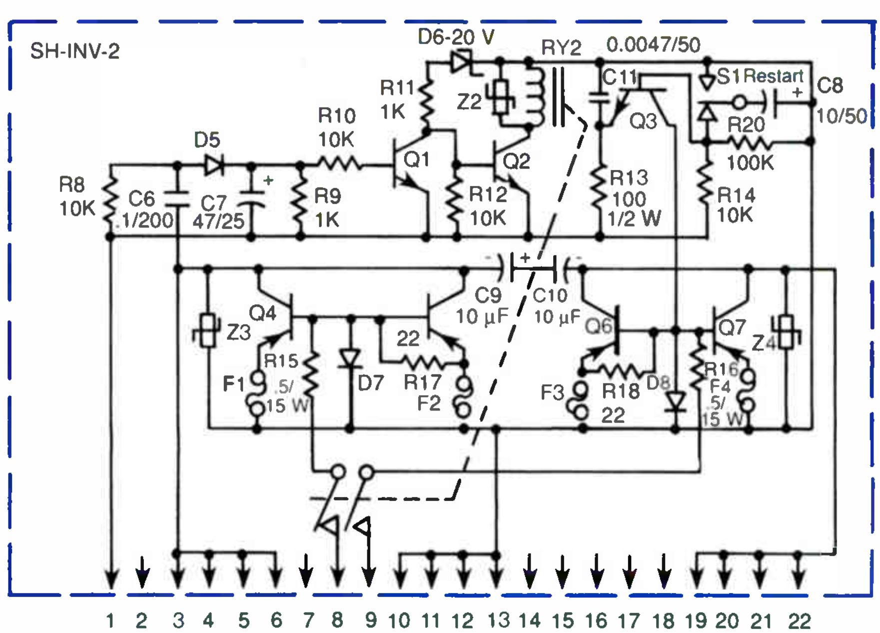


By Jud Williams
Owner, Performance Technological Products

As always, the process begins by visually examining the board to locate damaged components and making any obvious replacements. The second step is to plug the module into a motherboard and test to see if it is functional. When performing this test, a 200 to 300-watt (W) light bulb may be used as a load since it gives an immediate visual indication of whether the module is working or not. The module also "sings" when functioning, an additional verification of a good module.

While conducting the visual inspection of the circuitry, if the 22-ohm resistors are burned out, usually the associated power transistors have failed, so it's best to go ahead and replace them along with the burned resistors. Now make some resistance tests to verify the repair and check the condition of

Lectro inverter card schematic



the rest of the devices on the board. By measuring the resistance between the power transistor's base and ground, three associated components will be verified. If the meter reads 22 ohms, it means that not only are the resistors intact, but Rectifiers D7 and D8 and/or the base-emitter junctions of the power transistors are not shorted.

Any value other than 22 ohms may indicate that the resistor is open or the fuses located between the emitter and ground have blown. By the way, these fuses act as balancing resistors for the power transistors and may be replaced with other types of resistive devices.

Since fuses react to temperature and fail by melting, their use in an application such as this leaves much to be desired because they are subjected to heat from the current passing through them. When making a replacement, it is a simple matter to make up resistors to take their place. The fuse has a resistance value of approximately 0.005 ohms. Five inches of 20 gauge solid hookup wire has very close to the same value. A replacement resistor may be made by wrapping a 5-inch length of wire around a 1/8-inch drill bit so that it looks much like a coil and installing it in the space formerly occupied by the fuse. Always replace both fuses when doing this.

Power transistors

Now let's get back to resistance checks in the area of the power transistors. The collectors of each pair of power transistors are connected together and their bases are common to each other, so a single measurement covers each pair of devices. It is useful to know that the base-collector junction of a transistor is actually a diode junction, so keep that in mind when making measurements. Set the ohmmeter to the 2K ohm range (which often has a diode symbol) and check the junction, first in one direction, then the other. In the forward direction, the resistance will typically read close to 600 ohms. In the reverse direction, the reading will be "infinity," indicating the junction is probably good.

The low voltage cutoff relay may be tested by attaching the positive lead from a bench supply to the plus side of the circuitry located at the center section of the edge connector. Connect the negative lead to Connector 1. By varying the bench supply voltage around 20 volts (V), the relay can be heard clicking in and out. This verifies that the low

"The toggle switch serves no practical purpose so if it happens to be damaged, it may be removed and replaced with a jumper across the 'normally closed' position."

voltage cutoff is working properly. While maintaining the connection, set an ohmmeter to its lowest range and attach one lead to the outside wire of first one, then the other of the 0.5-ohm, 15 W resistors and connect the other lead to Terminal 8 and then 9 of the edge connector. The reading should be about 0.8 ohms when the relay is closed. This verifies that the 0.5-ohm resistors are good and that the contacts of the relay are clean.

Transistor Q3 of the start-up circuit should be checked before final functional test. This is easily done by imagining that the transistor is made up of two diodes placed back to back with the "base" of the device as their common point. Set the ohmmeter to the 2K ohm range and attach the red lead of the meter to the base of the transistor. Touch the black lead of the meter to each of the other leads (emitter and collector); in both instances the reading will be slightly lower than 1,000 ohms. When the leads are reversed, the readings will be infinity, verification of a good transistor. If R-13 (the 100-ohm resistor) is burned, the transistor has surely failed. The toggle switch serves no practical purpose so if it happens to be damaged, it may be removed and replaced with a jumper across the "normally closed" position.

A final consideration when working with these boards is the pair of 10-microfarad (μF), 150 V electrolytic capacitors. They frequently swell or explode and require replacement. I have found that reliability is greatly improved by replacing them with 250 V capacitors.

Readers with questions or wishing to discuss the contents of this article are invited to call me at (404) 475-3192 or write to P.O. Box 947, Roswell, Ga. 30077. **CT**

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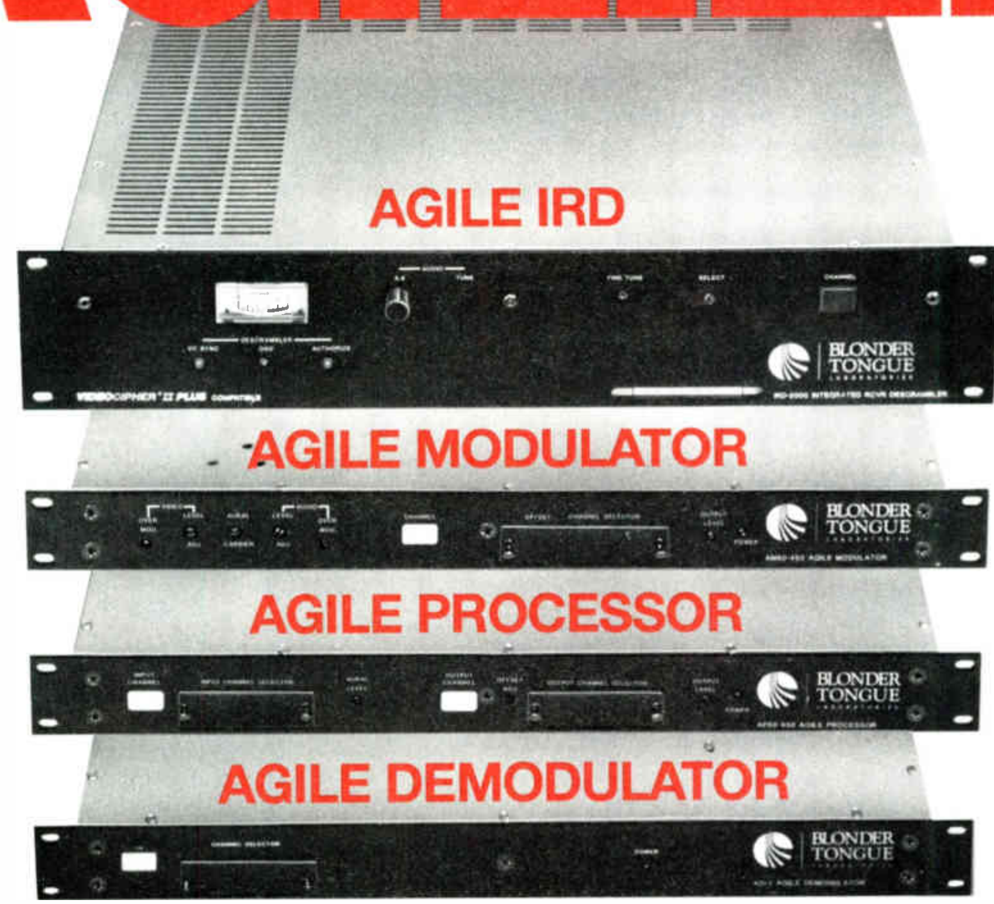

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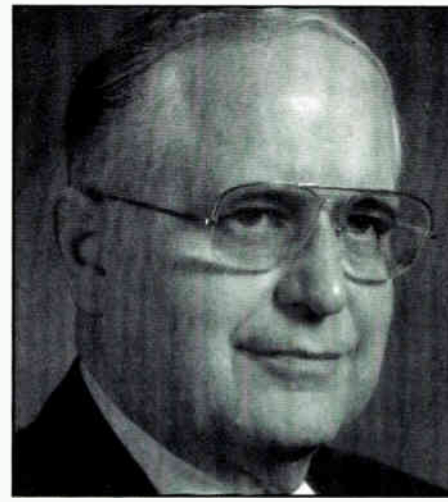
Film-to-video and video-to-film

By Lawrence W. Lockwood
President, TeleResources
East Coast Correspondent

Since the very early days of television, film and television have been inextricably intertwined — both as a program source for television and as a recording medium for TV programming. Of course film still is a major source of TV programming. In my May 1990 column, "About HDTV scanning line rates," I quoted Jeorg Agin, a Kodak



"Film will continue as a major program source and a storage medium for HDTV into the future as far as can be seen."

vice president — "80 percent of prime-time evening network programming and most TV commercials and music videos as well as feature films are produced on film" (although much of the production is often transferred to tape for broadcast). And it appears this is unlikely to change come HDTV.

There are even more compelling reasons to consider film as a source for future HDTV programming than for present NTSC. Two of the reasons are: 1) as indicated by the MTF curves reproduced in the column, film will have greater resolution than any HDTV short of an HDTV scanning rate of over 4,000 lines/frame and 2) film has the only universal and internationally accepted *common* frame rate — 24 FPS. An important caveat — television that must originate live (e.g., sports, news, etc.) will probably continue into the HDTV future to be recorded on, stored on and rebroadcast from videotape.

History — Television-to-film

Film served as the first recording medium for television. In the late '40s and early '50s (before the invention of videotape recording) TV stations were starting to spring up across the nation.

Figure 1: a) Film projected directly on the pickup plate of an iconoscope; b) a film island

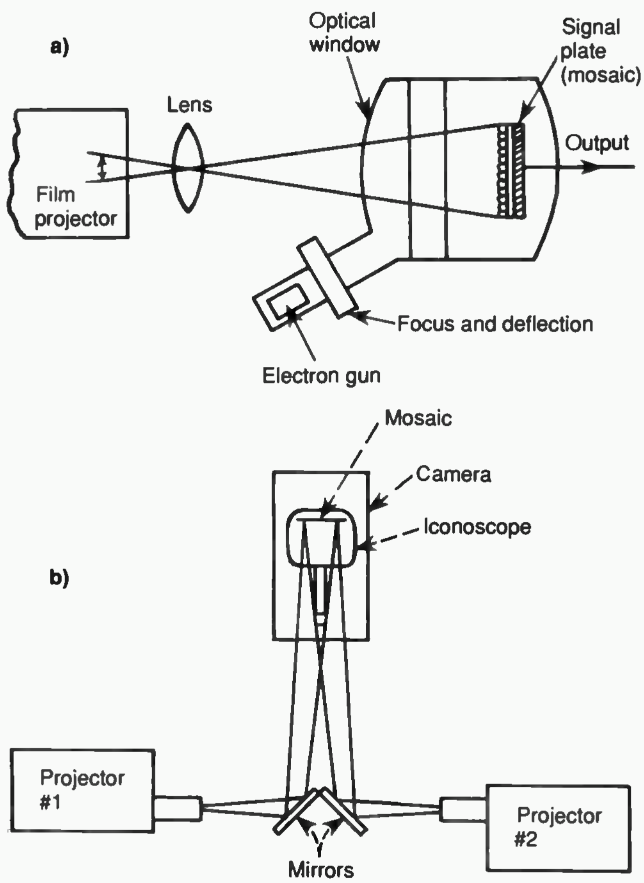


Figure 2: Relative timing of film frames in a standard projector and a TV projector, showing light flashes and field scanning intervals

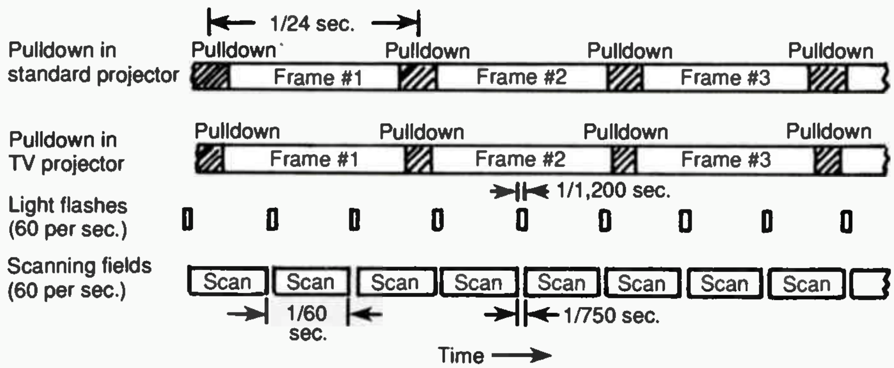
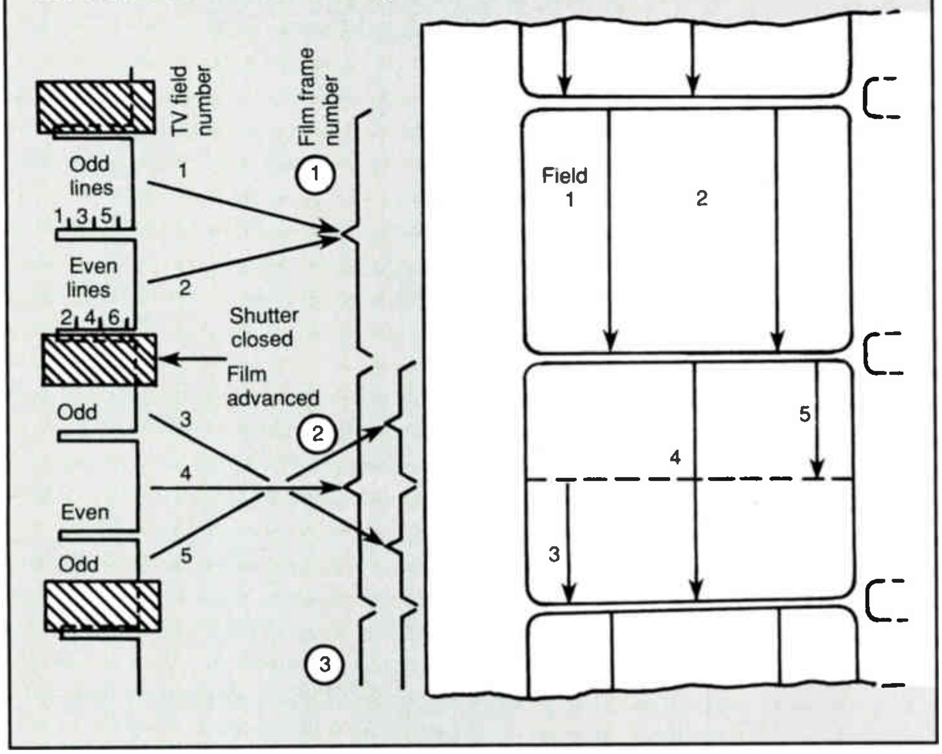


Figure 3: Conversion frame rate of 30 TV FPS to 24 FPS film for video to film recording



This was also before AT&T had adequate video transmission capabilities. Even after some transmission capabilities became available, the time shift across the nation mandated some kind of recording medium unless the shows were to be repeated live — an unsatisfactory solution (although that was done in the early days of the *Today* show). The resolution, until the advent of the VTR, was "kinescope recording," which basically was pointing a film camera at a kinescope (CRT). Any time a TV show made before the 1956 invention of the VTR is shown, it is certain that the show is from a kinescope recording (unless, of course, it is one of very few programs at that time originally shot on film). More about video-to-film later.

Early film-to-television

The most direct method for projecting film for television is an early method still widely used today — projecting the film directly on the pickup plate of a TV camera tube as shown in Figure 1a. For greater efficiency, a projection system know as a film "island" was developed that optically multiplexed several projectors onto one camera tube (Figure 1b). As new camera tubes were developed, such as the vidicon, plumbicon, saticon, etc., they were used in the same manner.

As previously mentioned the universal frame rate for film is 24 frames per second. It is sometimes referred to as 48 FPS. This is because the film is shot at 24 FPS but each frame is given two separate shots of light in the projector making the eye receive 48 separate flashes of light. This technique was developed to save film since it was empirically discovered that the double projection of each frame reduced perceivable flicker. (This analogy can be carried over to interlaced TV scanning

Sony EBR specifications

Input signal	**RGB component**
Gamma data	10 bits
Gamma data input	Sony SMC-70 microcomputer and 3.5-inch microfloppy disk
Film size	35mm
Film type	Black and white fine grain positive Fuji 71337 or equivalent
Film transport	Intermittent claw pulldown with registration pin
Film recording system	RGB color frame (sequential)
Writing lines	2,090 lines in effective picture area
Operation	Microcomputer aided

Figure 4: Laser color film recorder block diagram

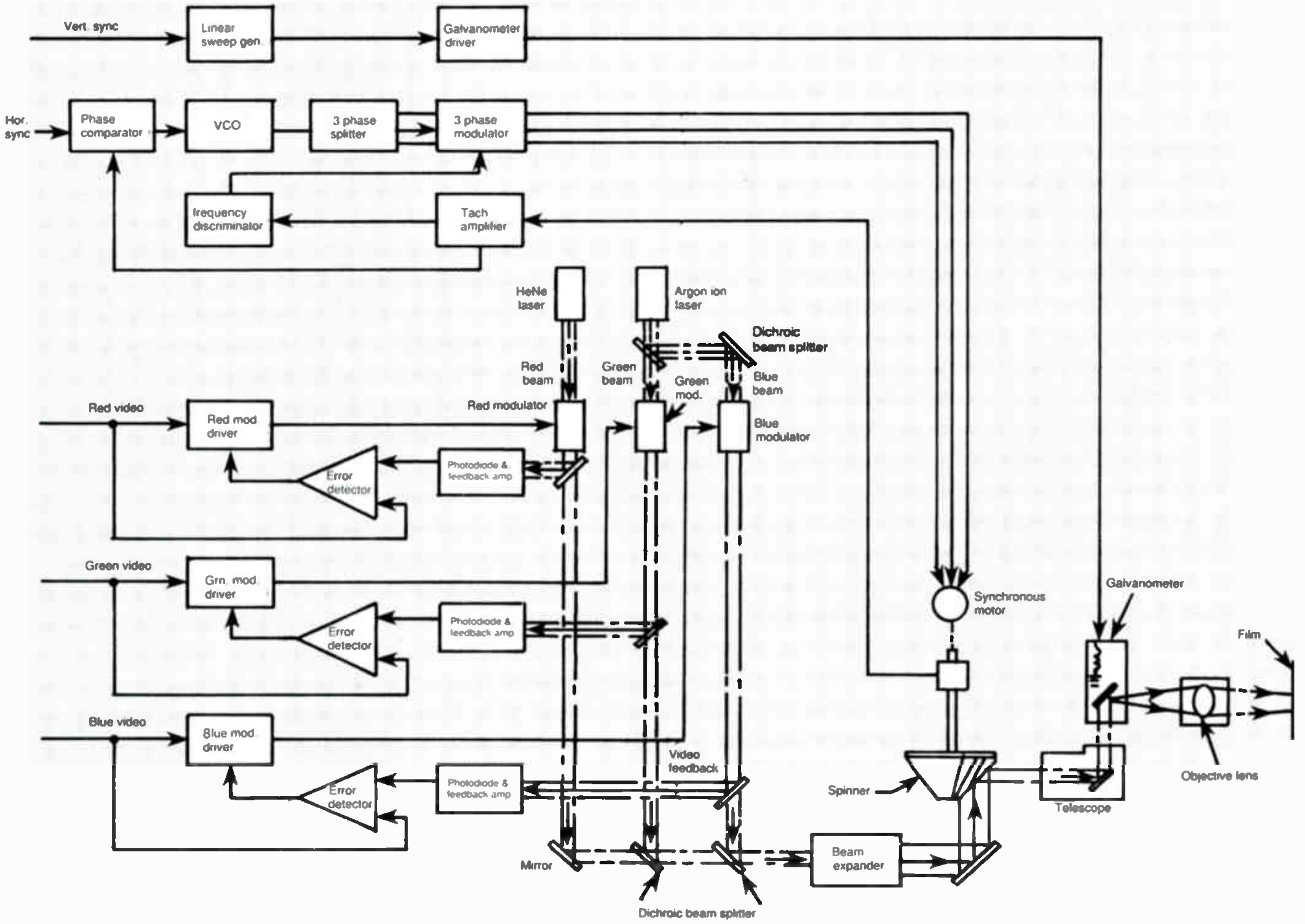
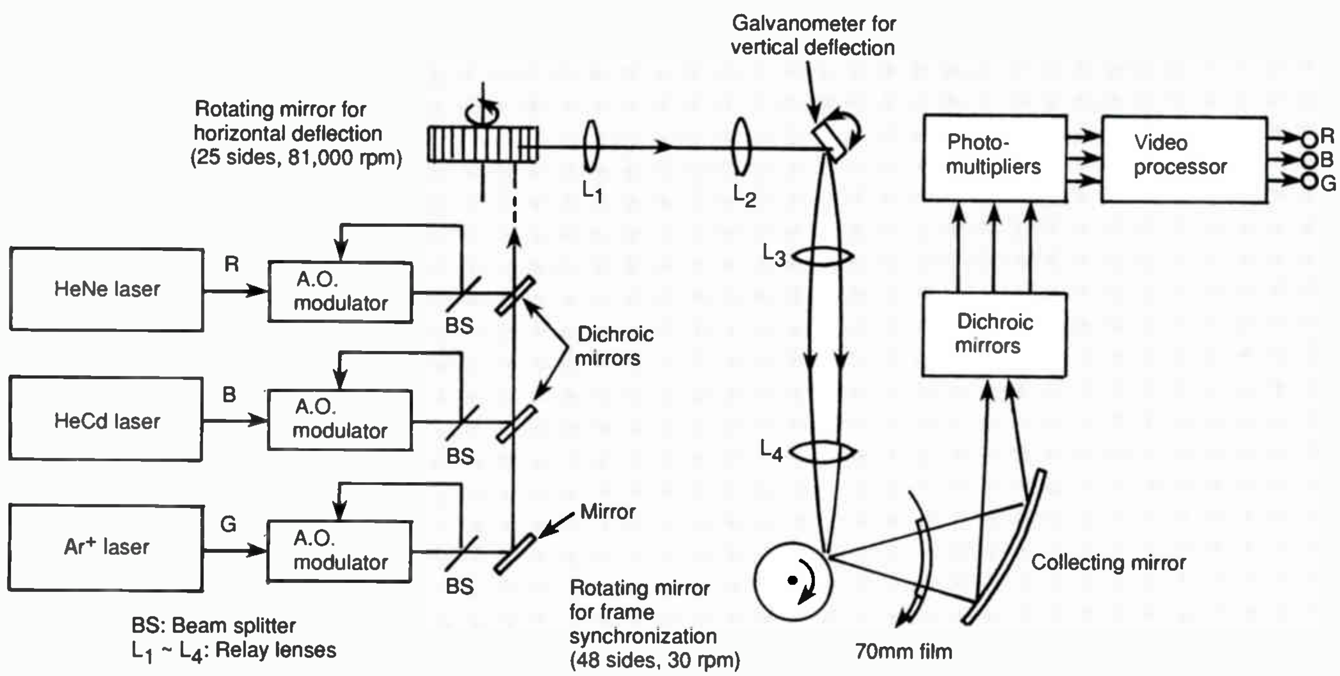


Figure 5: Elements of the mechanically scanned laser-beam telecine



— interlaced scanning was developed to save bandwidth but also each successive field of a TV frame is analogous to the double shot of light through one film frame.)

However, it is unfortunate that the 24 FPS does not match either the 30 FPS used in NTSC or the 25 FPS used in PAL and SECAM. The solution almost universally used for 25 FPS TV systems is simple, if not elegant. The film is projected at 25 FPS making a one-hour show 4.17 percent shorter (57.5 minutes) and music is 4.17 percent off key but the method has proved quite acceptable to the public.

But this method is unsatisfactory for 30 FPS NTSC TV since the speed difference in this case is 25 percent. The method universally adopted for scanning 24 FPS film at 30 FPS is illustrated in Figure 2. The film is passed through the projector in the normal intermittent manner, with equal dwell time for successive frames .

The only change from the standard intermittent mechanism is a reduction of the pulldown time to about two-thirds of the normal value. This change permits three vertical blanking periods to occur during one projection period (while the film is stationary), two vertical blanking periods during the next, three during the next and so on, as shown. (This is sometimes referred to as the 2-3 pulldown system.)

Light is passed through the film during the vertical blanking periods. Flashes of light, each about 5 percent of the scanning period, or about 1/1,200 second, are produced in synchronization with the field scanning rate. The blanking periods are so phased with respect to the pulldown motion that the film is never illuminated while in motion. Consequently, no blurring occurs. This type of projection depends on charge storage in the camera tube since following each vertical blanking during active scanning, the charge image, stored in the camera tube from the preceding light, is scanned and the sensitive plate restored to equilibrium. Some color projectors for television use a slightly shorter pulldown and a slightly longer light flash but the timing differences are small and operation is the same.

Early television-to-film

To go from video-to-film, such as the previously mentioned kinescope recording, requires a different timing schedule to accomplish the transfer of the 30 frame per second TV picture to the 24 frame per second film (Figure 3).

Since there are only four motion picture frames in the time interval occupied by five TV frames, one-half of a TV field is thrown away after each motion picture frame is exposed. The film is advanced during that half-field interval. As illustrated, the bottom half of motion picture Frame 2 is the second half of Field 3 and the top half is the first half of Field 5. (Of course all of Field 4 is exposed on motion picture Frame 2.) This half-field exposure of Fields 3 and 5 requires a very accurate shutter timing to prevent the overlap or gap of exposure in the middle of the picture where the fields butt, which would result in either a bright or dark horizontal bar.

Laser film recording

Since this method uses the light from the kinescope (CRT) for film exposure it has never been used to great effect for color recording. However, an interesting scheme for color film recording of color TV signals using video modulated red, green and blue lasers was developed at CBS labs under the direction of Ren McMann

Figure 6: BTS film-scanning and signal-processing sequence

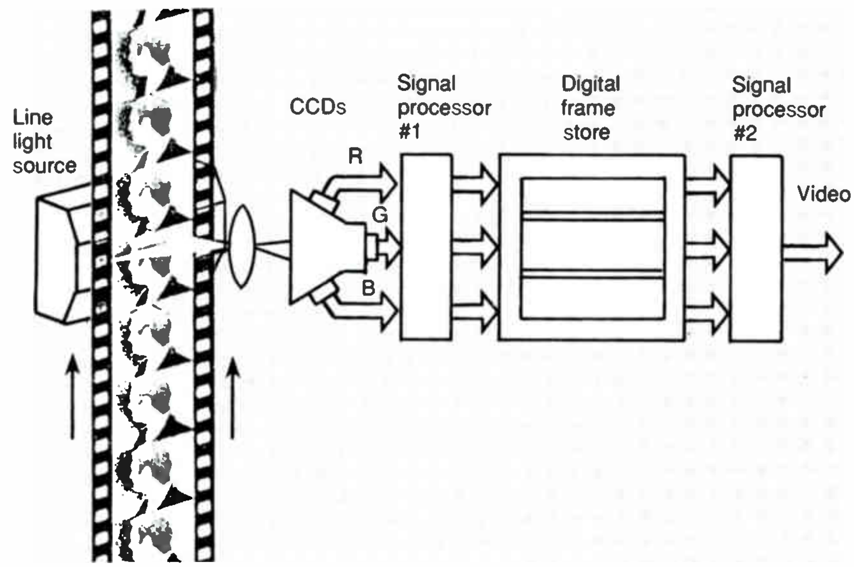
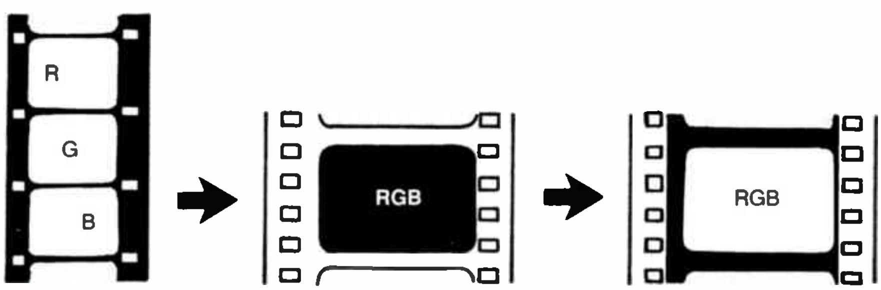


Figure 7: Steps for production of successive-exposure master and color internegative in the Image Transform tape-to-film transfer system



and demonstrated in 1971.[1] See Figure 4.

To obtain the required shutter timing shown in Figure 3 the laser system has an electronic "shutter" in a video processor (not shown in Figure 4), which is ahead of the laser modulators.

Subsequently, NHK (Japan Broadcasting Corp.) and other companies under its guidance in Japan, developed 16mm recorders using a similar system. This led to a design of an improved system for 35mm film recording of 1,125-line high definition TV signals. Several HDTV film programs so recorded were shown at the 1983 Montreux symposium but the use of the CBS and NHK laser film recording systems was limited to feasibility studies and demonstrations. No commercial use was undertaken.

Future of film and HDTV

For film-to-HDTV video, NHK experimented with straightforward film projection (70mm film) in the manner outlined in Figure 2. But the performance in both resolution and noise were not satisfactory so it developed a laser projection system. See Figure 5.

In essence, this projection system is the reverse of the laser recording system of Figure 4. The difference is that the laser light intensity is "modulated" by the film density and the light transmitted through the film is separated into the colors again for electronic processing by the dichroic mirrors.

Another interesting film-to-HDTV video scheme was developed by Broadcast Television Systems (BTS). Its uniqueness lies in the fact that the film motion is continuous — there is no projector intermittent providing film pulldown. See Figure 6.

In this system the vertical scan function is provided by the continuous motion of the film past a light source only one TV line in height. This line, after color separation by dichroics, is sent to three linear CCD arrays (one line of CCD elements for each color) to provide the red, green and blue video signals to the signal processor and frame store. The 2-3 timing is provided electronically by logic controlling the memory readout.

HDTV-to-film

There are a number of HDTV production houses in the country, such as Rebo Inc. and ZBig Vision both in New York City (and a half dozen others), that turn out all types of programming from feature length shows to commercials to music videos, etc. Sony has recently opened a 5,000-foot^2 HDTV production facility on its Columbia Pictures lot in Hollywood.

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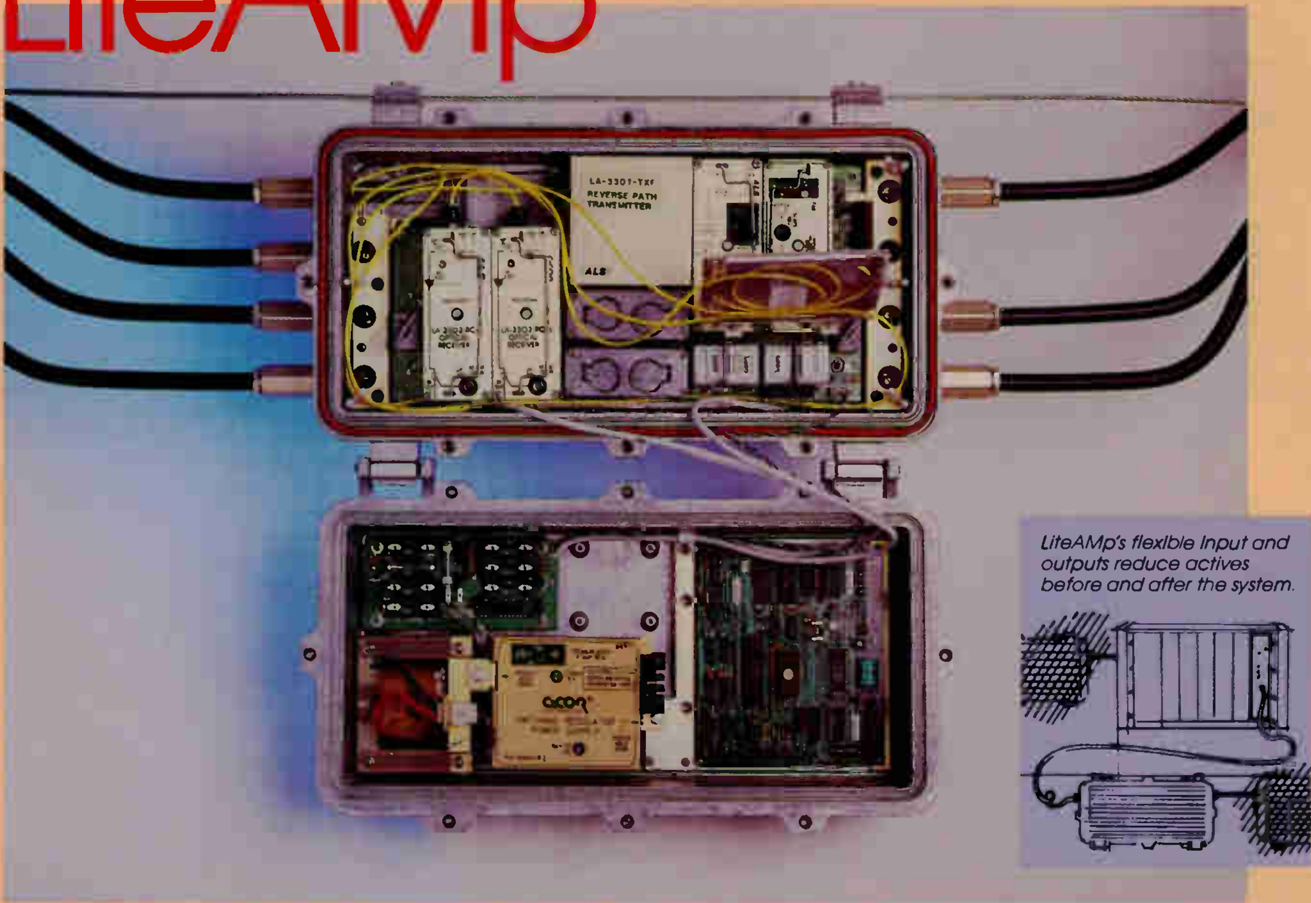

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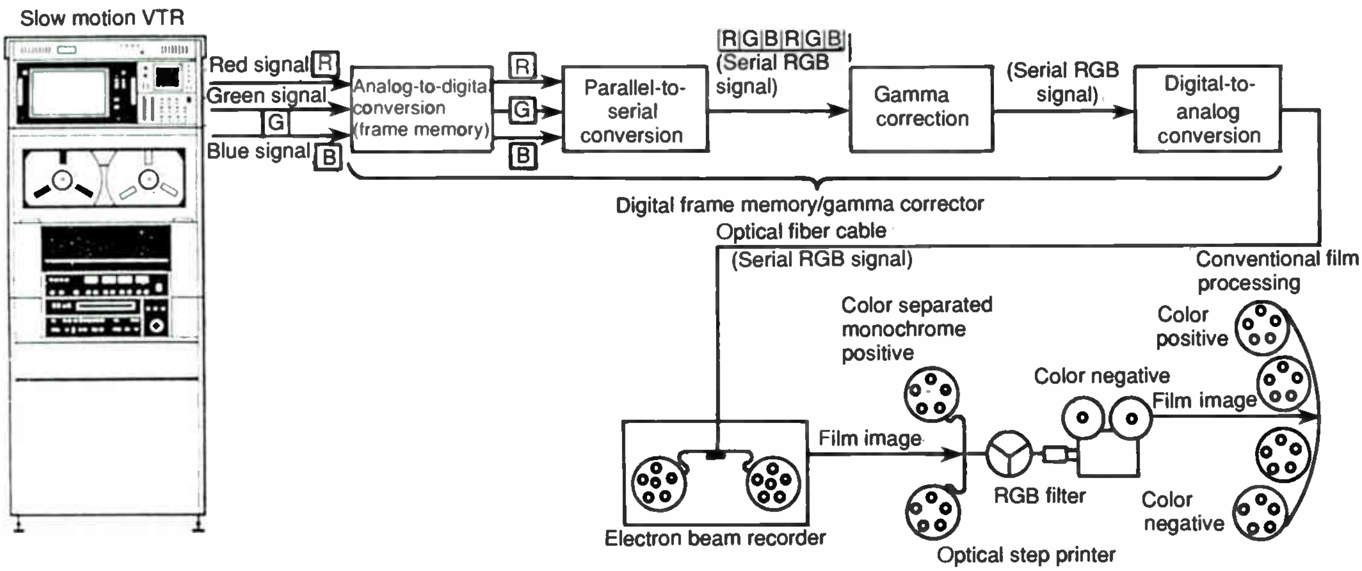
Figure 8: EBR system — HDTV tape-to-film transfer flowchart



duction facilities is film. Of course at present it is all in the 1,125/60 standard since that is the only equipment currently available.

As mentioned previously, experimentation with laser recording of HDTV video on film has been done but currently all HDTV recording is done by the electron beam recording (EBR) method. The sequence of EBR film production is shown in Figure 7.

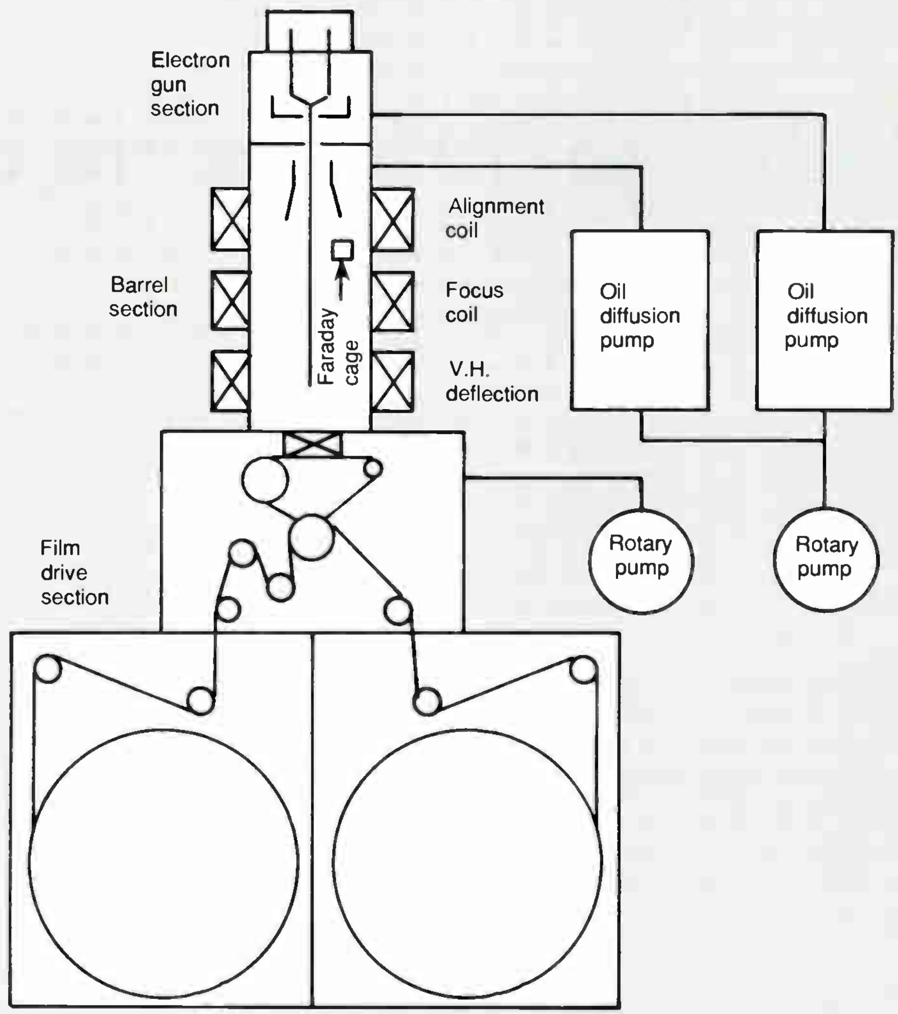
This system does not operate in real time. A modified VTR provides slow-speed red, green and blue component color playback capability at one frame per second to the EBR to produce the successive exposure black and white master. A color internegative is then made from this sequential B&W film from which color prints are made.

The block diagram of the Sony EBR system is shown in Figure 8. The high-definition red, green and blue analog video signals are converted to digital signals for: a) subsequent gamma correction to compensate for the characteristics of the master recording film and color negative, and b) conversion from 30 FPS interlaced TV scan to 24 FPS progressive scan in a red, green and blue sequence. The progressive-scan mode was chosen for a maximum of resolution and a minimum of artifacts. The sequential R, G, B digital signal is converted to analog to feed the EBR.

An outline drawing of the Sony EBR unit is shown in Figure 9. The sharply focussed electron beam scans the film surface in a vacuum, producing a latent image in the emulsion. The film is moved through the aperture gate in the electron-beam recorder chamber by an intermittent claw pulldown mechanism.

As shown in Figure 8 each frame of the color negative film is exposed sequentially to the B&W master frames corresponding to the red, green and blue video signals through appropriate R, G, B color filters mounted on a rotating disk, thus providing a color composite. The performance specifications of the Sony EBR system are shown in the accompanying table.

Figure 9: Outline drawing of Sony tape-to-film electron-beam recording unit



Conclusions

Film has been, is and will be a significant program source into the future of HDTV. The reasons for this felicitous situation for film are a combination of technical, economic and artistic factors. As noted, two of the technical factors are its higher resolution than any HDTV system under consideration or proposed and its universally accepted frame rate. Because of these, and other factors, Kodak has characterized film as a "future proof" medium for storage of the huge financial assets represented in a library of programming. The artistic reasons are best described when directors say they want the "film look."

Regardless of the worldwide accepted methods of conversion of the universal film standards into the various international TV standards, problems can occur if care is not take in the conversions. An example occurred in a program shot on film in the United States that was to be shown in Britain. This problem occurred in the world of current TV standards, but it is an indication of the vigilance that is required today in these conversions and will be required in the world of HDTV.

In 1987 the British public complained loudly about the picture quality degradation of the new season of *Dallas*. Until that year, the series had been shot, edited and distributed on 35mm film and the film had been shown directly on PAL with excellent quality. In 1987, the producers continued to shoot on film, but for economic reasons, the film was transferred to NTSC on videotape. The causes of the sudden quality problems were a concatenation of temporal problems in the series of conversions. As shown previously, the conversion of 24 FPS film to 30 FPS NTSC involves a slight, but acceptable, temporal "fudging." Likewise, the conversion of NTSC video to PAL involves another temporal effect. The cumulation of these temporal effects produced objectionable results particularly when compared to the previous arrangement where the film was shown directly on PAL.

However, with proper care and consideration, it appears that film will continue as a major program source and a storage medium for HDTV into the future as far as can be seen — and probably a lot further. **CT**

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Don't drop the ball on the drop

This month's "Lab Report" departs from the normal product-specific format and instead particularly addresses the performance of F-connectors. The following information is the result of extensive testing performed over the last three years.

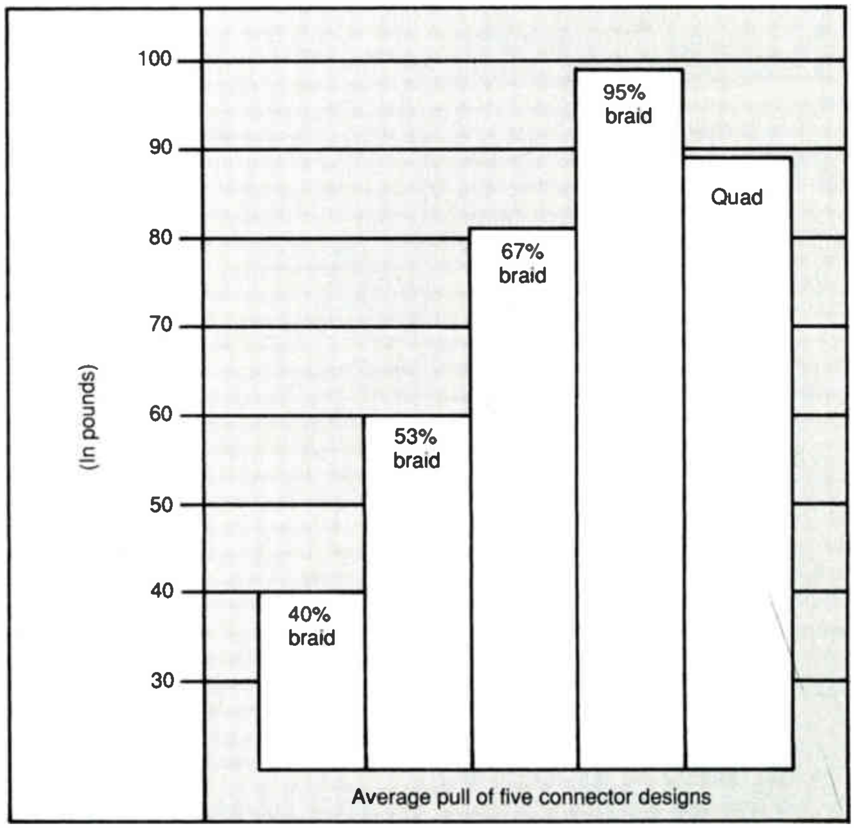
Times Fiber's Barry Smith has summarized some of the outcome of that testing in this "Lab Report," stressing the significance of craft sensitivity, proper weatherproofing and other connector interface issues we often take for granted. — Ron Hranac, Senior Technical Editor

By Barry Smith
Connector Specialist, Times Fiber Communications

The drop system has long been a source of customer service calls and constant maintenance for the cable industry. Over the past few years, the drop system has received a great deal of attention from both operators and manufacturers working to extend the life and dependability of the drop system.

The reliability of the trunk and feeder portion of our plants has improved steadily over the years, but, for the most part, the drop has been overlooked. Table 1 gives an idea of how

Figure 1: Connector/cable retention over different braid coverages



the demands on the drop have changed in the past 10 years.

This article will attempt to describe the sensitive nature of the F-connector relating to the mechanical and environmental performance of this interface. It also will briefly discuss some of the new products available designed to extend the life and reliability of the drop.

Cable, connectors and CLI

The number of F-connectors in a cable system far exceeds the number of trunk and feeder connectors. It is obvious that from a cumulative signal leakage standpoint, the F-interface is a dominant problem. Also anywhere from one-third to one-half or more of all service calls can be attributed to problems in the drop system. Reducing leakage at the drop is a major part of meeting Federal Communications Commission requirements and increasing customer satisfaction.

One of the first things to consider in designing a drop is selection of the drop cable for attenuation and shielding characteristics. Choosing low attenuation cables can increase signal levels at the home or can reduce system design costs by lowering tap output level requirements. Table 2 illustrates the lower attenuation of today's gas expanded foam dielectric drop cables compared to older solid dielectric or chemically expanded foam dielectric cables.

With the current cumulative leakage index (CLI) requirements, shielding effectiveness of the cable is also a serious consideration. All cables should have a bonded inner foil tape. This is needed for better shielding and the bonded tape makes connector installation more reliable. Braid coverage affects the mechanical strength of the cable as well as the shielding.

Initial shielding of RG-6 60 percent braid is sufficient for almost all drop cable requirements. (Two-way or dual-cable systems may require additional shielding.) With age and flexure there can be some degradation of the shielding but is still sufficient for most applications. The effects of corrosion is what destroys the shielding of most drops. The key here is that after six months or a year, a highly shielded cable with corrosion is likely to be worse than a lower braid coverage cable that has been kept dry.

The amount of braid coverage on the drop cable also has an impact on connector retention of the cable. A connector on a 53 percent braided cable should not be expected to have the same retention force as on a 95 percent braided cable. Figure 1 illustrates how the connector retention force varies with different braid coverage drop cables. These differences are mainly due the amount of metal in the outer shield.

Once the drop cable is identified, the connectors must be selected. Mechanically, an F-connector must provide reli-

Figure 2: Cable retention with different crimp ring IDs

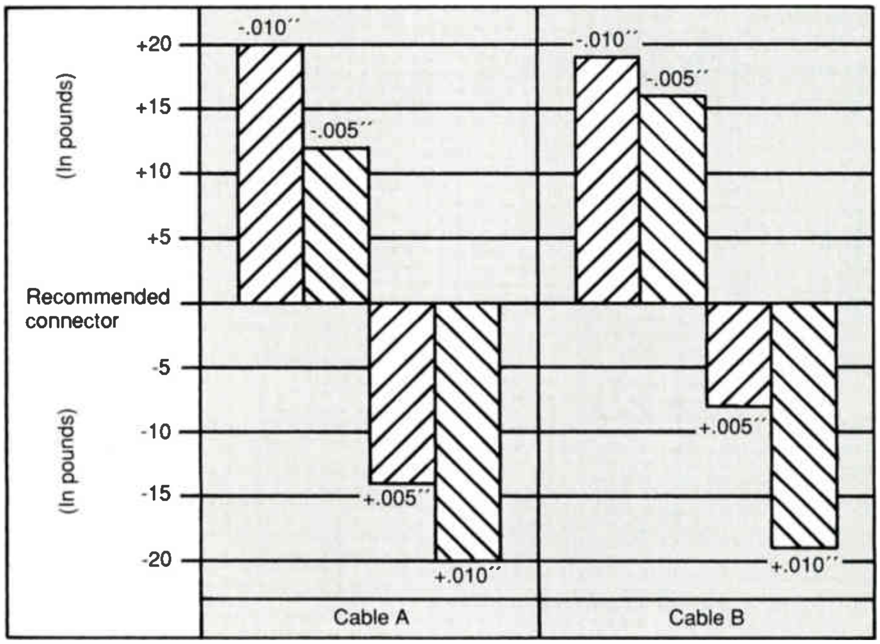
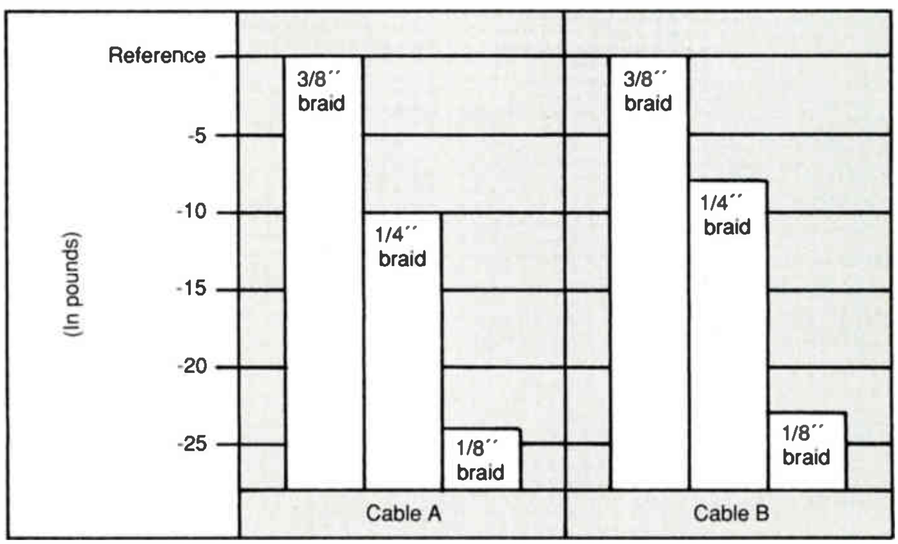
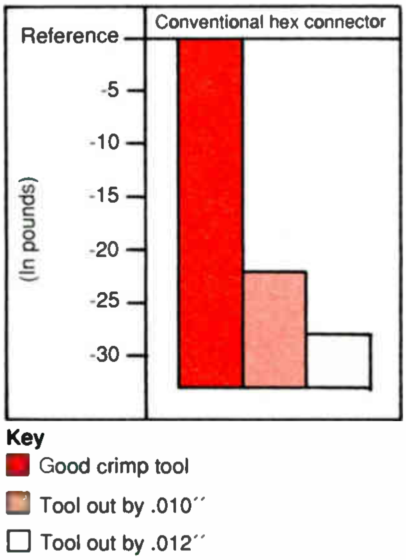


Figure 3: Cable retention with different braid prep lengths (conventional connector)



"Choosing low attenuation cables can increase signal levels at the home or can reduce system design costs by lowering tap output level requirements."

Figure 4: Cable retention with crimp tool out of tolerance



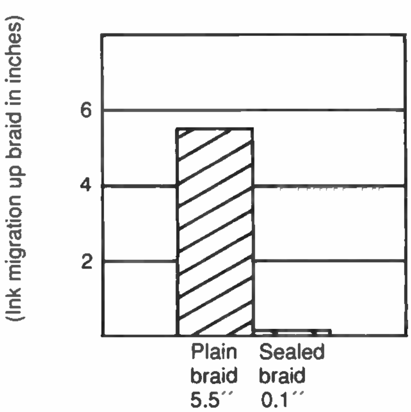
able long-term retention of the large variety of drop cables over a wide range of temperatures, wind flexure and vibrations. Close study of commonly available F-fitting components reveal thousands of possible combinations of installing a one-piece, RG-59, crimp type F-fitting onto an RG-59 drop cable. The advent of more universal sized connectors has greatly reduced the number of combinations, but selection of compatible components is still very important.

Figure 2 indicates that changing the connector crimp ring ID by just 0.010 inch has a significant impact on the retention of the cable. (Even though the undersized connectors increased retention they were difficult to install.) Talk with the manufacturers to ensure you are using the proper connectors for your drop cable.

Preparing the cable for connectorization affects the retention of the cable. Check with the manufacturers for the recommended prep dimensions and verify that the prep tools you use meet their requirements. Some connectors need 3/8 inch of braid, some need 1/4 inch of braid, and some need 1/8 inch of braid, so be sure to follow the manufacturers recommendations. Figure 3 shows how cable retention changes with various braid prep lengths on a conventional connector.

A poorly adjusted crimp tool also will reduce the connector retention of the cable. Contrary to popular belief, crimp tools are not hammers or pliers. Check to see you have the right tools for the connectors you are using, and make sure they are properly adjusted. Figure 4 shows the impact of crimp tools that were out of adjustment by 0.010 and 0.012 inch.

Figure 5: Cable sample set vertically in free flowing red ink for 10 minutes



The F-connector interface

The F-connector provides an electrical and mechanical connection between a device (such as a tap or splitter) and a transmission line (in this case a drop cable). Failure of the interface then will be either electrical or mechanical. F-connectors seldom fail mechanically, but the interface does corrode and break down electrically. For the most part, conventional F-connectors have been put into environments they were not designed for. Corrosion is the number one cause of electrical failure of the interface.

The F-interface is a sensitive, high frequency electronic connection. Some studies indicate that an unsealed interface exposed to corrosion will fail in as little as six weeks. In contrast, a tight and dry interface will last many years without a problem.

Electrically, the interface must maintain a nominal 75 Ω impedance in order to assure good power transfer. Low contact resistance must be maintained between the cable center conductor and the F-port terminal contacts to assure signal quality. For good shielding, low contact resistance must also be maintained between the fitting and the outer conductor (foil and braid) of the cable and between the fitting and the equipment port.

Environmentally, the interface must remain completely dry while maintaining its electrical and mechanical properties in all climates and environments.

Table 1

	1980	1990
Typical bandwidth	270 MHz	450 MHz
Typical TV set	19-inch	25-inch+
Number of outlets	One	Multiple
CLI requirements	Not really	Yes
Competition	Little/none	Videos, MMDS, DBS

The three components that make up the typical F-interface are: the device (tap, splitter, etc.), the transmission line (drop cable) and the connector interface (F-fitting).

• *The device:* Today's quality products are seldom the cause of moisture contamination of the interface and will not be covered here.

• *The transmission line:* Other than a nick or cut, there is little chance of moisture entering through the cable jacket. But once moisture reaches the braid, the capillary action of the wires will allow the moisture to travel rapidly throughout the cable (see Figure 5). Aluminum creates a layer of aluminum oxide to protect the underlying aluminum. When aluminum comes in contact with moisture the oxide layer deepens (like rust on steel). Braid wires are only 0.0063 inch in diameter. If from contact with moisture, the braid develops an oxide layer just 0.003-inch thick around the wire, the braid is gone. It has become aluminum oxide, a nonconductive white powder. A 0.0027-inch thick foil tape and a group of 0.0063-inch diameter aluminum wires is all that stands between you, a service call, an unhappy customer and the FCC.

• *The F-connector:* This is considered the weak link in the interface. As illustrated in Figure 6, the conventional hex crimp F-connector leaks at the threads, coupling nut swivel joint and cable entry point. These locations are suceptible to moisture contamination resulting in certain failure of the interface. →

"It is obvious that from a cumulative signal leakage standpoint, the F-interface is a dominant problem."

Capital Gain

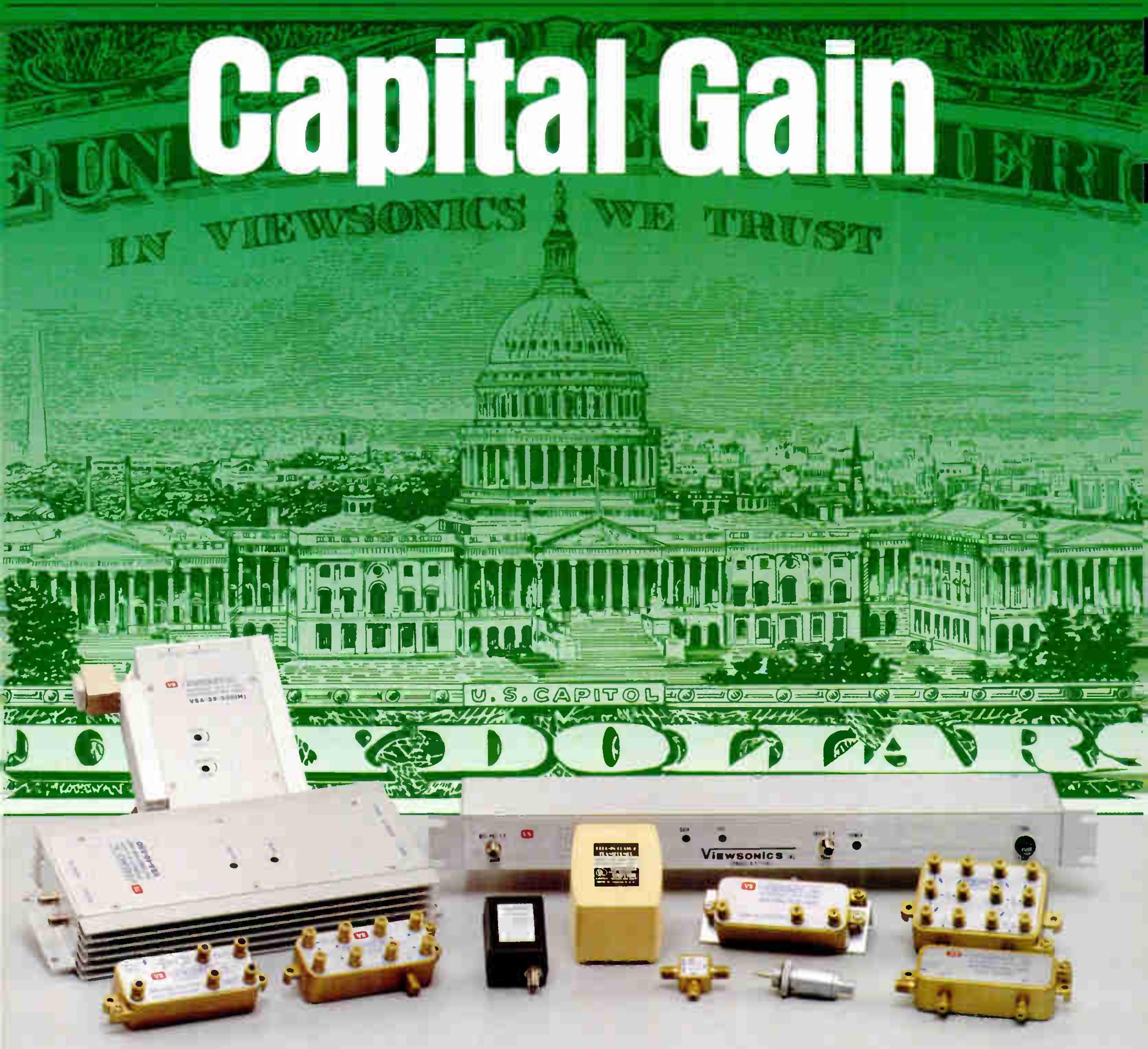


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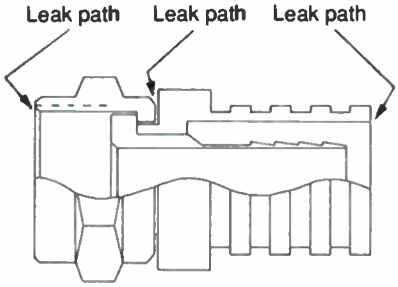
Figure 6: Conventional F-fitting



Encapsulants

There are numerous devices designed to encapsulate the connection and keep moisture out of the interface. These devices work well when they are *properly* installed.

- *Heat shrinkable tubing:* Do not use too much heat when shrinking the tubing since this may damage the cable. Care must be taken not to nick or cut the cable jacket when removing the shrink.
- *Chemical shrink tubing:* Ensure that the shrink tubing is resistant to ozone and ultraviolet rays and will not deteriorate over time. Here too, care must be taken not to nick or cut the cable jacket when removing the shrink.
- *Boots and grease:* Spark plug boots also must be UV and ozone stable. Most common greases are safe and will not harm the components in the interface. Be sure the boot is full of grease. A spark plug boot without grease holds moisture in and creates a terrarium; it is worse than using no sealant.

If these sealing devices are not installed correctly you will be wasting time and money.

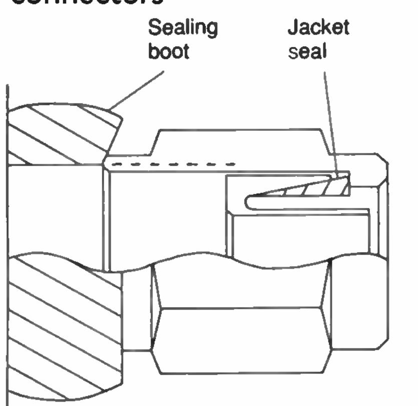
Table 2: Approximate attenuation (dB per 100 feet)

Cable type	RG-59 @300 MHz	RG-59 @450 MHz	RG-6 @300 MHz	RG-6 @450 MHz
Solid dielectric (max.)	5.8	7.0	4.8	5.8
Chemical blow foam (nom.)	4.6	5.8	3.8	4.6
Gas injected foam (nom.)	4.1	5.0	3.3	4.1

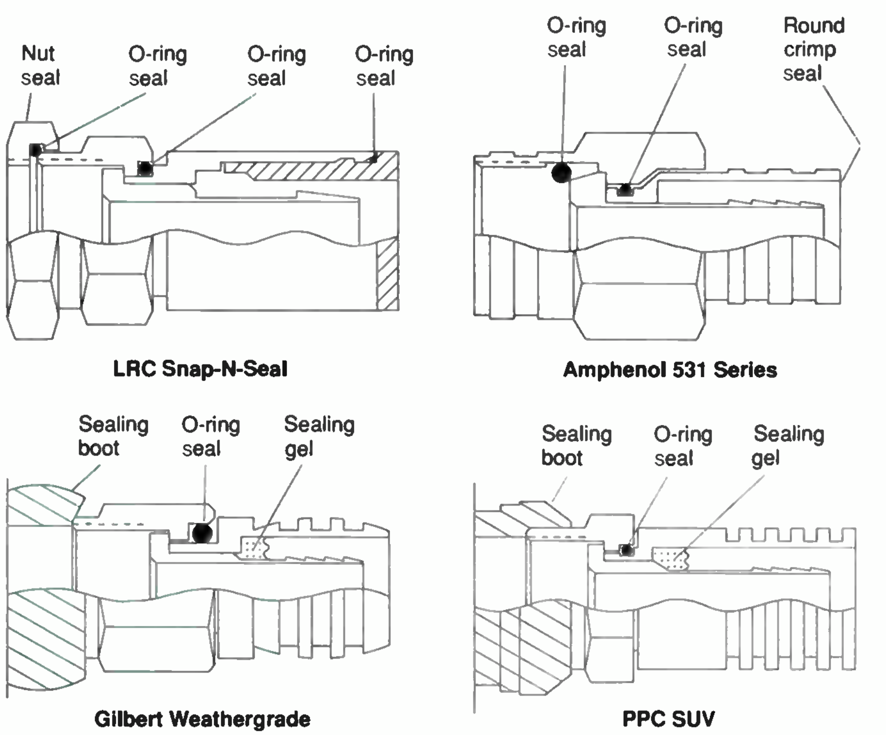
Premium connectors

The first 30 some years of F-connector development saw improvements in the convenience and mechanical performance of the connector, but virtually no development on the environmental performance of the interface. It only has been in the past seven or eight years that we have seen an emphasis on developing F-connectors that seal the interface as a function of connectorization. When properly assembled, these new connectors work very well to keep moisture out of the connection. Figure 7 is a look inside some of the more common sealed F-connectors.

Figure 7: Sealed F-connectors



Raychem EZ-F



As with the encapsulating devices, correct application and installation is essential for reliable performance. For example, sealing sleeves must have adequate length to protect the threads. If the sleeve is too short, it may not seal at the nut or can allow moisture to travel in the threads and into the interface. Braid wires left too long may also allow moisture to enter at the cable jacket and contaminate the interface.

The majority of the sealed connectors require cable preparation that is different and easier than the conventional hex crimp connector prep. All of them have cable prep tools available and may have unique installation or attachment tools.

The environmental seal of these encapsulants and sealed connectors is demonstrated in Figure 8. These samples were immersed in a mixture of free flowing ink with water and left at room temperature for up to 10 days.

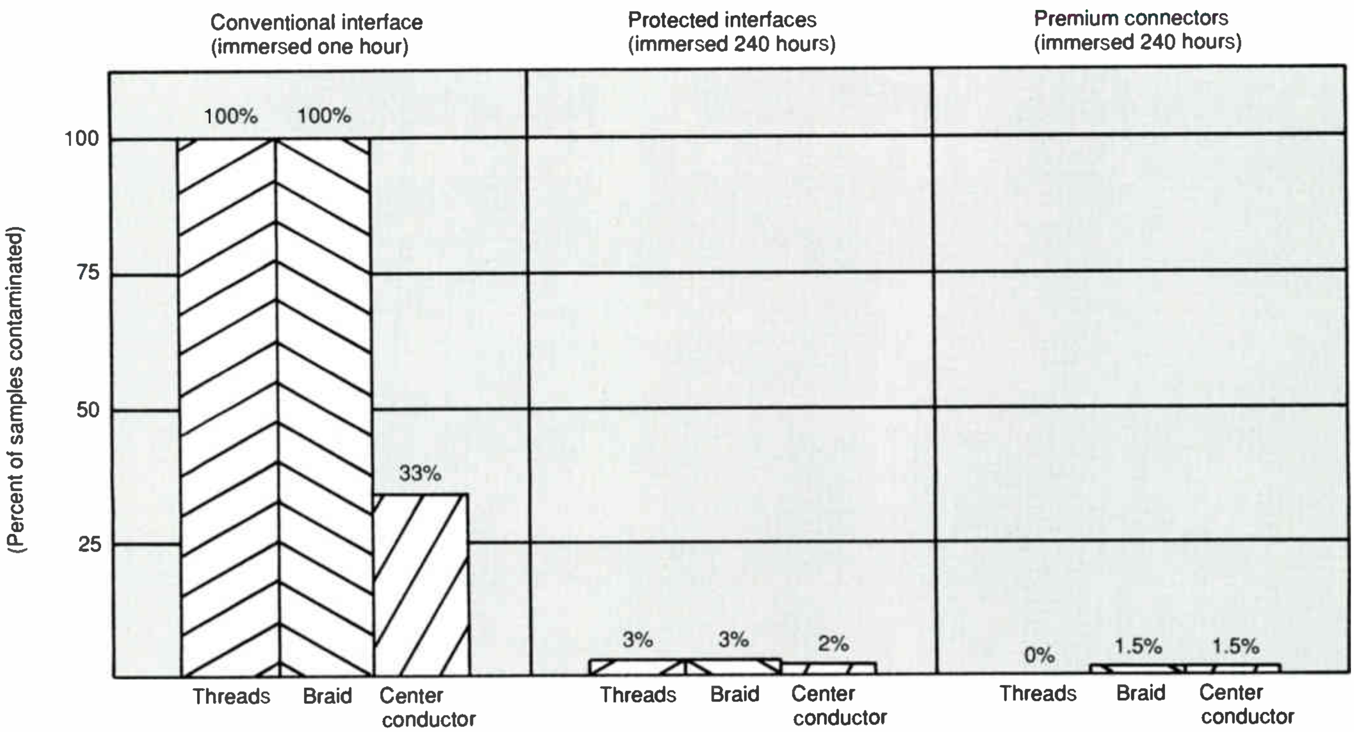
Connector selection also should take into consideration craft sensitivity. The term "craft sensitivity" means more than just attaching a connector, it now refers to the assembly of the entire interface. All of the sealing mechanisms and sealed connectors work great in presentations, demos and testing. Craft sensitivity comes into play in field applications.

1) How does the seal work when the auxiliary devices are improperly or not installed?

2) Will the interface be properly assembled in inclement weather or after the installer has had a rough night?

3) What happens when one of the

Figure 8: Environmental seal of encapsulants and sealed connectors



"The drop system is our lifeline to our customers. Improvements in quality and reliability of the drop can have significant impact on reducing service calls and increasing customer satisfaction."

extra parts drops to the bottom of the pole?

When choosing a drop system keep in mind the number of parts and pieces required to be inventoried, stocked and carried to assemble a reliable sealed interface.

The drop system is our lifeline to our customers. Improvements in quality and reliability of the drop can have significant impact on reducing service calls and increasing customer satisfaction. These new products may cost a little more initially, but are well worth the investment. Remember, we don't get paid for pretty pictures in the distribution system, we get paid for pretty pictures on TV sets. **CT**

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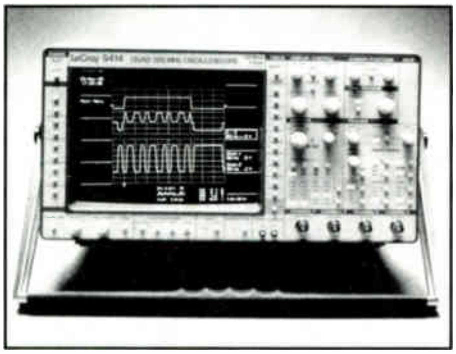


Oscilloscope

The Model 9414 digital oscilloscope was introduced by LeCroy. It offers quad-channel capture and analysis for signals up to 150 MHz in frequency and features ultra-fast signal processing. Each of the four channels uses high-resolution "flash" ADCs, which digitize single-shot events at rates up to 100 megasamples per second. Repetitive waveforms are digitized at 4 gigasamples per second.

The unit has 10K of memory per channel and according to the company, the instrument's long acquisition memories ensure excellent timing resolution to reveal the signal details on any time-base setting. Live, stored or process waveforms can be expanded up to 200 times for maximum timing resolution.

Reader service #139

Surge protection

Power Guard introduced its Power Clamp surge protection devices. The units are made for use with C-COR trunk amplifiers as well as Regal, Scientific-Atlanta, Magnavox, General Instrument, RMS and Antronix power inserters, couplers and splitters.

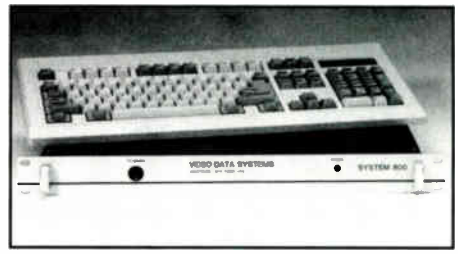
Reader service #138

Meter panel

Sachs Communications' SC51 meter panel connector provides a means of bonding the sheath of the cable TV drop cable to the metallic frame of a meter panel when alternative NEC bonding is inaccessible. Its design allows a fixed and positive mechanical contact without interfering with the opening of the meter panel front cover.

Applications include: underground installations where the #6 copper wire is inaccessible or the conduit is PVC; aerial installations where utility companies will not permit bonding to the mast or riser; and wherever alternate NEC bonding is inaccessible or cold water pipe has PVC in the system.

Reader service #137

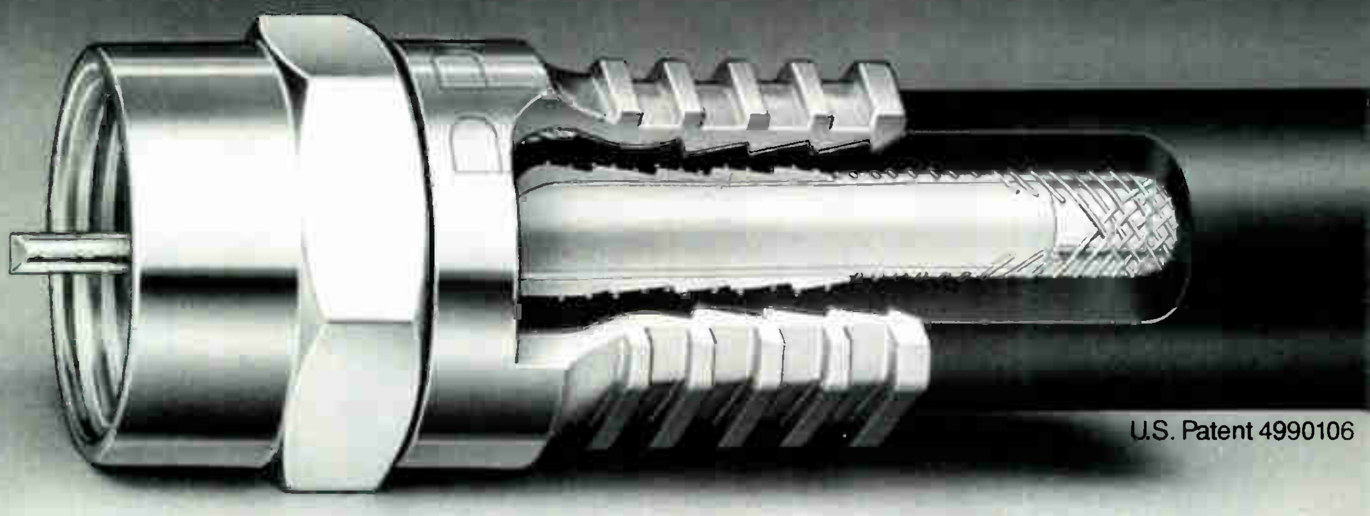


Downstream keyer

Video Data Systems announced its Model 800-CI compact downstream keyer with a 5,000-character battery backed-up memory. It provides a one-line message for applications such as promotion of pay TV, local news and advertising.

The system is rack-mountable and

THE NEW PPC SERIES OF UNIVERSAL "F" CONNECTORS



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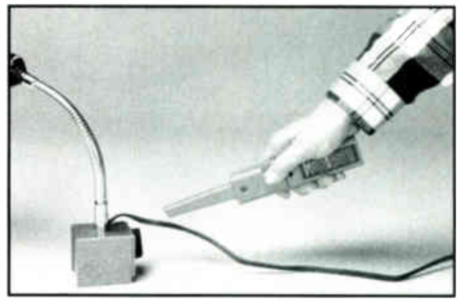
features two crawl speeds and queue format flexibility in the number of pages and their frequency. It includes a real-time clock and calendar line with battery backup and allows word flash and automatic deletion of time-tagged messages.
Reader service #136

Dehydrator

Environmental Technology announced its ADH-2COM rack-mounted air dehydrator with remote communications capability. It provides 0.5 psi dry air for pressurizing waveguide and coaxial cable. It displays important operating conditions (including six alarms) digitally and the alarm relay controls remote indicators and similar devices.

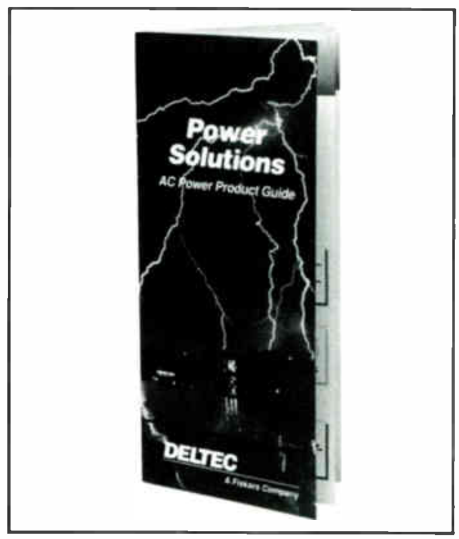
The unit operates from 120/220-240 VAC 50/60 Hz without derating. Options include outdoor and wall mounting. It features EIA RS-422 electrical interface with both full and half-duplex configurations available. The standard asynchronous protocol at baud rates 1,200 or 9,600 meet earth station requirements.
Reader service #134



Safety device

Direct Safety's new Volt Stick non-contact voltage tester has dual settings for low and high range. At low range, the product detects electrical current as low as 25 VAC. At high range, it ignores low-level current and responds only in the presence of 1,500 to 122,000 VAC.

Requiring no physical contact or connections with the power source, it operates on a single 9 V battery and indicates the presence of electrical current in the selected range visually (LED) and audibly (tick). The closer the tip of the detector comes to the source of voltage, the faster the device will tick until it sounds a continuous tone.
Reader service #135



Power booklet

Deltec is offering a free information booklet, *Power Solutions: AC Power Product Guide*. It explains power problems, their effects on computers and other sensitive equipment and how you can solve them. The guide also assists users in determining what size UPS they need and provides information on Deltec's complete line of power conditioners and UPSs.
Reader service #133

(Continued on page 101)

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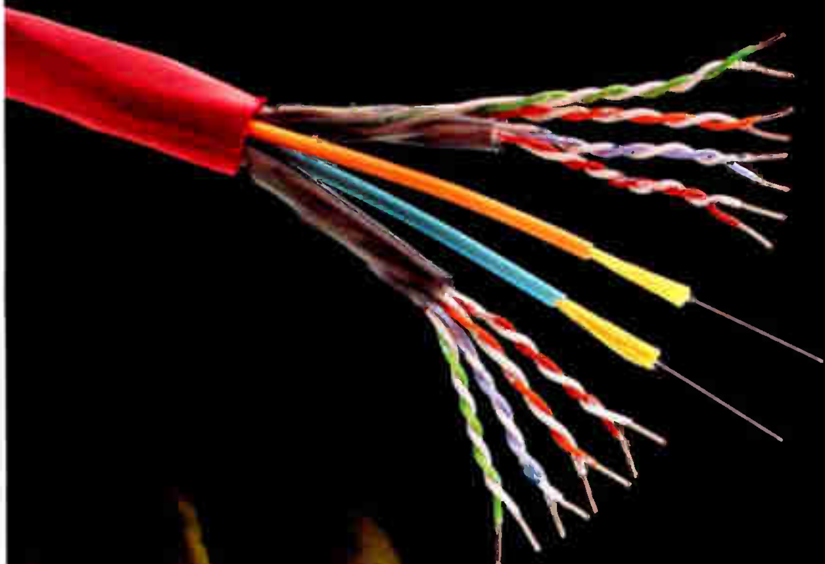

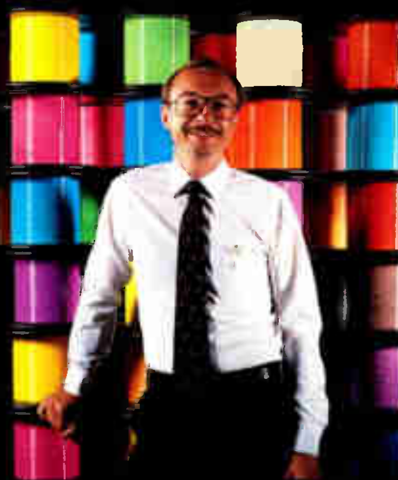

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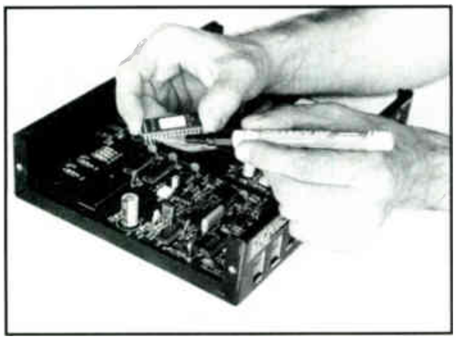
Product news

(Continued from page 96)

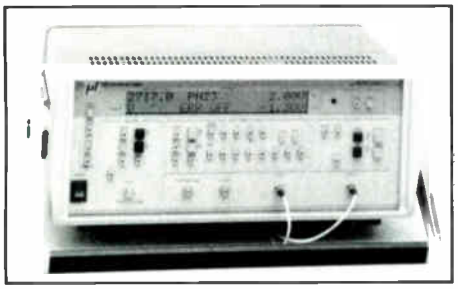


Applicator

The Cramolin DeOxidizer pen applicator is now available from Caig Laboratories. It is non-flammable, non-corrosive, non-toxic and ozone-safe. It provides convenient application of Cramolin DeOxidizer and includes two chisel head tips and one round head tip that are replaceable.

The DeOxidizer improves conductivity on connectors and contacts by dissolving resistive oxides from metal surfaces and provides protection from future oxidation. It is said to be effective on all metal surfaces.

Reader service #132



BERT set

Microwave Logic introduced its gigaBERT-2700 bit error rate test set. The transmitter and receiver operate with internal or external clock over the range of 10 MHz to 2,700 MHz. PRBS patterns of 2E7-1, 2E15-1, 2E17-1, 2E20-1, 2E23-1 and a 16-bit programmable WORD with 10 memory locations are provided.

An optional 64 kb programmable WORD allows user front panel or GPIB and RS-232C programming of standard or proprietary framing patterns. The transmitter has 10 memory positions for clock frequency storage and errors may be injected into the output data. Both data and clock amplitude and offset are adjustable. Front panel settings are controllable via GPIB and RS-232C.

Reader service #131

Editing software

Calaway Editing announced its E-E preview editing software for its CE series of videotape editing systems. It became standard on the company's CE-25, CE-75, CE-100, CE-150 and CE-200 products as of January. The software is said to provide greater convenience by eliminating the need for hookup of an external preview switcher for preview editing.

According to the company, the advantage to an editing system that previews through the record VTR's E-E circuitry is in the convenience of installing the edit system. The disadvantage is that E-E preview edits may not be clean nor framed accurately because of the electromechanical head switching involved in changing the VTR output from playback to E-E mode during the preview edit. The new software allows the operator to compensate for any inaccuracies caused by this head switching during a preview edit.

Reader service #130

LNB products

Three new C-band LNB products were introduced by California Amplifier. They are the professional C-band LNB, the commercial C-band LNB-high gain and the Slimline II C-band LNB.

The Professional is available in noise figures ranging from 30°K to 40°K with 65 dB of gain. It features double transient suppression for added surge protection, a gold-plated probe and a gold-plated F-connector. The Commercial is available in noise figures ranging from 35°K to 50°K with 65 dB of gain and features an LED and full-bandpass filtration. The Slimline is available in noise figures ranging from 30°K to 50°K with 62 dB of gain and features an LED.

Reader service #129

Fiber cable

Optical Cable is manufacturing a new product in its D-series product family, the S-type plenum fiber-optic cable containing from two to 12 fibers within one cable. The final jacket color standardizes on yellow, orange and gray to reflect fiber types of single-mode, 50/125 and 62.5/125 respectively. The company recommends the product for applications in building risers and air plenum areas requiring a small and very flexible product.

Reader service #127

Generator

Advantest's TR6142 programmable DC voltage/current generator is a power source for general use and automated inspection. The 160-step, nonvolatile memory allows for linear testing of active and passive components and calibration of measurement instruments.

Mechanical switching of the output has been eliminated by using time division D/A conversion. The unit is equipped with a GPIB interface as a standard and the K command of the product allows continuous variation of each digit of the output.

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Why are forty major MSO's across the country training their employees with the assistance of a revolutionary interactive video training system developed by Mind Extension Institute™ Inc.? Simple, because it works.

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Jeremy Jones • Installation Manager • Jones Intercable

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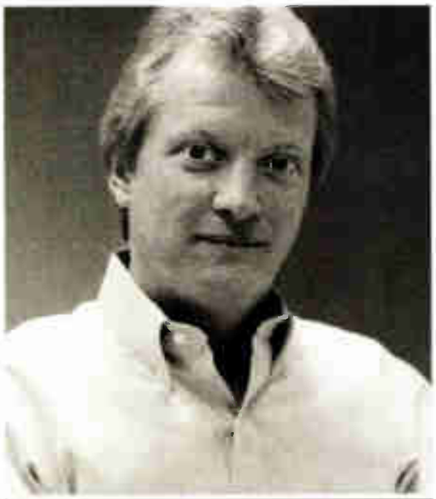
Jeremy has recently implemented **Installer Training**, part of our new technical training series which also includes **General Safety**. It's a two-part program that covers not only the "how" but the "why" of installation and safety. According to Jeremy:

"It's really thorough...it allows me to requalify my associates whenever I want. They can be re-tested at any time...there are going to be a lot fewer truck rolls, I can tell you that."



Frank Zaeringer • Regional Human Resources Director • United Artists Cable

CONSISTENT. EFFICIENT. THOROUGH.

United Artists Cable, Louisiana Region, has extensive experience with **Customer Service: Your Key to Success** and **Sales Through Service**, courses that cover customer relations and sales skills. Says United Artists' Frank Zaeringer:

"We feel that we simply can't afford not to put every new CSR we hire through these programs... they give them the important ideas and techniques they need to know to deal effectively with customers."

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The self-pacing, one-on-one nature of interactive video is a big advantage for United Artists.

"Whenever someone is slipping we'll use the interactive video to enhance their skills...as a refresher...No one's ever embarrassed by moving at their own pace...they find it fun...and they're not afraid to go back and refresh themselves."

Post-Newsweek's Mitch Bland sums it all up this way:

"These interactive training programs fill a void in training that can be frequently overlooked. The technical programs ensure that everyone gets consistent, solid background training. We even use the 'Customer Service' course as a screening tool for new hires. We believe these programs can't help but do well for us."

Mitch Bland • General Manager • Post-Newsweek Cable

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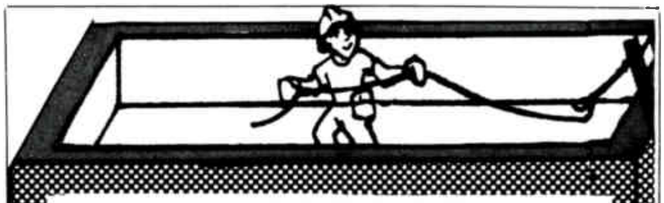

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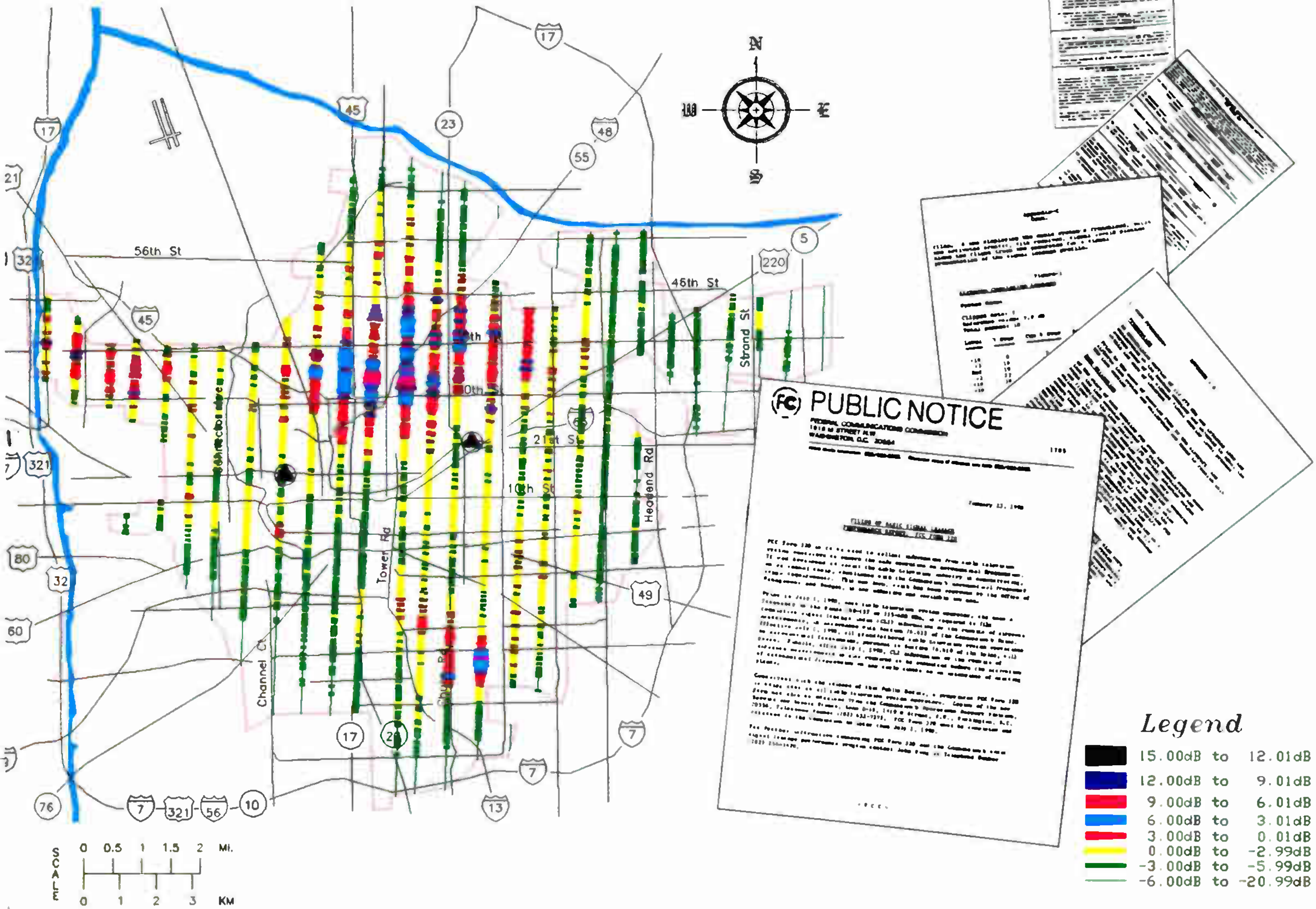

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☛ *Primer on CATV Signal Leakage — Methods of Managing and Controlling CATV RFI* — This publication is possibly the most complete study in print on signal leakage and CATV systems. It includes signal leakage programs established by some of the industry's leading engineers, understanding and correcting plant signal leakage and standards of good engineering practices for measurements on cable TV systems. This book should be a must for every cable system engineer, chief technician and system technical library. Order #TR-4. Member: $20, non-member: $45.

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☛ *Understanding Lightwave Transmission: Applications of Fiber Optics* by William Grant — An introduction to lightwave transmission systems and the equipment and optical fibers used in such systems. It also explains the characteristics of lightwaves and optical fibers themselves. This excellent book will give you the edge on this important technical area. Order #TR-6. Member: $37, non-member: $43.

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☛ *Secrets of Supervision — A Concise Guide to Good Management* — This National Safety Council publication is an excellent guide for supervisors at any level. It contains all of the basic rules and requirements of being an effective supervisor in simple, easy-to-understand language. Order #PD-1. Member: $4, non-member: $6.

☛ *Employee Management and Personnel Development* — An excellent publication for managers and supervisors. Includes information on good personnel and management practices, developing job descriptions, providing employee motivation, delegating authority, training programs and much more. Order #PD-2. Member: $15, non-member: $22.

To order: All orders must be prepaid. Shipping and handling costs are included in the continental United States. All prices are in U.S. dollars. SCTE accepts MasterCard and Visa. To qualify for SCTE member prices, a valid SCTE identification number is required, or a complete membership application with dues payment must accompany your order. Send orders to: SCTE, 669 Exton Commons, Exton, Pa. 19341 or FAX with credit card information to (215) 363-5898.

April

April 3-4: Scientific-Atlanta training seminar on subscriber systems, Atlanta. Contact Patti Kitchens, (404) 925-5103.

April 4: SCTE Upper Valley Meeting Group technical seminar on construction techniques (tentative), Holiday Inn, White River Junction, Vt. Contact Matthew Alldredge, (203) 328-0640.

April 7-8: SCTE Razorback Chapter technical seminar, Little Rock, Ark. Contact Jim Dickerson, (501) 777-4684.

April 9: SCTE Central Illinois Chapter technical seminar on headend maintenance. Contact John Heck, (309) 353-8777.

April 9: SCTE Chattahoochee Chapter testing session for BCT/E examinations. Contact John Williamson Jr., (404) 376-5259.

April 10: SCTE Great Plains Chapter testing session for BCT/E examinations. Contact Jennifer Hays, (402) 333-6484.

April 10: SCTE North Country Chapter technical seminar on BCT/E Category VI, Sheraton Midway, St. Paul, Minn. Contact Rich Henkemeyer, (612) 522-5200.

April 10-11: SCTE Dakota Territories Chapter technical seminars on CARS band microwave systems, Radisson Inn, Bismarck, N.D. (April 10) and Ramkota Inn, Pierre, S.D. (April 11). Contact Kent Binkerd, (605) 339-3339.

April 11: SCTE Chattahoochee Chapter technical seminar on AML. Contact John Williamson Jr., (404) 376-5259

April 13: SCTE Boulder Dam Meeting Group technical seminar. Contact Brian Nebeker, (702) 384-8084.

April 14: SCTE Old Dominion Chapter testing session on all BCT/E and installer categories, Williamsburg, Va., (to be held in conjunction with Virginia CTA Show). Contact Margaret Davison-Harvey, (703) 248-3400.

April 16: SCTE Florida Chapter, Central Florida Meeting Area technical seminar, Lakeland, Fla. Contact Keith Kreager, (407) 844-7227.

April 16: SCTE Greater Chicago Chapter testing session. Contact Bill Whicher, (708) 438-4423.

April 17: SCTE Golden Gate Chapter technical seminar on CLI. Contact Mark Harrigan, (415) 785-6077.

April 17: SCTE North Central Texas Chapter technical seminar on back to basics. Contact Terry Blackwell, (214) 578-7573.

April 17: SCTE Palmetto Chapter technical seminar, Columbia, S.C. Contact Melanie Burbank-Shofner, (803) 777-0281.

Planning ahead

June 13-16: SCTE Cable-Tec Expo, Convention Center and Bally's Hotel, Reno, Nev. Contact (215) 363-6888.

August 25-27: Eastern Show, Inforum Exhibit Hall, Atlanta. Contact Nancy Horne, (404) 255-1608.

Sept. 24-26: Great Lakes Cable Expo, Cobolt Hall, Detroit. Contact (517) 484-4954.

Keeping Society chapters strong

By Wendell Woody
President, Society of Cable Television Engineers

Certainly we have many national SCTE members who are not members of a chapter/meeting group and have never attended a local meeting, unless it was held in conjunction with a state/regional show. However, the fact remains: The activities at the local level are the core strength of the Society and the initiative for continued growth and fulfillment as the professional engineering society for our industry.

With 62 chapters/meeting groups now and still growing, we have had only about six groups that failed or reorganized. Generally, the inspired inaugural leaders of a group will see it through until reaching chapter status. It becomes paramount that each chapter is so structured that it remains strong year after year. There are three key elements to that: leadership, membership and training.

Chapter leadership

Within every group you will find a "spark plug," someone always willing to make sure the job gets done and his group succeeds. God bless those people; it is their initiative that makes a voluntary organization happen.

The next step is to spread this enthusiasm to others in the group and develop a team leadership. If not, such monarchy-style leadership will evolve from a successful beginning to a choking and stymieing status over time. It is always advantageous, however, to have the "spark plugs" remain on the sideline as supporting observers while new developing leaders reign.

The chapter officer structure I prefer is a president, first vice president (in charge of training), second vice president (in charge of membership), secretary and treasurer. The secretary and treasurer may be combined into one office if the logistics deem it so. I like to see the officers elected to the specific job and not advance through the chairs. A good secretary or treasurer might never be a good vice president and vice versa. Again, a key person might be able to spend one very devoted year as vice president or president, but couldn't commit to a long period of time up through the chairs. Stay flexible and make use of your very best people.

Establish a board of directors to govern and direct your chapter, consisting of all officers, a chairman (who generally would be your past president) and a few extra members as directors. These directors may be the pool of candidates when selecting new officers or have key skills that make them excellent supportive leaders for your group but never serve as officers. Strive to have a good balance of industry representatives for your board — large system and independent operators, contractors, manufacturers, suppliers and consultants. A good mix has always demonstrated the strongest chapter success.

Chapter membership

Sharing information and technical training is the major charter of the Society. However, at the local level I equate the same amount of importance to the vice president of membership and his duties and responsibilities as I do the vice president of training. Without a good membership base and strong attendance for all local events, the best of training will soon degenerate to something similar to mere tech-talk or a sales pitch session.

Therefore, it is most significant to dedicate this importance to membership maintenance and growth. In general, the office of vice president of membership is best served by a contractor, manufacturer, supplier or consultant who is acquainted with all cable people in the area. Often he has contacts or sees these people in his regular line of work and has an excellent opportunity to promote local membership and meeting attendance.

The vice president of membership also can expand his abilities by appointing a committee that he chairs. This committee should consist of a good mix of operator- and vendor-related chapter members. It is always a positive to involve the maximum number of people in the infrastructure of your chapter leadership.

The membership committee develops various programs for seeking new members, increasing national membership and getting all members to each chapter meeting. Sometimes this committee establishes a telephone subcommittee or functions as one itself. They divide up the membership roster and contact each member as to the next meeting or BCT/E testing event. The chapters implementing this procedure find the results very significant — just another way to keep chapters strong!

Chapter training

Training is the motherhood of our Society. It deserves the assignment of a vice president. Here again this person should appoint a committee to amplify the capabilities of chapter training. This group should plan and initiate all training programs as well as every supporting detail and function. This committee may subdivide the duties or appoint subcommittees to plan the program, arrange for instructors/speakers, establish the meeting location/facility, arrange for A/V equipment and room setup, arrange breaks and meals, prepare meeting announcements/mailings, advise SCTE's national office so the meeting will be publicized, and all other details that make for an excellent training meeting.

I encourage you to develop diversified training programs. First, schedule only about half of your training time to the support of BCT/E test training and the other half to subjects of high interest to all your membership. Next, don't always seek big-name out-of-town speakers for every meeting. Instead, use chapter members or a guest from a neighboring chapter when they are qualified.

Also strive to divide an all-day event into a variety of segments. Your main subject may last all day or you may have two half-day subjects. Meanwhile, always establish some 15-, 20- or 30-minute spots for selected mini-speakers. Reserve these for chapter members only. The variety keeps your program interesting and provides excellent speaking experience for the personal growth of your participating members, a way to keep your chapter strong. **CT**

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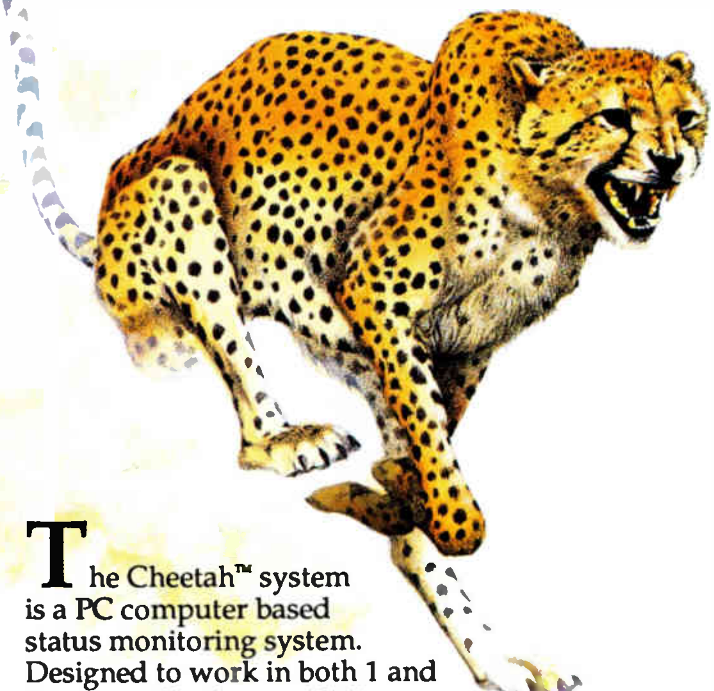

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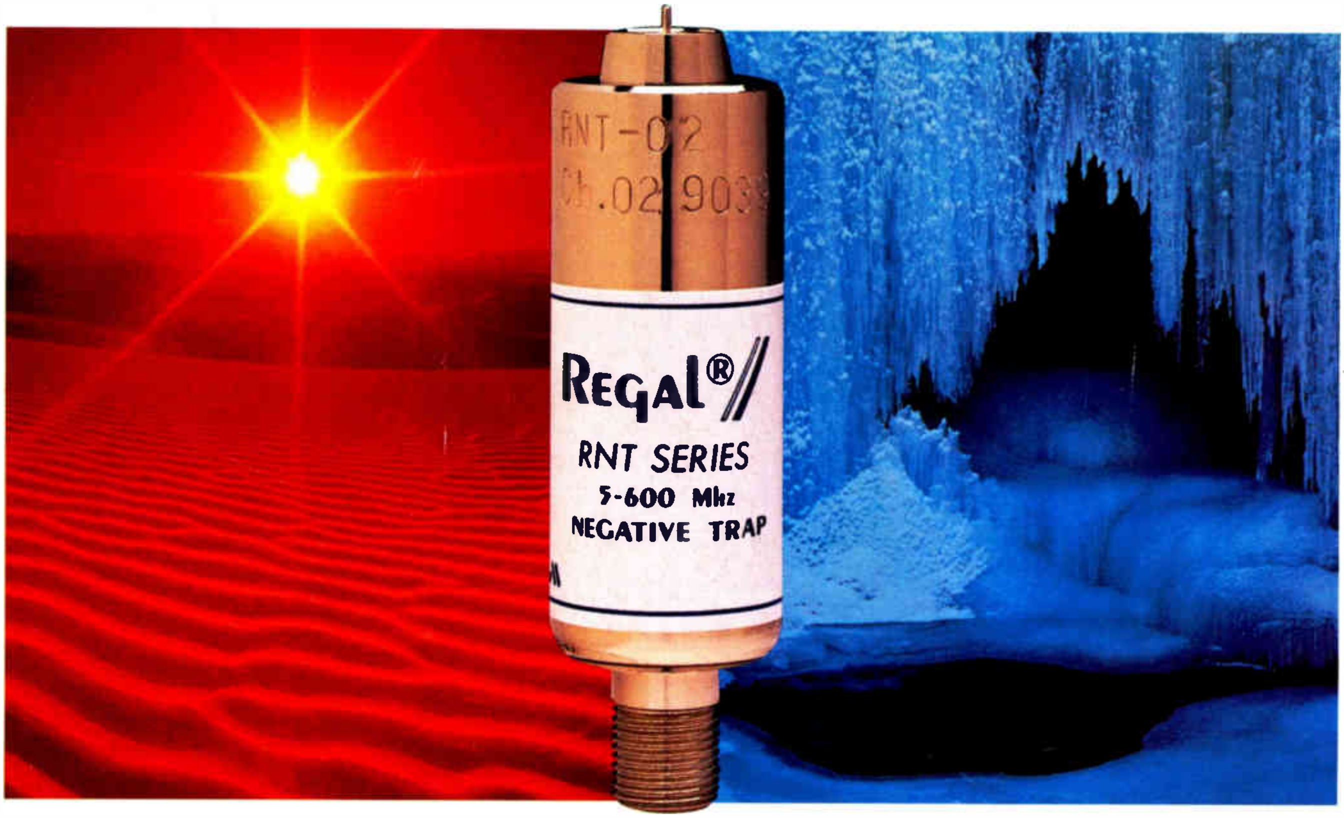

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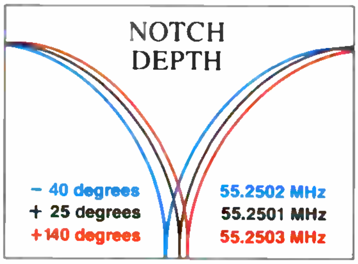

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