November 1988

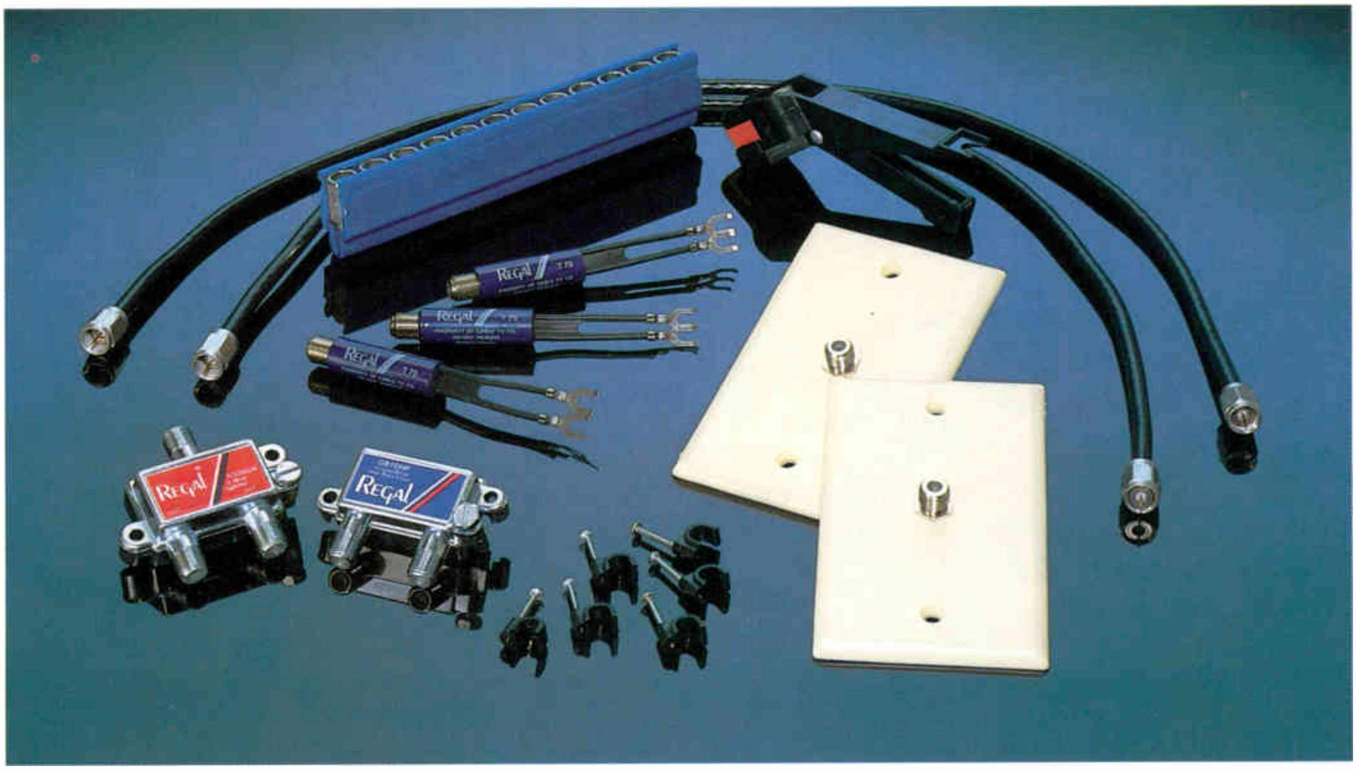
IT INSTALLER TECHNICIAN

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

Spotlight on subscriber drops

From Raychem's EZF Connector to Regal's Passives...

Hook up a new subscriber today...



...with ANIXTER's top quality products.

ANIXTER®
CABLE TV

"LIGHTING THE WAY TO THE FUTURE"

Call us — We'll ship today!

WEST-ANAHEIM: (714) 779-0500, (800) 854-0443; **ANCHORAGE:** (907) 274-8525; **DENVER:** (303) 373-9200, (800) 841-1531; **SEATTLE:** (206) 251-6760, (800) 426-7665; **MIDWEST-CHICAGO:** (312) 364-7000, (800) 544-5368; **DALLAS:** (214) 446-7337, (800) 231-5006; **IRON MOUNTAIN, MI:** (906) 774-4111, (800) 624-8358; **SKOKIE, IL HDQTRS:** (312) 677-2600; **EAST-ATLANTA:** (404) 449-6533, (800) 241-5790; **EAST FARMINGDALE, NY:** (516) 293-7788, (800) 645-9510; **NEW JERSEY:** (201) 328-0980, (800) 631-9603; **TAMPA:** (813) 626-7115, (800) 237-6466; **CANADA-CALGARY:** (403) 250-9646; **MONTREAL:** (514) 636-3636; **TORONTO:** (416) 625-5110; **VANCOUVER:** (604) 321-5885.

In an emergency, weekends and holidays or after 5 P.M. call toll free 1-(800) 323-8167.
CORPORATE OFFICES, ANIXTER BROS., INC., 4711 Golf Road, Skokie, IL 60076, (312) 677-2600

Reader Service Number 1.

Total service for the cable industry.

Number One in Addressable Repair

BradPTS repairs/remanufactures all Jerrold, Oak and Zenith addressable converters. Plus, BradPTS is the only company that is factory authorized by Oak for pay and addressable repair. Systems in every state of the union rely on BradPTS for quality repair and fast turnaround.

Line Gear Repair

BradPTS has pioneered complete remanufacturing service of extenders, bridgers, amplifiers, power supplies, motherboards and modules. Fast quality service—from the leader—BradPTS.

Headend Repair Service

BradPTS provides the same quality repair service for signal processors, modulators, satellite receivers, standby power supplies, field strength meters, SLM's and security panels.

In-Stock Inventory of Converters, Amps and Parts

Immediate shipment. Call BradPTS for new Jerrold converters or all makes and models of quality remanufactured converters. Plus, BradPTS stocks distribution equipment and the world's largest inventory of cable converter and amp parts.

Quality People

BradPTS technicians are factory trained and backed by a full service engineering department. Customer service reps are knowledgeable and courteous. Every person at BradPTS is committed to quality. Quality workmanship. Quality service.

BradPTS™

Call the BradPTS customer service hotline today at 1-800-382-2723. In NY call 518-382-8000.

BradPTS Corporate Office:
Bloomington, IN
1-800-441-1334

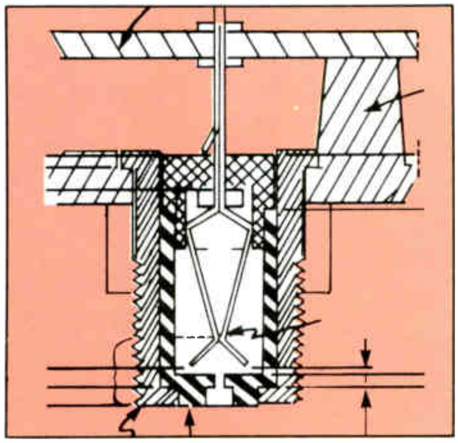
BradPTS General Office:
Schenectady, NY
1-800-382-2723

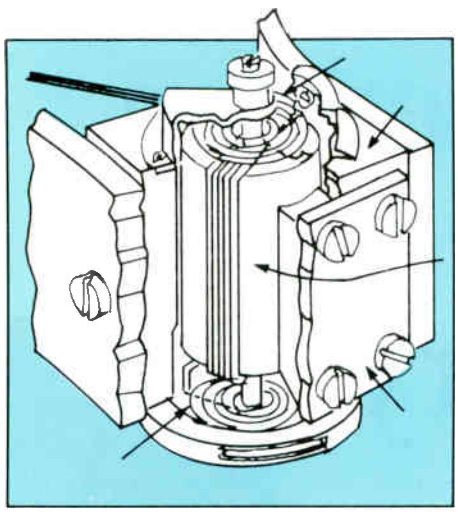
Arvada, CO • Bloomington, IN
Cherokee, NC • Fenton, MI
Fife, WA • Jupiter, FL
Longview, TX • Pittsburgh, PA
Schenectady, NY • Tampa, FL
Ventura, CA • West Columbia, SC

See us at the Western Show, Booth 342. Reader Service Number 2.

Contents

Departments

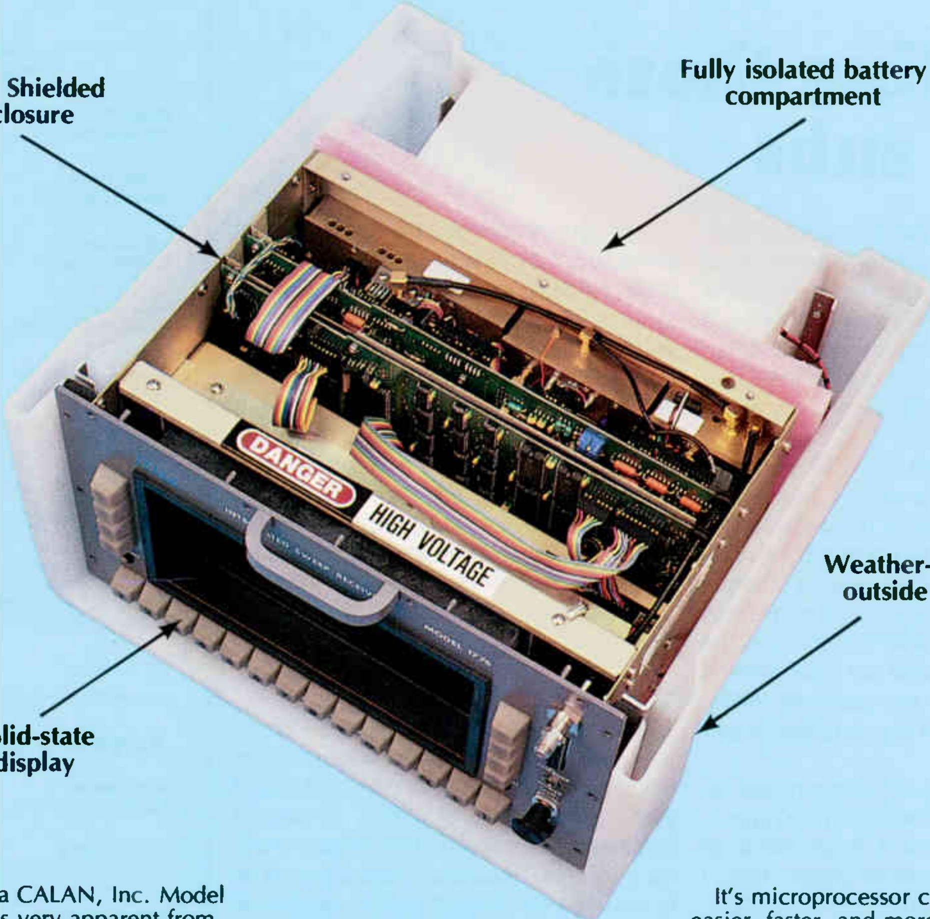




Features

Installer/Technician (ISSN 104-1253) is published monthly by Communications Technology Publications Corp., 12200 E. Briarwood Ave., Suite 250, Englewood, Colo. 80112—or—P.O. Box 3208, Englewood, Colo. 80155, (303) 792-0023. November 1988, Volume, 1, Number 7. Office of publication is 12200 E. Briarwood Ave., Suite 250, Englewood, Colo. 80112. Change of address notices should be sent promptly; provide old (or copied) mailing label as well as new address, including ZIP code; allow 6 to 8 weeks for change. Second-class postage paid at Englewood, Colo., and additional mailing offices. POSTMASTER: Please send address changes to *Installer/Technician*, Box 3208, Englewood, Colo. 80155.

The Inside Story on Reliability



Reliability built into a CALAN, Inc. Model 1776 Sweep Receiver is very apparent from the outside: the totally weather-sealed case; the ruggedized overall construction; the moisture-sealed key covers on the front panel.

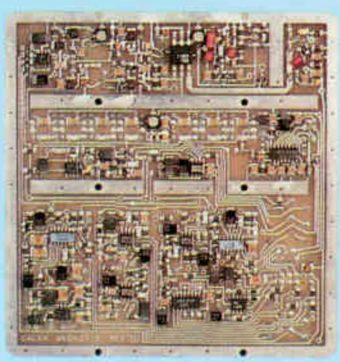
But what really makes this unique equipment reliable is on the ***inside***.

It's high-reliability components throughout the design, allowing incredible stability over temperature and humidity extremes.

It's complete RF shielding, allowing extended dynamic range for precise tests like Composite Triple Beat.

It's a solid-state Electro-Luminescent display, replacing the outdated CRTs.

It's new Surface-Mount RF Technology, making critical RF boards more reliable and more accurate than ever possible before. And a battery compartment that is totally isolated from the electronics, for absolute protection of the unit.



CALAN Surface-Mount RF Technology

It's microprocessor control, making testing easier, faster, and more accurate.

But all of these careful design criteria would be useless without the 75 years of CALAN engineering experience that went into the unit, making it the most reliable test equipment available today.

But if you ask a CALAN user, he'll most likely tell you that he hasn't seen the inside of his unit...just the outside, improving his system performance with no interference, and allowing more with his limited maintenance budget.

Maybe that's the **real** inside story.

CALAN

CABLE AND LOCAL AREA NETWORKS

See us at the Western Show, Booths 710 & 712.

CALAN, Inc., R.R. 1, Box 86T, Dingmans Ferry, PA 18328 • (717) 828-2356

Reader Service Number 3.

From the Editor

Handling those pesky subs

For months the staff at *Installer/Technician* has been hammering away at the theme of customer service—how to handle those pesky subscribers who are the bane of the installers' and technicians' existence. Just take a look at some of the angry letters that come across my desk every day:

A service tech from Des Moines, Iowa, had a major gripe. He wrote, "Some customer had been calling us for two days because not only was his picture quality poor, but the guy's VCR wouldn't clearly record what he had programmed. He had the gall to demand that the situation be fixed immediately—what am I, Superman?—and he didn't pull any punches telling us what he thought of our company or personnel."

In another letter, an anonymous installer (from the Northeast, I think) enumerated his pet peeves. It reads like a list from the David Letterman show: "I don't like subs who: 1) gripe about their bad picture, 2) think I should do the hookup right the first time, 3) want to add a premium service when I get there, 4) expect me to be at their house when the CSR told them I'd be there, 5) want me to hook up a VCR while I'm there, 6) won't let me park in their driveway, 7) comment upon my appearance, 8) complain about my smoking, 9) ask me stupid technical questions while I'm trying to work and 10) fret about where I drill."

Finally, we received a post card from a tech from Southern California: "You guys think poor customer service is a big problem? I think not. Why worry—our subs can't possibly get all of those channels anywhere else but with us. Why should we care when we're the only game in town?"

Well, maybe you're right. Maybe we shouldn't have made customer service such a hot topic. After all, I hear some of you saying that customers are just a nuisance you have to put up with. You do your job, put in your required hours and get paid. Being courteous, having a pleasant appearance and working in a professional manner doesn't exactly mean more money in your pocket.

No, you're wrong. The reality is that these subs do pay your salary—and more. If the system provides poor quality pictures and if you practice bad customer service habits, maybe there won't be many homes with cable *to* service. So, the cable operator (your boss) won't need many technicians or installers (you). On the other hand, having high quality pictures cuts down on service calls. It often increases new installs, which means more money for the system and more jobs for techs and installers.

Somehow, I just knew *IT* was on the right track.

Taking the first step

Don't you wish making a good F fitting was easier, what with all the various types of connectors and cable you face daily? Well, the Society of Cable Television Engineers is looking into the situation with its Interface Practices Committee. The committee will attempt to standardize the basic requirements for drop cable and aluminum cable interfaces, as well as testing and evaluation procedures. This is only the first step in what will eventually change for the better the way we do the most common but most important part of our business.

If you can make it, please attend the next meeting of the committee, to be held at the Hilton Hotel in Anaheim, Calif., on Dec. 6 (the day before the Western Show). The subcommittees will meet at 1 p.m. and the committee will meet at 2:30 p.m. For more information or to participate, contact Tom Elliot at TCI, (303) 721-5349, or Joe Lemaire at Raychem, (415) 361-5792.

Happy Thanksgiving!

Toni I. Barnett

IT INSTALLER TECHNICIAN

Paul R. Levine
President/Publisher

Robert C. Stuehrk
Associate Publisher

Toni I. Barnett
Vice President of Editorial

Lu Ann Curtis
Account Executive

Wayne H. Lasley
Editor in Chief

Neil Anderson
Account Executive

Rikki T. Lee
Managing Editor

Maria Sullivan
Production Coordinator

Shelley Bolin
Editorial Assistant

Carroll A. Barnes
Production Assistant

Sharon F. Lasley
Art Director

Kenny Edwards
Controller

Brad Hamilton
Assistant Art Director

Geneva Hobza
Assistant to the Publisher

Mary L. Sharkey
Circulation/Data Manager

Office: Communications Technology Publications Corp., 12200 E. Briarwood Ave., Suite 250, Englewood, Colo. 80112, (303) 792-0023. **Mailing Address:** P.O. Box 3208, Englewood, Colo. 80155.

"IT'S SO EASY TO INSTALL EVEN I CAN DO IT..."

Leonard DeRenzo, Director of Sales

And if you know Len you know that LRC has done the impossible, developed an easy-to-install connector with LRC quality components. LRC introduces Snap-N-Seal™, the revolutionary new "F" connector designed and produced exclusively by LRC.

Snap-N-Seal™ simply snaps on instead of having to be crimped. All that's required is our convenient tools for cable preparation and connector installation. And only Snap-N-Seal™ can claim:

- our 360 degree compression on the cable jacket ensures a complete radial seal, virtually eliminating RF leakage
- a triple seal for maximum environmental protection
- longer dependable service life with reduced maintenance

Snap-N-Seal™. It's easy, effective, and exclusively LRC.

For more information, call us at 607-739-3844, or write to Augat Communications Group, LRC Electronics, P.O. Box 111, Horseheads, NY 14845.

THE SEALED "F" CONNECTOR THAT'S EXCLUSIVELY LRC

Snap-N-Seal is a trademark of AUGAT/LRC Electronics.

MELCO
LRC
FIBEROPTICS
BROADBAND
AUGAT
AUGAT COMMUNICATIONS GROUP

WE'RE AUGAT COMMUNICATIONS GROUP. WE TIE IT ALL TOGETHER. WITH EASE.

See us at the Western Show, Booth 515.
Reader Service Number 4

News

SCTE strives to standardize the interface

EXTON, Pa.—The Society of Cable Television Engineers recently formed the Interface Practices Committee to try to standardize the basic requirements for drop and aluminum cable interfaces and testing and evaluation procedures. Its goal is to optimize the electrical, mechanical and environmental performance of the CATV cable to equipment interface.

This group is designed as an open forum to encourage communication between the various component manufacturers, between manufacturers and end users and to promote the use of quality products and procedures. It will be studying all components as they relate to the interface rather than individual parts.

The first meeting of the Interface Practices Committee was held at the SCTE Cable-Tec Expo '88 in San Francisco and was attended by cable, connector and equipment manufacturers, MSOs, consultants and engineers. At this meeting, the basic direction of the committee was identified and officers were elected: Tom Elliot of Tele-Communications Inc. is chairman and Joe Lemaire of Raychem is secretary.

The second meeting was held at the Atlantic Cable Show in Atlantic City, N.J. This meeting initially formed three subcommittees: the Aluminum Cable Interface (5/8-inch and 1-inch ports), chaired by George Bollinger of Comm/Scope; the Drop Cable Interface (3/8-inch port), chaired by Bill Down of Gilbert Engineering; and Interface Testing Procedures, chaired by Barry Smith of Tele-Communications Inc. The group decided to focus on recommended minimum mechanical, electrical and environmental performance along with recommended test and measurement procedures and practices. Ways to increase the purchase of compatible parts and tools and simplify the component purchasing process also were discussed.

The Aluminum Cable Interface Subcommittee will define and standardize cable prep dimensions and prep tool performance requirements, minimum and maximum connector grip forces; standardize the effectiveness of the O-ring interface; and recommend electrical and environmental requirements. A timely issue will be the 1-inch interface direction.

The Drop Cable Interface Subcommittee will define and standardize the cable and fitting interfaces and recommend dimensional tolerances and performance requirements, thread quality and shape of male and female sides of the interface, minimum terminal contact gripping force and minimum environmental performance.

The Interface Testing Procedures Subcommittee will define and standardize many of the currently used test procedures for electrical and mechanical performance, along with developing recommended procedures and performance requirements for examining drop system and trunk/distribution interfaces.

The next meeting of the Interface Practices Committee will be held during the Western Cable Show in Anaheim, Calif., Dec. 6.

Siecor cable beats the heat

MUNCIE, Ind.—Siecor cable used in a statewide university network survived a fire at Ball State University here and kept communications alive during and after the blaze. The fire, presumed to have started in the duct work for power and telephone cables in the administration building, resulted in over $2 million in damages.

Service on the armored four-fiber section of Siecor loose tube cable never lost communications transmission, while its copper counterpart running within the duct was destroyed. Only a 35-foot section of the Siecor cable was replaced because of its charred sheath.

Installer Certification workshop to be aired

On Nov. 29, the Society of Cable Television Engineers (SCTE) will present a technical program focusing on its new Installer Certification Program on its Satellite Tele-Seminar Program. This workshop, which was videotaped at Cable-Tec Expo '88 held June 16-19 in San Francisco, marked the official unveiling of the Society's new level of professional certification geared towards cable installers.

This video workshop, featuring SCTE Director of Chapter Development and Training Ralph Haimowitz, provides an overview of the program and presents the main topics that candidates for certification in this program will be tested on.

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

The Installer Certification Program was created to establish a standardized level of both technical and practical expertise for drop installations through a program that will be endorsed by both cable operators and contractors. This workshop is being aired in hopes of informing our industry's installers of the program and inspiring them to participate in this valuable educational undertaking.

Through the Satellite Tele-Seminar Program, SCTE provides uplinked videotape programs on technical training each month, making them available to cable systems across the country for downlink recording. Tele-Seminar programs may be received by any cable system and recorded for immediate and future employee training purposes.

Tele-Seminar programs scheduled for the next three months also will feature workshops from Cable-Tec Expo '88. These three programs are review sessions for the Society's Broadband Communications Technician/Engineer (BCT/E) Certification Program, but each of these workshops will be of interest to the industry's technical personnel. Category III, Transportation Systems, will be the focus of the Dec. 27 program, which features Dr. Tom Straus of Hughes Microwave. The program scheduled for Jan. 31 deals with Category V, Data Networking and Architecture, and features Al Kuolas of American Cablesystems. William Cohn and Mike Long of Zenith Electronics Corp. will present a program on Category VI, Terminal Devices, on Feb. 28. All programs will air from 12 noon to 1 p.m. ET on Transponder 7 of Satcom F3R.

"Technology for technicians" update

Following the warm reception that greeted the first SCTE "Technology for technicians" three-day seminar, held Sept. 12-14 in Dallas, the Society is conducting the second in the series Nov. 14-16 in Charlotte, N.C.

At press time, preregistration for the event (which will be conducted by Ralph Haimowitz at Charlotte's Luxbury Hotel) indicated another successful seminar that would further the Society's goals of a well-educated, well-trained technical community. This seminar was designed for installer/technicians, service technicians and their field supervisors, combining comprehensive technical theory with actual hands-on training presented in a laboratory environment.

"Technology for technicians" covers such important topics as customer relations, installation materials, standard housedrop procedures, customer education, safety, cable and connectors, the service connection and testing and troubleshooting. Topics to be covered in the hands-on lab include cable preparation, proper fitting installation, signal level meters, volt ohmmeters and testing for signal leakage.

If you want information on future presentations of "Technology for technicians" or would like to see it presented in your area, please write to SCTE at 669 Exton Commons, Exton, Pa. 19341.

Please watch future editions of "You and the SCTE" for details on upcoming seminars.

Health and safety

Ralph Haimowitz recently represented SCTE at the National Safety Council's 1988 Convention in Orlando, Fla. The cable television industry will benefit greatly from his presence at the convention, as he gathered information for the upcoming revised edition of the Society's Health and Safety Manual. This manual has long been regarded as a vital resource on health regulations and recommended safety practices for use by systems throughout the country.

A noted authority on safety in the field, Haimowitz will be utilizing the information gathered at the convention to make certain that the revised manual is in accordance with current health and safety regulations as they apply to the industry. Haimowitz also used his time at the convention to procure video programs on safety topics for future airing as Satellite Tele-Seminar Programs. Watch future editions of SCTE's monthly newsletter, *The Interval*, for information on tele-seminars on health and safety.

SCTE Chapters and Meeting Groups

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

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

Appalachian Mid-Atlantic Chapter
Contact: Ron Mountain, (717) 684-2878
Cactus Chapter
Contact: Harold Mackey, (602) 866-0072
Cascade Range Chapter
Contact: Norrie Bush, (206) 254-3228
Central Illinois Chapter
Contact: Tony Lasher, (217) 784-5518
Central Indiana Chapter
Contact: Steve Murray, (317) 788-5968; or Joe Shanks, (317) 649-0407
Chattahoochee Chapter
Contact: Richard Amell, (404) 394-8837
Delaware Valley Chapter
Contact: Diana Riley, (717) 764-1436
Florida Chapter
Contact: Dick Kirn, (813) 924-8541

(Continued on page 41)

RF splitter specs and parameters

This is the second article of a two-part series on RF (radio frequency) splitters.

By Michael Holland
President, Pico Macom Inc.

Since we looked at the splitter's functional requirements in each major area and some of the options available last month, we will now detail actual specifications and some of the specs vs. cost trade-offs.

Most of today's splitters are available in frequency ranges of 5-500 MHz or 5-600 MHz. The state-of-the-art limitations of ferrite material permeability is the main factor determining the maximum frequency range at specification of the hybrid passive device. (See Figure 1.)

There is a difference in definition of splitter bandwidth specs used in the CATV industry as compared to those commonly used elsewhere. Bandwidth is defined as the upper and lower frequency where the 3 dB or the half-power point exists.

Looking at typical isolation and return loss specifications it is clear that the use of the word "bandwidth" on splitters refers to a frequency range that the device can be used at and not the half-power point. Therefore, the engineer still must determine the acceptable performance levels at 5,500 or 600 MHz:

	5 MHz	300 MHz	Good device 600 MHz	Average device 600 MHz
Isolation	30 dB	35 dB	25 dB	20 dB
Return loss	16 dB	26 dB	18 dB	14 dB

A possible reason for the CATV industry's loose definition of bandwidth is that many engineers realize that the lower specifications using present bandwidth interpretation are still greater than those needed for flawless operation.

Isolation

Isolation is defined as the signal loss that occurs between output ports of a splitter having a terminated input (See Figure 2.) The following are typical isolation specifications of today's splitters:

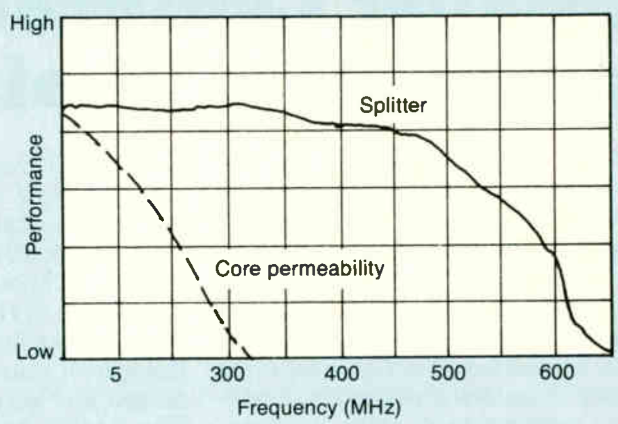
	5-400 MHz	500 MHz	600 MHz
Lowest	32 dB	26 dB	16 dB
Typical	35	29	20
Best	38	32	25

As shown here the difference between the three typical specification levels is 6 dB at frequencies lower than 500 MHz and 9 dB at 600 MHz. Often, it is discovered that many systems' criteria for choosing splitters are based upon manufacturer's specifications alone.

The lowest isolation device is not functionally bad because it is low, rather the higher isolation device is technically better. So if the engineer remembers his goal of finding the best specifications for dollar spent, he will get the best splitter for his application.

Insertion loss is the amount of signal that is lost as the signal passes from the input to the output. An ideal two-way splitter loses 3 dB of signal when splitting its power equally between two matched loads. Typical splitter best to worst specifications are as follows:

Figure 1: CATV splitter frequency range



	5 MHz	100 MHz	300 MHz	400 MHz	500 MHz	600 MHz
Worst	3.3 dB	3.4 dB	3.5 dB	3.5 dB	4.2 dB	5.5 dB
Typical	3.3	3.3	3.4	3.4	3.8	4.5
Best	3.2	3.2	3.3	3.3	3.5	4.0

As you can see, all specifications are similar up to approximately 400 MHz at which point the more carefully built splitters maintain their lower loss advantage despite a rapid increase of their rate of change. Although the highest spec, most expensive splitter seems to be the most desirable, the engineer's aim is to get the most for his dollar in all areas of performance and reliability. He must weigh which features are really desirable and which are not worth the expense.

The textbook definition of return loss is:

$$R = 20\log\frac{1}{p}$$

Where:

$$p = \frac{E_r}{E_1}$$

Simply stated, the return loss (RL) is the value of the reflection coefficient expressed in decibels.

In practical CATV terms, the closer a device's impedance approaches 75 ohms, the higher its return loss. The further from 75 ohms in either direction, the lower the return loss. As mentioned in Part 1, low return loss can cause:

- ghosts or reflections
- slight loss of power and

Figure 2: How isolation is defined

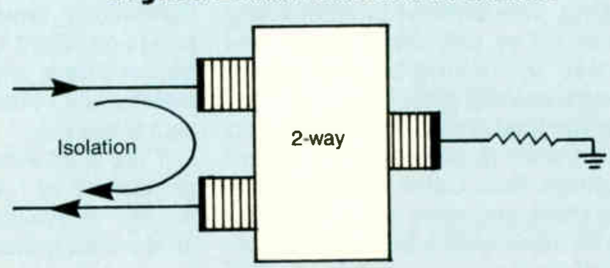
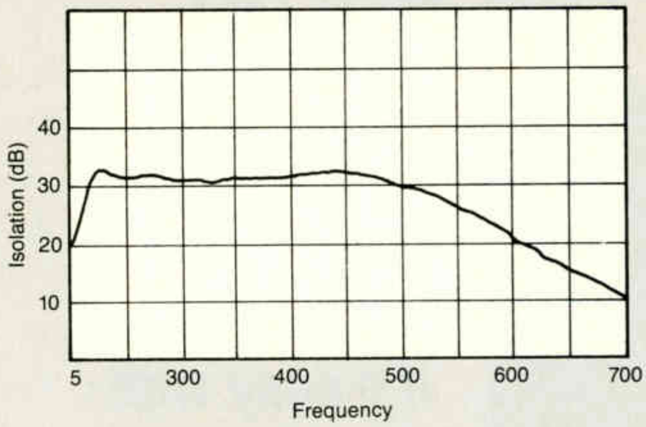


Figure 3: CATV splitter isolation range



- radiation due to discontinuities acting as an antenna

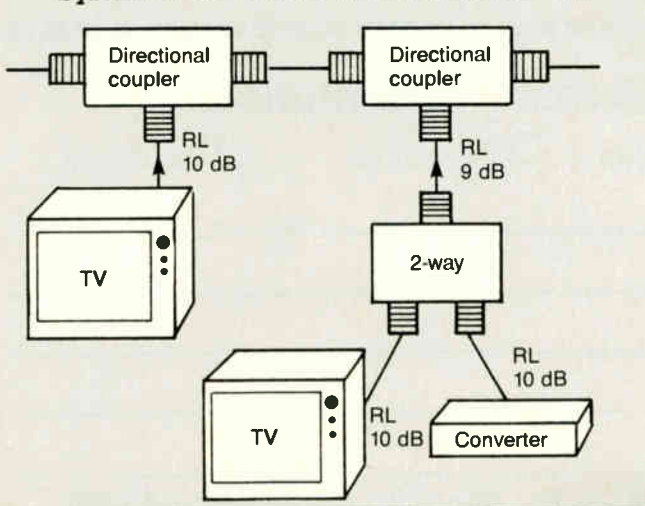
To put return loss better into perspective, consider a 75-ohm system. If a device or load is either one-half or two times 75 ohms (37.5 or 150 ohms) the return loss would be approximately 14 dB. Obviously, cable converters and TV sets with RLs of 9-10 dB do not come too close to the desired 75 ohms. An active cable amplifier typically will have 16-18 dB return loss, which is still not what we would call precise.

A typical return loss between 16-22 dB is usually acceptable in the CATV industry demonstrating the "forgiveness" of CATV systems when compared to other types of equipment. Since this lower RL limit is acceptable, it has proven that no noticeable picture degradation or radiation will occur in this RL range. To verify this, consider the 10 dB return loss TV set and converter that has been used for years and the quality pictures they've provided (See Figure 4.)

Note how the directional coupler prevents the reflections from the low RL TV from going downstream. Comparing the matching of Case 1 and Case 2, it is obvious that the splitter return loss (being typically over 20 dB) is so much greater than that of the TV that it only reflects the lower TV RL (10 dB) to the tap.

Consider again our discussion on trade-offs. If, in fact, the TV and set-top converter exhibit a 10 dB RL as a given spec, and if a splitter with 15 dB to 40 dB RL reflects a combined RL of 10 dB when connected to the TV, then the RL spec in standard applications is not a high priority chip in the trade-offs of specifications for dollars.

Figure 4:
System TV sets and converters with low RL



Fortunately, the three main electrical specs, insertion, isolation and RL cannot be traded easily for one another. If the splitter is made carefully, all specs will be maximized. The following are typical return loss specifications:

	5 MHz	10-300 MHz	400 MHz	500 MHz	600 MHz
Lowest	10 dB	25 dB	20 dB	16 dB	14 dB
Typical	16	30	25	20	18
Best	18	35	30	22	20

Note that RL, like isolation, is extremely frequency-dependent and does not follow the typical 3 dB bandwidth rule for specifications. That's why all manufacturers spec the RL, isolation and insertion loss at different frequencies, leaving it up to the user to determine acceptability. The RL, over 400 MHz, is extremely dependent on placement of wire, size and shape seizing pins, and inside cavity volume.

For example, a precision 1 percent 75 ohm resistor can be placed in a terminator housing and repositioned to increase a 25 dB RL terminator to 35 dB when in the 500-600 MHz range. The capacitive and inductive reactance effects are a greater determining factor in RL at upper frequencies than the part's actual resistive value and accuracy.

At the high frequency range we must consider splitters as almost stripline devices. It has been shown that the measurement of RL at high frequency can vary greatly with different lengths of cable center conductors and with the tightness of the connector. Today the judged value of a splitter must be based on its specifications relative to its cost (i.e., what level RL will produce an improved or degraded picture and how critical these levels are on everyday methods of installation).

Shielding

In recent years, shielding has been viewed as one of the most important splitter requirements because system leaks beyond FCC levels have costly effects. With shielding, the goal is to:

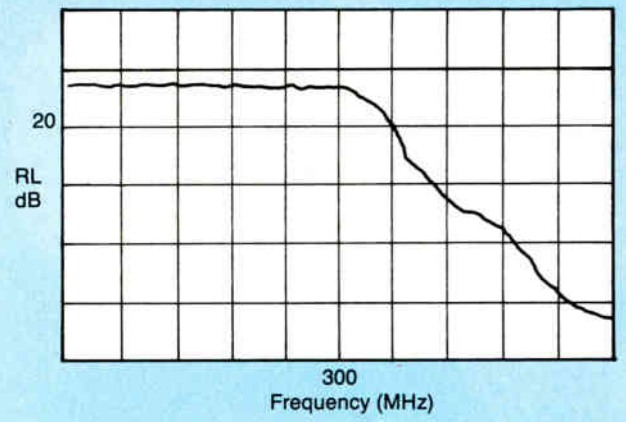
1) Determine when installed, at what level a device's pure leakage will exceed FCC field leakage limits.
2) Determine relative shielding levels of different RFI shielding methods.
3) Determine how to measure pure leakage levels.

Although other methods of testing, such as MIL-SPEC, far-field and return loss conversion, are available, the RFI chamber method has been used most extensively in the cable industry. This method's simplicity provides a reasonable method of comparing sealing techniques. Unfortunately, it is impossible to determine absolute leakage levels using an RFI chamber. Moreover, there has been little or no test data produced that correlate chamber leakage results to field installed UV/meter levels.

Therefore, due to the possibility of severe leakage in a system and the lack of any serious data, a "lower leakage is best" method of evaluation must be used. The specification section of this article will focus on leakage level comparisons and sealing methods used today. Leakage levels discussed here are those of manufacturers' and cable systems' RFI chambers. The following are sealing methods and relative leakage levels of currently available splitters:

	Leakage
1) MATV-type, 0.5 mm AL cover, pressed and epoxied	–60 dB

Figure 5: CATV splitter return loss range



2) CATV-type, 1 mm thick cover, pressed and epoxied —70 dB
3) CATV-type, 1 mm cover, pressed and staked (4 pts.) —80 dB
4) CATV-type, 1 mm cover, 2 mm apart serrated piercing edges, pressed and staked down (4 pts.) —90 dB
5) CATV-type, 1 mm cover, outer case edge fully rolled and staked over —100 dB
6) CATV-type, stainless steel cover, pressed and staked —100 dB
7) CATV, Japanese/European-type with full RFI screen material under and around edges of 1 mm cover —120 dB
8) CATV, multiple tongue and groove edges, heavy diecast cover —130 dB
9) CATV, completely solder-type sealed case to cover metallically bonded —140 dB

Some test engineers will find that these readings differ 10-20 dB from their own data, but most will agree their relative levels are correct. How is the proper selection made? Perhaps you buy the best you can afford with either savings from unneeded electrical specs or simply spending more.

All CATV splitter cases use zinc diecast material due to its ease of casting and low cost. Zinc is used in marine environments because it corrodes before other less active metals such as the brass in propellers and drives. In our applications the zinc case needs a corrosion proof protective coating. The plating methods currently used are:

1) Zinc chromate bath—gold color
2) Zinc chromate bath—silver color
3) Tin electroplate
4) Nickel over copper electroplate
5) Chrome over copper electroplate
6) Silver over copper electroplate

During the last 20 years 90 percent of all splitters have been plated with the inexpensive gold and silver colored chromate finishes that provide excellent corrosion results. The advantage of these finishes is low cost and proven reliability.

Why is there a recent growth in the use of the other more expensive platings? Chromates are an oxide protector that forms an insulator on the case's metal surface. When a connector is installed and wrench-tightened, the electrical contact is made when the chromate on the zinc splitter and connector is rubbed away producing a brass/zinc contact surface. At frequencies normally used, a perfect RF connection can be made even if actual DC continuity does not exist.

When the raw diecast is exposed under the connector threads, corrosion can begin because induced lower frequency and ground loop currents speed the corrosion process at the junction of the two dissimilar metals. If this occurs slightly, standard CATV system performance at low frequencies would not be diminished.

Today with the increased use of higher frequencies and data transmission this corrosion can form a non-linear material causing signal distortion and hum modulation. In turn, this new discontinuity at the higher frequencies can cause reduced return loss and leakage. Why look at more expensive tin and nickel plating?

1) They are conductive platings not oxides. Corrosion, if existent, is not electrically accelerated with ground loops and AC hum.
2) They are plated thicker and more consistently than chromates, providing more protection.
3) They allow better RFI cover sealing. The cover does not have to cut through the chromate insulation before making electrical contact.
4) It is solderable, which means internal ground connections may be soldered, rather than staked to ensure reliability.

Returning to the issue of trade-offs, it must be remembered that for 20 years chromate coatings have performed well despite their lower cost. As higher frequencies, data transmission and CLI tests are increasingly used it may become difficult not to choose the more expensive type of plating protection.

One note regarding silver case plating: On the outer case it is too expensive and too soft to be worth its slightly better corrosion ability. A hard tin plating appears to be more popular than nickel due to the brittleness of nickel (from brighteners) under the pressure of tightened connector threads. High quality military connectors use nickel except when crimping is required. In this case tin is used. In the CATV industry, ½-inch attached ring drop connectors use cadmium chromate or tin where the same connector for MATV is sold with cheaper nickel plating. The same logic is true in the plating of diecast splitters.

Most splitters use an epoxy to weather seal the standard pressed-on cover. This is satisfactory unless the epoxy is not applied thoroughly or chipping occurs. Splitters are often installed with nails and when the hammer misses and hits the splitter, the epoxy can crack. Moreover, the splitter's thin aluminum cover can flex when dropped or hammered causing the epoxy to separate.

If the splitter budget permits a higher level of environmental sealing, two cover sealing methods provide superior moisture

Figure 6:
CATV splitter mechanical specifications

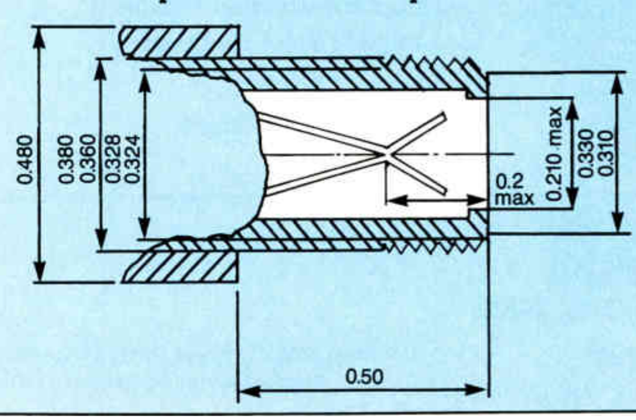
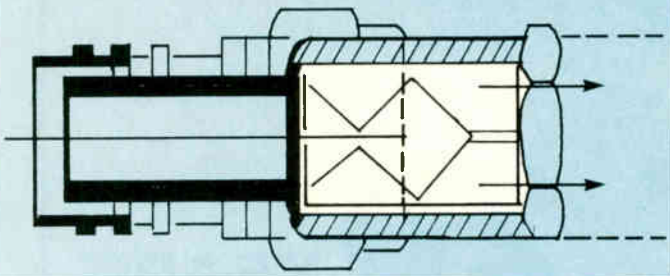


Figure 7: Male connector and splitter end port



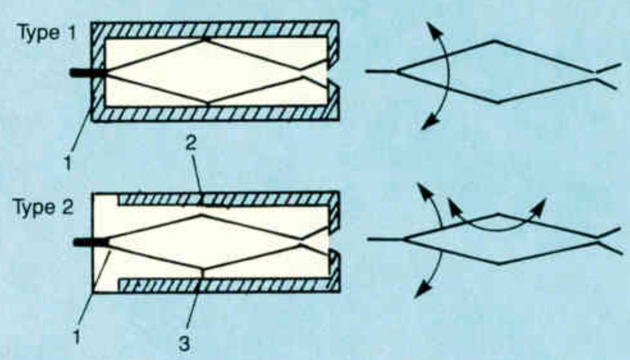
protection reliability: complete metallically (solder-type) sealed cover, and multi-tongue and groove and epoxy-type cover.

F ports

The following mechanical specifications are presently available on many of today's splitters and can be used as a guide for purchase specifications:

1) Threads: All F ports should be 3/8-32 UNEF with a minimum of eight complete threads. Testing should be made using a quality thread gauge rather than a connector, in that the connector dimension may vary. In addition, buildup of plating in the threads can cause poor connector/splitter port mating.
2) Overall size: See Figure 6.
3) F port length: Length should be 0.5 inches (±.020). Outdoor splitters using sealing sleeves require this length to seal properly. In most splitter applications however, a 10-15 percent variance from 0.5 inches is acceptable. Moreover, horizontal port splitters, which have their ends staked to hold the pin and insulator assembly, cannot easily meet this ±.02-inch maximum variance. The only reason to consider this tight length specification is if your sealing sleeve requires it.

Figure 8: Contact pins Type 1 and 2



4) F port base: When sealing sleeves, or boots, are used, a minimum base diameter of .480 inches is required for a proper sealing surface.
5) F port end: For higher quality connections, the end of a diecast splitter F port should be flat, not staked. Although vertical port diecast splitters and line taps with brass connectors are flat, the horizontal port diecast splitter can be flat or staked. The disadvantages of the non-flat or staked splitter ports are a) due to a non-perpendicular face, the connector makes contact with one edge only resulting in lower return loss and b) using ½-inch attached ring drop connectors, the insulator can be pushed into the splitter reducing tension of the center conductor. As shown in Figure 7, the outside diameter (OD) of a male connector's shank (inside the nut) is only slightly larger than the typical inside diameter of the insulator in a cast port. This becomes a problem with wrench tightening. A flat end port, though more expensive, removes the potential for these problems to occur.
6) Port OD taper: To ensure proper contact with all threads, the taper of the port diameter should not change more than 0.01 inches from base to end.
7) Distance from port end to pin contact: The maximum distance from port end to seizing pin contact point should not exceed 0.2 inches.
8) Center conductor contact tension: With a standard RG-59 center conductor of #20 wire, the seizing pin should produce a retention force of 200 grams.
9) Contact pins: They should be made from either beryllium copper or phosphor bronze. Plating should be silver with a 0.0002-inch (0.2-mil) minimum thickness at the contact point. This plating thickness is minimum standard on MIL-SPEC connectors. Contact points should be separated during plating process.
10) Contact pin-force point: Note that over time and repetitive use, spring retention is directly related to maximum spring displacement distance. Pin Type 1 uses one point of movement whereas Type 2 uses three points of spring action. (See Figure 8.) ■

This article was presented at the 1988 Cable-Tec Expo.

RF splitters is one of the topics being investigated by the SCTE's Interface Practices Committee.

TRAP TALK

800-338-TRAP

Have a question about traps?
Call the experts at Intercept.
Dial 800-338-8727 toll-free, and speak to
an authority on traps, not just a salesman.
Intercept has been a recognized leader
in the cable industry since its beginnings.
So talk with us.
Because when the question is traps,
the answer is Intercept.

INTERCEPT

INTERCEPT SALES
Gedi Corporate Park, Englishtown, New Jersey 07726
(201) 446-1010 FAX (201) 446-2717

Reader Service Number 10.

How to make a proper F connector

By Donald Dworkin
Rebuild Coordinator, TKR Cable

One of the things we all absorb from the first day we get involved with CATV is that we are dealing with a *system*. In practical terms this means that every part must work, without exception, no matter how small, for the whole system to work. Every tech can tell us horror stories about the loose screw or the cracked washer that caused an entire system outage. Let us then examine one aspect of the reliability of what is probably the single most commonly used component in the CATV system—the F connector.

Tens of millions of F connectors are used each year and a generic fault would have major consequences in CATV. Our suspicions were aroused when we looked through the log books of the systems' repair crews. We counted the percentage of trouble calls due to F connectors and found anywhere from 25 to 90 percent of all repairs are to tighten "loose" connectors, remake or open an intermittent or wrench-tighten a termination.

When we found the same problem on our laboratory bench, we took the opportunity to look into it carefully. After all, it is the lowly F connector that brings the RF signal from our carefully-constructed system from the tap, through the ground block to the subscriber's TV set. Every single one of these connections must make secure and reliable electrical contact, regardless of temperature, wind, rain or, as far as the subscriber is concerned, the system is down.

Adding to the problem is the fact that widely varying instructions as to what length to cut the center conductor exist among technicians. These range all the way from slightly below flush to 1/16 inch above flush and no idea of what the tolerance should be.

Let's start by examining precisely how the F connector center contact is supposed to work by looking at Figure 1, which shows a cross-sectional view of the female or port connector. In the center is shown the two contacting springs that, at their closure point, are supposed to make the connection with the center conductor of the male F connector. As the male connector, shown in Figure 2, is threaded onto the port, the center conductor is carried to meet the spring contact's closure point.

Obviously, only if the center conductor is long enough will it penetrate the spring contact's closure and establish a reliable pressure contact.

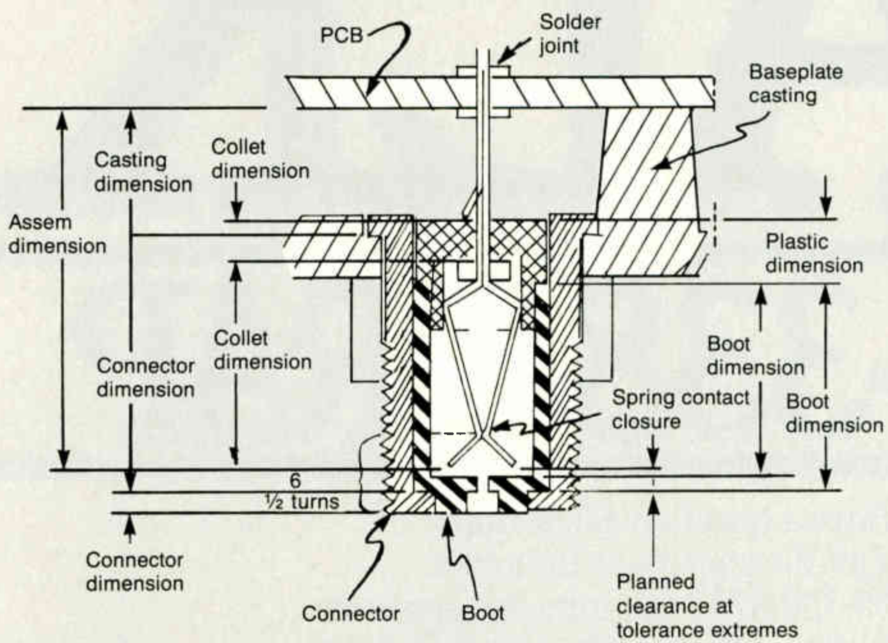
To see exactly how reliably this works, we set up a simple test, as shown in Table 1. We counted how many half-turns (approximately 180 degrees hand/wrist rotation) it took to have a termination make contact. We cut the center conductors of the terminators to four lengths, 0 or flush, 1 mm or 0.04 inch, 2.5 mm or 0.10 inch, and 4 mm or 0.16 inch. We used five well-known tap brands and found that all of them took between six and a half to seven turns to "bottom" the male connector. This is graphically shown in Figure 1 by the bracket labeled "6½ turns."

The first column of the test, zero or flush, shows that the distance the male connector travels axially is about equal to the distance from the contact closure to the outside of the port. This is shown by the fact that three of the nine samples did not make contact at all (N/C), three just barely did (seven turns which is bottomed), while four did make contact in five turns. Our tests confirm that if the center conductor in the male F connector is cut off flush with the outer shell face, it will have only just about reached the contact closure!

Only the length of center conductor protruding above the shell face makes contact with the closure point. In other words, "what you see is what you get."

Depending upon tolerances, the center

Figure 1: Cross section of a tap port connector



Each dimension noted carries with it a ±0.005 inch tolerance

Figure 2: Typical F fitting assembled

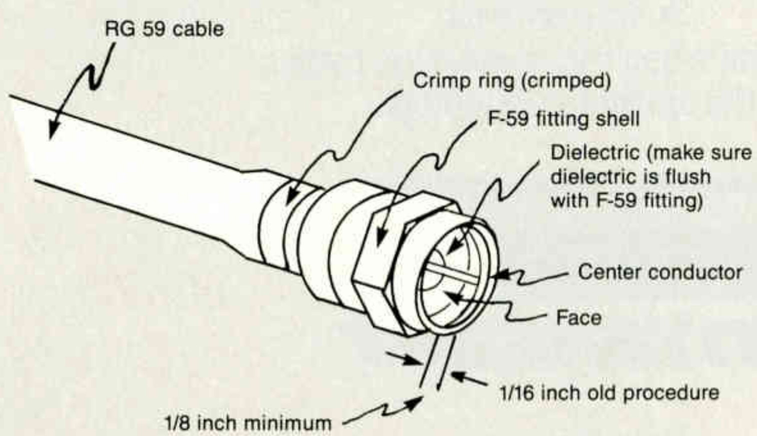


Table 1: Turns vs. center conductor projection

Tap brand	Projection above flush 0	1 mm	2.5 mm	4 mm
	Turns to contact			
A	N/C	6	3	1
A	7	4	3	1
A	N/C	6	4	1
B	5	3	2	1
C	5	4	3	1
C	5	4	3	1
D	7	4	6	4
D	5	3	2	1
E	N/C	4	3	1

conductor, if cut flush with the shell face, may not contact the closure point at all or might just touch without penetrating the closure point fully, thereby causing a lack of spring pressure on the contact. This is a condition that would cause an open or intermittent contact especially in cold weather when the cable pulls back.

Even if the center conductor were cut 1/16 inch above the shell face, as advised by most people, we found that the average penetration of the contact closure was only about 0.06 inch. That much grip does not provide for a reliable connection given the mechanical and temperature stresses the connection is subject to. F connectors are notorious for loosening up causing pullback on the center conductor. Even corrosion might turn such a marginal connection into an intermittent one on a freezing night. No wonder that the repair logs show so many connectors being tightened or remade!

A good rule to follow in setting the proper length of center conductor to cut is contained in "what you see is what you get." Once this is explained to the techs as the length protruding beyond the shell, they will be able to pick a reasonable length.

Our recommendation is that the center conductor be cut between 1/8 inch to 1/4 inch beyond the shell. There is no danger from a conductor cut to these lengths; to the contrary, the extra length guarantees additional contact with the springs, as can be seen in Figure 1. Every tech should understand that what is to be avoided are the barely-made connections that cause the system so much unnecessary cost and the tech so much unnecessary trouble.

Historical note

For more than curiosity's sake, we traced the probable history of the connector and its drift to its present unsatisfactory state.

About 1980, a leading CATV manufacturer introduced the internal sealing boot that sealed the jack against moisture penetration on the taps. They carefully positioned the spring and collet assembly back from the internal boot so that it did not interfere. Otherwise the spring would have been prevented from closing freely on the center conductor (See Figure 1, "planned clearance of tolerance extremes.") But through the years, other companies adopted the same type of internal boot with slightly different designs, clearances and tolerances. This explains the wide variety of contact-turns listed in Table 1.

The standard we have proposed will provide a satisfactory contact with all the different types of F-type jacks. ■

Acknowledgement: I wish to acknowledge the cooperation and assistance of Robert Wanderer of the United Artists Technlogy Center and Michael Hoffman of the United Artists Quality Assurance Department in this project.

Reprinted with permission from the National Cable Television Association's "1988 Technical Papers."

Basic electronics theory

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

By Kenneth T. Deschler
Cable Correspondence Courses

This month we will begin a study of the basic measuring instruments used to "sense" the quantities of electricity that we cannot see, hear or feel. The ability to measure current, voltage, resistance and power is essential to working on both electrical and electronic equipment used in the cable industry.

Ammeters

An *ammeter* is an instrument used to measure the amount of current (electron flow) present in either a component or an entire circuit. The heart of any measuring instrument using a meter is the meter movement itself. The most common meter movement used today is the D'Arsonval movement, which consists of a horseshoe-shaped permanent magnet with a coil of wire between its poles. Figure 1 shows the D'Arsonval meter's coil assembly.

When current flows through the coil, the resulting electromagnetic field reacts with the permanent magnetic field causing the coil to rotate on its pivots. The amount of rotation is dependent upon the magnitude of the current flowing through the coil. By placing a pointer on the form that supports the coil and allowing it to pass over a calibrated scale, the current's value can be read. In order to return the pointer and coil to the beginning of the scale, small springs called hairsprings are used. The complete D'Arsonval meter movement is shown in Figure 2.

The measure of a meter movement's quality is its *sensitivity.* A meter's sensitivity is determined by the amount of current needed to cause full-scale deflection (maximum reading) of the meter movement. The lower the value, the greater its sensitivity.

A schematic drawing of a multirange ammeter is shown in Figure 3. This meter is capable of measuring 50 μA (microamperes), 10 mA (milliamperes), 50 mA and 100 mA. The meter movement used has 100 ohms of internal resistance and a sensitivity of 50 μA.

As you will notice, R_1, R_2 and R_3 may be placed in parallel (shunt) with the meter movement through the use of a rotary switch. The purpose of the *shunt* resistors is to shunt or bypass any current that exceeds the full scale deflection value of the meter movement. We can see that the rotary switch is not connected to a shunt resistor when we desire to measure 50 μA or less because this represents the meter's sensitivity value. Whenever we wish to measure current values greater than this, we must provide a path for the excess current.

To determine the value of a shunt resistor, we use the following formula:

$$R_s = \frac{I_m \times R_m}{I_s}$$

Figure 1: D'Arsonval meter's coil assembly

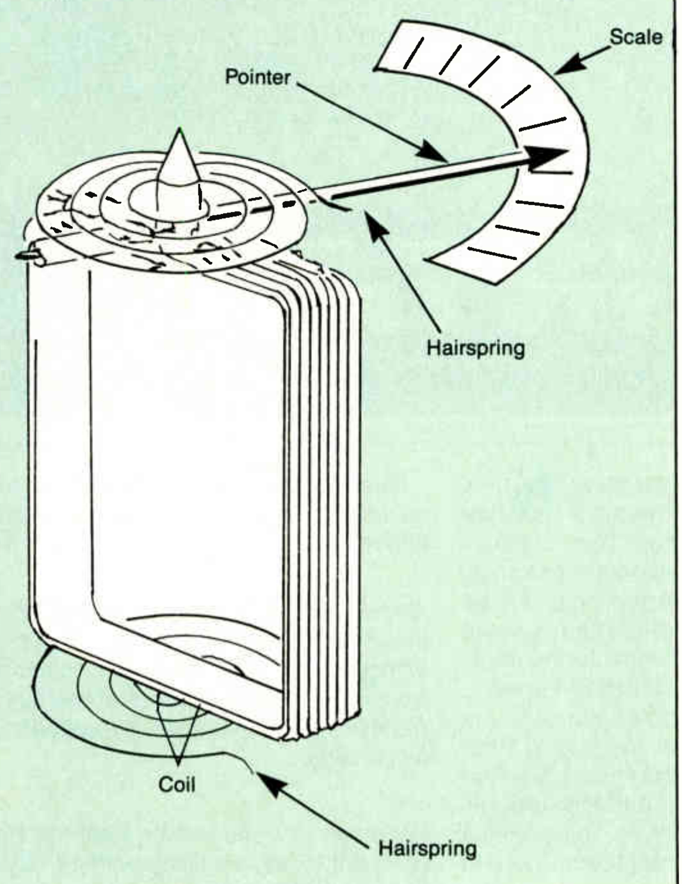
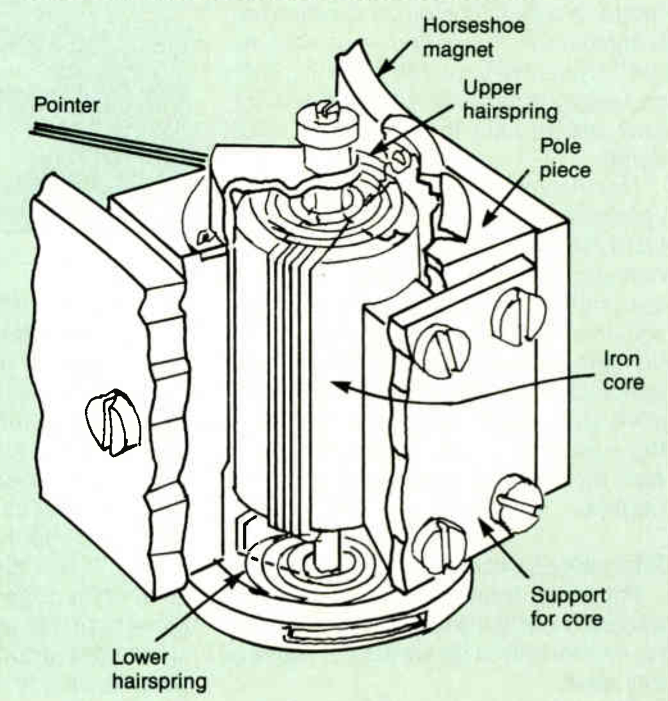


Figure 2: D'Arsonville meter movement



Where:

R_s = Value of shunt resistor
I_m = Maximum current value of the movement
R_m = Internal resistance of the movement
I_s = The amount of current we wish to bypass or shunt. Where $I_s = I_{Range} - I_m$.

In our example, R_1 is used when we wish to measure 10 mA of current. Placing the known values into the formula we find that:

$$R_1 = \frac{(50 \times 10^{-6})\ (100)}{(10 \times 10^{-3}) - (50 \times 10^{-6})}$$

$$= \frac{0.005}{0.010 - 0.00005}$$

$$= 0.5025 \text{ ohm}$$

If on the other hand we wished to find the value of a shunt resistor that would allow us to measure up to 50 mA, we would simply set up our formula as such:

$$R_2 = \frac{0.005}{0.05 - 0.00005}$$

$$= 0.1001 \text{ ohm}$$

From this formula we can see that the range of an ammeter can be changed simply by choosing the appropriate value of shunt resistor.

Voltmeters

When it becomes necessary to measure the voltage (potential difference) present in an electrical circuit, an instrument known as a *voltmeter* is used. Voltmeters are made up of a meter movement and one or more series resistors called *multipliers*. Voltmeters are placed in parallel with the device to determine the amount of voltage present. To understand how a current measuring meter movement is used to measure voltage let us look at Figure 4. Since the meter movement is in series with R_{mult}, it will indicate the current through the multiplier resistor. By knowing the current and resistance values we can determine the *approximate* voltage present by using the Ohm's law relationship:

$$E = I \times R$$
$$= 0.1 \times 50$$
$$= 5 \text{ volts}$$

If the sensitivity of the meter movement was 100 mA, we would have full-scale deflection and thus have a voltmeter whose range was from zero to 5 volts. By doubling the value of the multiplier resistor we could double the voltmeter's range to read from zero to 10 volts:

$$E = I \times R$$
$$= 0.1 \times 100$$
$$= 10 \text{ volts}$$

The reason we said that only an approximate value could be obtained was because we did not take into consideration the value of the meter movement's internal resistance (R_m).

Figure 5 is a schematic of a multirange voltmeter with three

Figure 3: Schematic drawing of a multirange ammeter

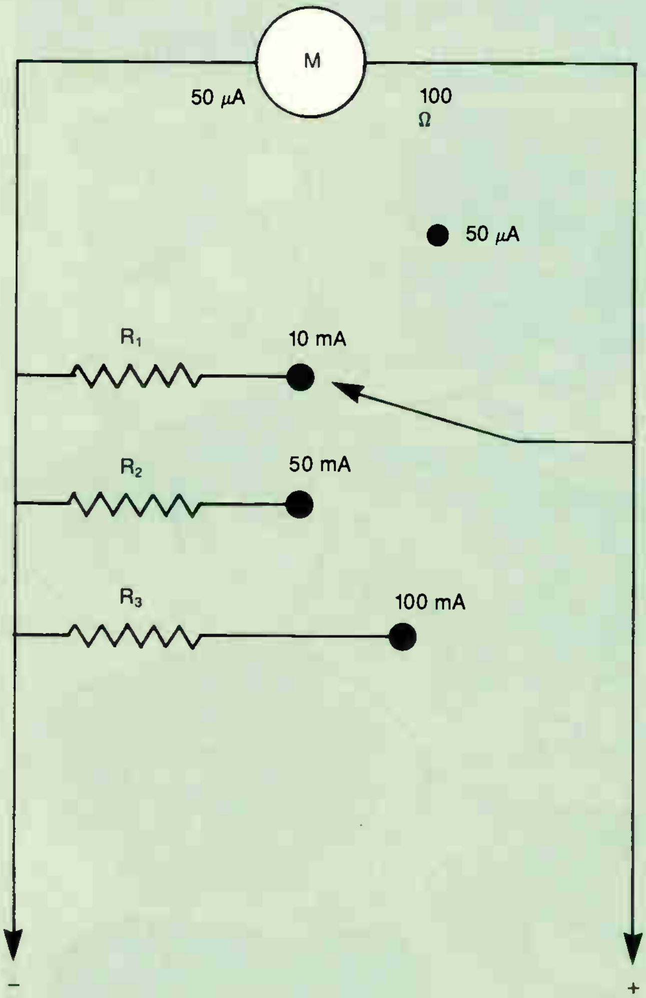


Figure 4: Measuring voltage

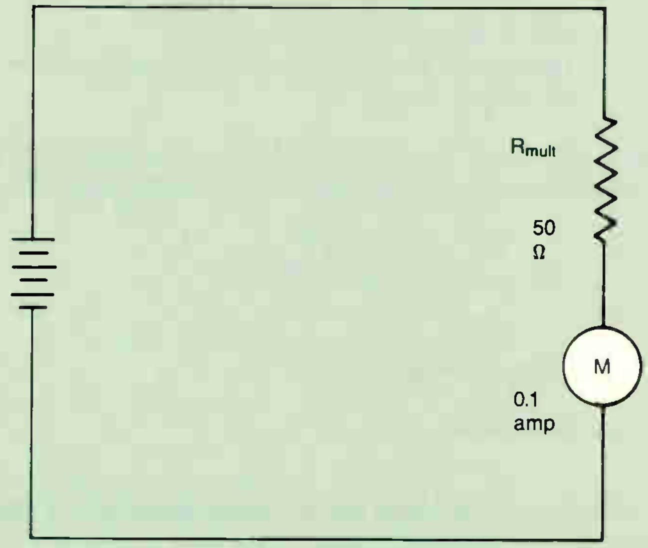
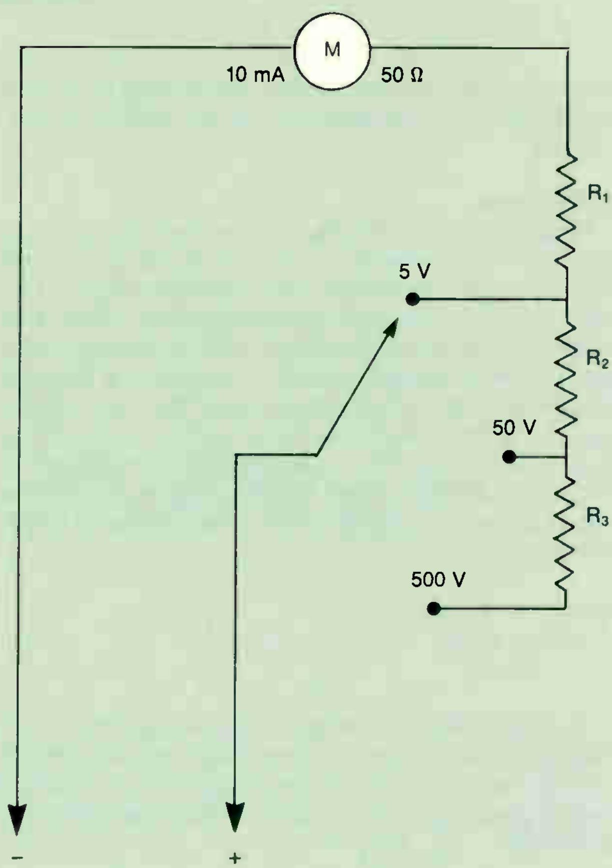


Figure 5: Schematic drawing of a multirange voltmeter



multiplier resistors—R_1, R_2 and R_3—in series with a meter movement whose internal resistance is 50 ohms and whose full-scale deflection is 10 mA. To determine the values for the multiplier resistances use the following formula:

$$R_{mult} = \frac{E_{full\ scale}}{I_m} - R_{meter}$$

To find the value of multiplier resistor R_1 used for readings up to 5 volts, fill in the known values:

$$R_{mult} = \frac{5}{0.01} - 50$$

$$= 500 - 50$$
$$= 450 \text{ ohms}$$

To find the value of multiplier resistor R_2 used for readings up to 50 volts:

$$R_{mult} = \frac{50}{0.01} - 50$$

$$= 5000 - 50$$
$$= 4{,}950 \text{ ohms}$$

This of course is not the value of R_2 alone but rather the series combination of R_1 and R_2. Therefore:

$$R_2 = 4{,}950 - R_1$$
$$= 4{,}950 - 450$$
$$= 4{,}500 \text{ ohms}$$

The term *loading* is the condition where the voltmeter represents a parallel branch that unbalances the circuit. To prevent loading, voltmeters with high resistance values in the millions of ohms are used.

The sensitivity of a voltmeter is the resistance of the voltmeter at the full-scale reading in volts. The unit for sensitivity of a voltmeter is its "ohms per volt" rating, which is found by dividing the movement's full-scale current value into one. Using the value given for the meter movement in Figure 5, we find that its sensitivity is:

$$\frac{1}{0.01} = 100 \text{ ohms/volt}$$

A sensitivity of 100 ohms/volt is very poor because if it were used to measure the voltage across a 100 ohm resistor, half of the current that normally goes through the resistor would go through the voltmeter instead. This would be an example of severe loading. Most general purpose voltmeters have a sensitivity of 20,000 ohms/volt or better.

When either an ammeter or voltmeter is to be used to measure AC values, a device called a *rectifier* is placed in series with the meter movement. A rectifier is a device that only allows current to flow in one direction thereby changing AC to DC. Rectifiers will be covered in more detail in a future article. Remember, the term meter refers to a total instrument not just the movement itself.

Voltmeter and ammeter rules

The following rules should be practiced when using either an ammeter or voltmeter to make measurements in an electrical circuit:

1) Ammeters are always placed in series with the device whose current is to be measured.
2) Voltmeters are always placed in parallel with the device whose voltage is to be measured.
3) Always make sure that the circuit is not energized before connecting or disconnecting an ammeter or voltmeter.
4) Always place the meter on the highest range before energizing the circuit and reduce the range value until an acceptable reading is obtained.
5) Always observe proper polarity and never use a DC voltmeter or ammeter to measure AC voltage or current.

Check yourself

1) Determine the value of R_3 in Figure 3.
2) What do ammeters measure?
3) What is the name of the meter movement used in this lesson?
4) What is the value of the multiplier resistor R_3 in Figure 5?
5) Why are ammeters always placed in series with the device or circuit? ■

Answers

1) 0.05 ohm.
2) Current (electron flow).
3) D'Arsonval.
4) 45,000 ohms. (Remember: $R_{mult} = R_1 + R_2 + R_3$).
5) To allow all of the current to flow through the meter.

Why glass optical fiber is not as "fragile as glass"

By Scott A. Esty
Market Development Supervisor
Telecommunications Products Division
Corning Glass Works

"Careful!" an installation supervisor warns his installation crew. "Don't bump that cable against anything—there's glass fiber inside. We don't want to shatter it."

An experienced engineer at the installation site wonders how these misconceptions get started. Of course, he's familiar with the manufacturing process, knows about fiber testing and is well acquainted with the product's mechanical properties. Installers who have experience handling optical fiber sometimes forget most people assume glass is fragile. Until optical fiber becomes more widespread in cable TV systems, some common misconceptions about fiber may need to be explained.

Many properties of bulk commercial glass don't apply to optical fiber. For example, common glass is a brittle material, but as a drawn fiber it is flexible. It can be wrapped around a pencil without breaking.

Windows and container glass are made by a melting process in glass tanks and furnaces. Optical fiber is made by a completely different vapor deposition process; glass fiber and fiberglass are only distantly related cousins.

Drawn glass fiber has been woven into fabric, as early as 1713 by Venetian glass artisans, examples of which are on display in Corning's Museum of Glass, in Corning, N.Y. This was not transmission quality fiber, so today's optical fiber is certainly even more flexible with its low impurity levels.

Although artistic applications may be intriguing, it is the clear transmission quality of optical fiber that has captured the attention of CATV design engineers. Glass fibers offer an unlimited bandwidth path for video signals across our communities, releasing system designers from the noise and distance limitations of coaxial cable. Flexible optical fiber will easily take light signals around corners and beyond solid obstacles.

Fiber's flexibility contributes to its resiliency. A field report from AMP Inc., illustrates this: A small reel of optical-fiber cable was hit by several cars after it had fallen out of a truck on its way to a work site. The reel of fiber was tested later on an optical time domain reflectometer. Despite the punishment, fibers inside the cable showed no increased optical loss.


Courtesy of Corning Glass Works.

Optical fiber is immersed in various solutions as part of a battery of environmental tests.

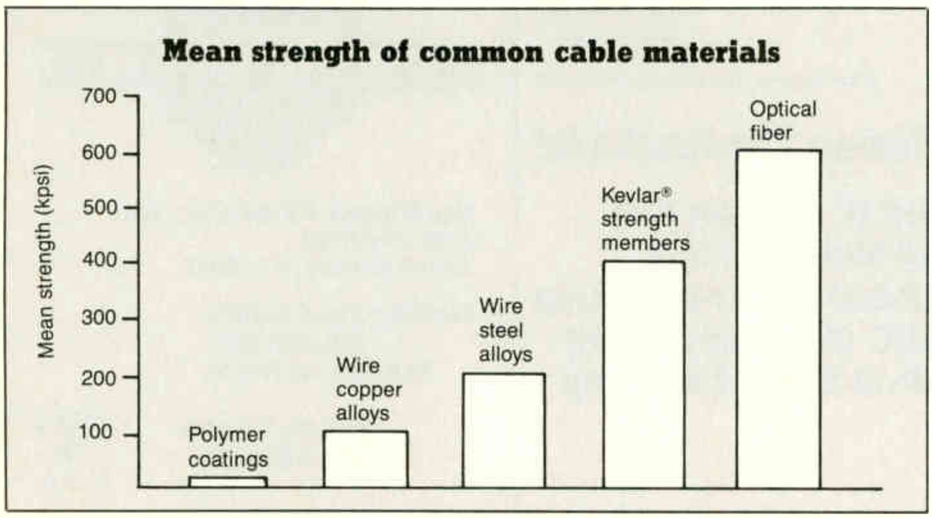
Fiber is tough

An important characteristic of glass fiber is, in fact, high strength. Typical breaking strengths of optical fiber exceed the breaking strengths of steel, copper and aluminum. (See accompanying figure.) The mean tensile breaking strength of optical fiber is about 600,000 pounds per square inch (psi). This can be thought of as the equivalent of 50 male African elephants suspended in a stationary elevator by a strand of optical-fiber glass with a one square-inch cross section. Theoretical strength of glass molecular bonds, at 2.6 million pounds per square inch, is more than four times the typical fiber strength level. Submicroscopic surface flaws in the fiber ultimately govern its strength; these flaws can grow under tension, limiting fiber strength.

Care is taken in manufacturing to produce as pure and unflawed a fiber as possible. Corning scientists have eliminated the requirement for a pre-made tube to form the outside of the fiber. This tube was the source for most flaw problems since it is impossible to remove all impurities in the tube's forming stages, including melting. Today, Corning fiber is entirely made of vapor-deposited glass with parts-per-billion purity. The entire process is carefully controlled to reduce defect-forming conditions to an absolute minimum.

To ensure a minimum strength level, the fiber is proof-tested to monitor strength prior to shipment. In this operation, every inch of the fiber is passed through a screener, the proof-testing workhorse, and a tensile load equivalent to 50,000 psi is applied to the fiber. Fibers that pass through the proof-tester are strong enough to withstand the rigors of cabling and installation.

Samples of fiber also are regularly tested to failure. The rotating capstan fiber tester deliberately stresses the fiber to its ultimate breaking point, providing a baseline strength test. The tension on the fiber at failure is recorded, and failure data are analyzed. These laboratory test results consistently show fiber, when tested in short lengths, can typically withstand average levels of stress at 600,000 psi before breaking.



A heroic fiber-cable performance was reported by Siecor Corporation, a manufacturer of optical cable. A West Coast storm felled a 4-foot-diameter tree that snapped a CATV coax line and a copper wire pair cable. An optical cable containing Corning fibers stretched, but didn't break! Telephone service was unaffected.

The weather itself presents some tough challenges of its own to cable performance. Reliable, unchanged performance after long-term exposure to temperature and humidity extremes and even submersion in water or some watery mixture are the requirements. Consequently, Corning has closely examined the glass and coating components of optical fiber in a battery of environmental tests. Accelerated-life testing in various water-solution soaks and temperature-humidity cycling chambers demonstrate fiber's long service life.

Fiber research

In pursuit of a further understanding of fiber strength and longer fiber life factors, we have performed some other interesting experiments to test the product. Back in 1980, Corning's Product Engineering Laboratory initiated a test of fiber performance with an ambitious experiment called Procrustes (named for a Greek giant who stretched or shortened his captives to fit one of his iron beds). The Procrustes project was designed as a long-term, long-length static fatigue test using production fibers in field environments. Changes in ambient temperatures would thus stretch (expand) or shorten (contract) the fiber, as did Procrustes with his victims.

A narrow 935-foot trench was dug and inlaid with a wooden trough to house the fibers. More than 500 uncabled fibers were installed in the trough and held under tension by devices located in sheds at both ends of the trench. The trough was covered but the fiber otherwise was unprotected. Left exposed to the effects of temperature and humidity fluctuations, fiber measurements provided important strength-related field data.

Fiber cable is not as susceptible as coax to being dented or crushed. Although it is not recommended, field crews have been known to accidentally run over fiber cable with a truck, with no discernible effect on the fiber. As you might suspect, fiber-cable manufacturers have some elaborate tests of their own. They crush, bend, twist, shake and stretch-test their cable product for functional durability.

The fiber's light weight, small diameter and high flexibility are great handling advantages when compared with coaxial cable. These characteristics have sparked intense interest for many system operators.

System designs can be simplified not only by the reduced size and weight, but by the dielectric nature of glass. Optical cable is immune to magnetic and electrical interference and poses no shock or fire hazard, thus it can be run safely alongside high-voltage power lines. This opens new right-of-way possibilities where previously electromagnetic interference would have jeopardized the integrity of coaxial signal transmission. In one situation, a Bell Atlantic Telephone company found that the electrical discharge of two power lines touching a tree destroyed the jacketing of an optical cable caught in the middle. The exposed Corning fibers operated trouble-free for six months before the damage was discovered and repaired.

As installation crews gain experience installing optical cable, misconceptions about fiber fragility will fade and the way installers approach an optical cable project will change. In fact, optical cable installation can become as routine as coax with a little practice. This is not a product that requires a "Fragile—Glass" label. Fiber does indeed have the strength needed to provide reliable CATV service to cable customers. ■

Noise accumulation

By Joseph M. Baniak
Senior CATV Specialist
New York State Commission on Cable Television

With the growing number of large-screen and high-definition TV sets, controlling the noise component is more critical than ever before. Outlined is a review involving factors that have the greatest noise influence. During the testing of cable systems across New York state, we have noted noise to be the most common source of degradation of picture quality. The snowy or grainy pictures that result from poor signal-to-noise (S/N) ratios are probably the main subscriber complaint.

In electronics it is common practice to use tangible objects to express or form mental perceptions of what is taking place in electronic circuits. Water flow, for example, works well. For noise accumulation, the use of an inverted logarithmic pyramid showing area being added may be helpful to demonstrate the addition of noise.

In Figure 1 each square block is equal to the noise generated by a main line amplifier. A common amplifier specification has a noise figure of 9 dB or −50 dBmV. We will use this figure with a design input level of +10 dBmV.

Examining Figure 1 we find 64 square boxes stacked vertically in a logarithmic doubling configuration. This pyramid of area shows seven tiers of boxes.

Tier 1, which consists of Box 1, is the first amplifier's noise output and establishes our reference noise level. Tier 2 doubles the area of Tier 1 and thus produces a 3 dB increase in noise, which results in a loss of 3 dB in our overall carrier-to-noise (C/N) ratio. Tier 3 doubles the area of Tiers 1 and 2, producing another 3 dB increase in area. Tier 4 doubles all preceding tiers with four squares of its own to equal the accumulated four squares of Tiers 1, 2 and 3. Tier 5 has eight boxes to equal the accumulated area of Tiers 1 through 4. Tiers 6 and 7, respectively, equal all the tiers before them and, in like manner to the tiers before them, produce a doubling effect in the accumulated noise.

The similarities between the doubling effect of area and that of random electrical noise has many parallels and can work well as a visual aid to better understand noise accumulation in RF transportation systems.

Pitfalls of the pyramid

Obviously, a problem develops when, in a logarithmic diagram of vertical dimensions, one chops the independent parts on the horizontal plane algebraically. This becomes a paradox because, if we correct our individual box sizes to truly represent their effect in the horizontal addition of area, we lose our perspective of identical devices all with the same specification.

For example, Amplifiers 3 and 4 in Figure 1 appear to be equal contributors to the 3 dB gain of noise in Tier 3. However, Amplifier 3 actually contributes 1.76 dB, or approximately 59 percent of the noise in this tier. At the highest tier of the scale, Amplifier 33 adds 0.135 dB or approximately four percent of the total noise for this tier compared to Amplifier 64, which contributes 0.068 dB or approximately 2.3 percent of the total noise for Tier 7. In the diagram the equal parts of the boxes, how-

Figure 1

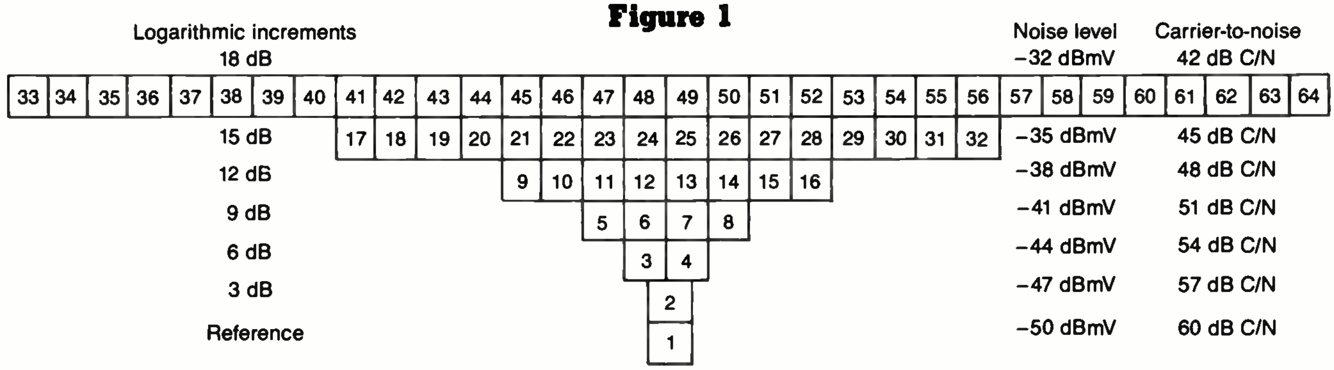
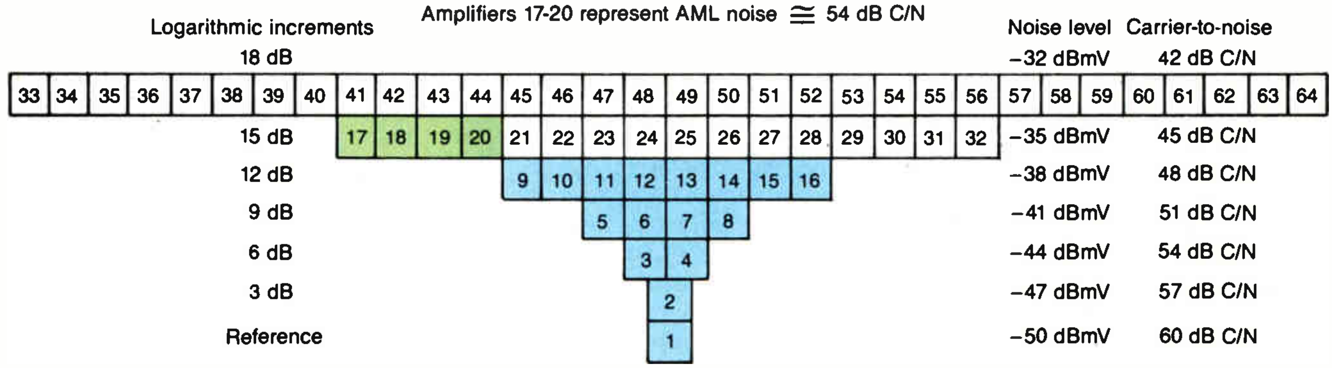
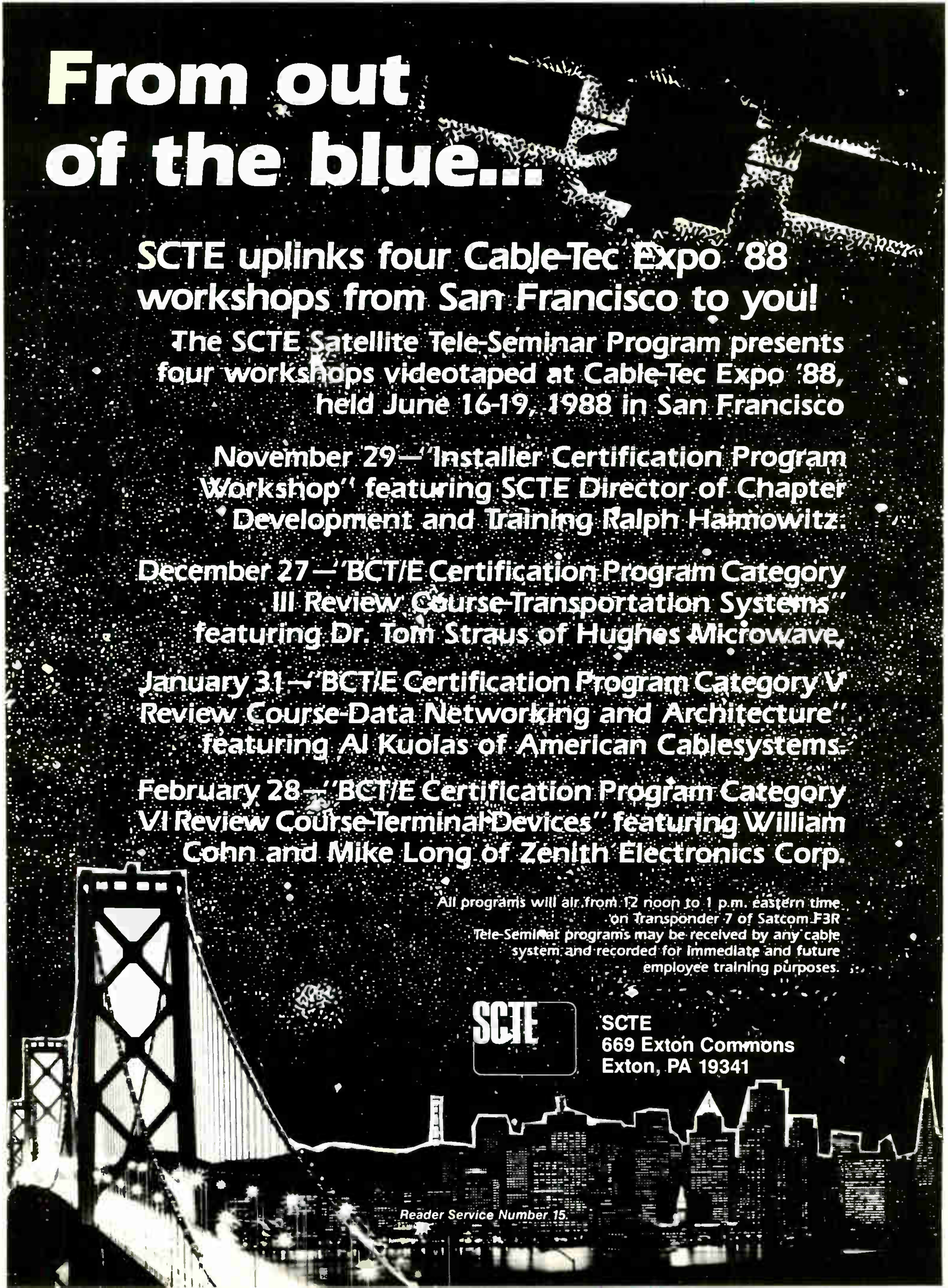


Figure 2

Amplifiers 1-16 represent satellite noise ≅ 48 dB S/N
Amplifiers 17-20 represent AML noise ≅ 54 dB C/N




From out of the blue...
SCTE uplinks four Cable-Tec Expo '88 workshops from San Francisco to you!
The SCTE Satellite Tele-Seminar Program presents four workshops videotaped at Cable-Tec Expo '88, held June 16-19, 1988 in San Francisco
November 29—"Installer Certification Program Workshop" featuring SCTE Director of Chapter Development and Training Ralph Haimowitz.
December 27—"BCT/E Certification Program Category III Review Course-Transportation Systems" featuring Dr. Tom Straus of Hughes Microwave.
January 31—"BCT/E Certification Program Category V Review Course-Data Networking and Architecture" featuring Al Kuolas of American Cablesystems.
February 28—"BCT/E Certification Program Category VI Review Course-Terminal Devices" featuring William Cohn and Mike Long of Zenith Electronics Corp.
All programs will air from 12 noon to 1 p.m. eastern time on Transponder 7 of Satcom F3R
Tele-Seminar programs may be received by any cable system and recorded for immediate and future employee training purposes.
SCTE
SCTE
669 Exton Commons
Exton, PA 19341
Reader Service Number 15.

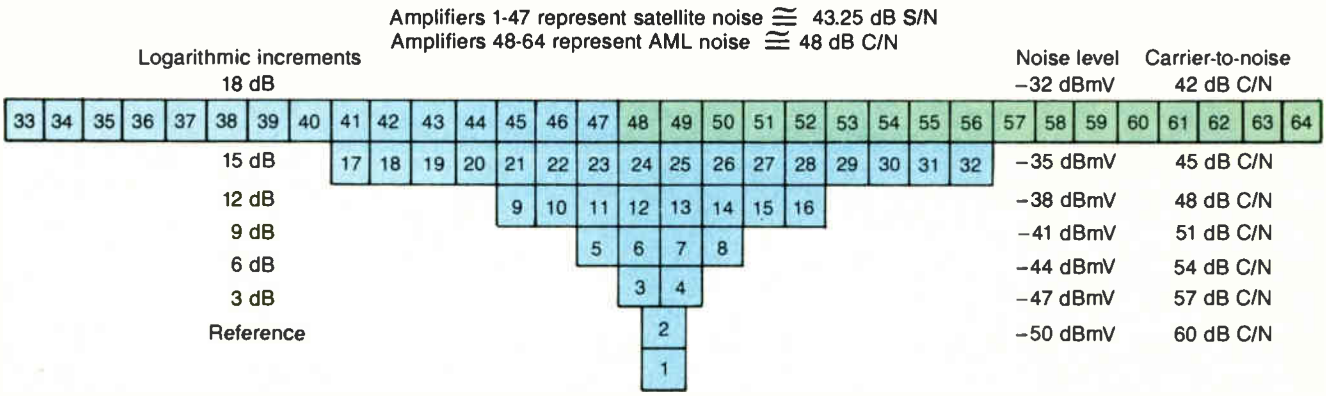


Figure 3

ever, look as though each amplifier adds 3.125 percent of the noise for this level.

Keeping this in mind, we will use Figure 1 to see where and to what extent significant noise is added to the signal by various stages of networking. If we substitute a square for each amplifier's generated noise (a square of noise), the pyramid becomes a 64-amplifier cascade representing the total level of noise generated by such a cascade.

Summarizing the pyramid, the right-hand column shows the actual level of noise expressed in decibel-millivolts and next to it the C/N for our typical CATV amplifier. The left column shows the doubling of area logarithmically in 3 dB increments.

By using the pyramid, the following perspectives are easy to understand about noise accumulation:

1) The first stages of the cascade, Amplifiers 1-8, generate 50 percent of all the noise in a 64-amplifier cascade. Amplifiers 1 to 8 add 9 dB of noise. To obtain another 9 dB of noise we need to add 56 more amplifiers!
2) If Amplifier 1 is faulty and generates twice its normal area of noise, it fills its box and that of Amplifier 2, which causes a 3 dB worsening of C/N. If Amplifier 16 becomes twice as noisy it fills its box plus that of Amplifier 17 on the next tier. Since it is only one of a possible 16 boxes on this tier, only a fractional part of the 3 dB increase will be realized. If we had a 16-amplifier cascade our performance would now look like a 17-amplifier cascade, or 0.263 dB of additional noise due to the 16th amplifier's additional noise.

Combining networks

Modern signal distribution systems are made of many noise-contributing networks, all of which impact on the quality of the signal. Amplitude modulated link (AML) and frequency modulated link (FML) microwave systems, dedicated transportation trunks, fiber-optic networks, satellite transmission systems and many other modes of signal delivery may supply the CATV distribution systems. When the noise contributions of these systems are expressed in the same terms as those in CATV distribution systems we may use the noise pyramid to evaluate system end-to-end noise performance.

For example: An AM microwave link that has an operating C/N specification of 54 dB is equivalent (from Figure 2) to four amplifiers in cascade. Should this network develop losses that reduce the C/N to 48 dB, the pyramid shows this would equate to 16 amplifiers in a distribution network. Using this higher noise feed for the distribution plant would give the output of the first main line amplifier noise characteristics equivalent to a 17-amplifier cascade and would measure as such.

This example clearly shows the importance of improving early stages in networking in establishing high ratios of carrier-to-noise.

S/N and C/N

All active transportation networks add their part to the overall noise in the desired signal. The sum of all transportation network noise is found in the baseband signal-to-noise ratio.

A camera or video source establishes the basic value of S/N. The object of all networking is to deliver a signal to the viewer that is as close to its original quality as possible. "Transparency" is the coined phrase—to have no visual degradation that can be attributed to the transportation network. The key is to keep the transportation network's C/N so much greater than the S/N that it will not have any significant effect.

For example, a videotape machine produces a 53 dB S/N that is modulated onto a network carrier with a 63 dB C/N. The two levels of noise will combine and result in a 52.58 dB S/N for our desired signal. For all purposes, transparency has been obtained.

Weighted, unweighted, CCIR (International Consultative Committee for Radio) weighting, EIA (Electronic Industries Association) weighting, etc., why all the various methods? Let's apply some common sense. As long as we have one standard for measurement and stick with it, we are comparing apples to apples. In CATV the C/N measurement is made by comparing the RMS (root mean square) value of noise with a resolution bandwidth of 4.2 MHz to the peak visual carrier level. By using a baseband S/N measurement that resembles this criteria the two measurements can be interchanged.

If we had the luxury of an extra megahertz of bandwidth to allow the noise of our video source to pass through our networks unimpaired, we could use this noise measurement spectrum at any point in our transportation link to make quality checks. As our signal went from carrier to carrier, transportation link to transportation link, we would always allow the noise measurement spectrum to pass through just like the desired video information.

This, in effect, would accumulate all the noise at the video signal and would be an easy quality check. Unfortunately, we can't. However, there are methods by which in-band active S/N measurements can be made with the same result as the total measurement of noise by all contributing factors upon our signal.

The Tektronix alternate S/N measurement procedure is a good one to follow. Briefly, the method allows for a 4.2 MHz bandpass with no weighting networks. A correction factor of 4 dB is added to the S/N measurement to satisfy Federal Communications Commission requirements for C/N. I believe it to be a worst-case adjustment and to compensate for the difference between peak or 100 percent carrier level and the modulated blanking level of 75 percent carrier where the S/N measurement is made.

Adding network noise

We have evaluated an AM microwave link that we can measure with standard RF noise measurement techniques. Let's look at a satellite-received signal where FM transmission is applied and the Tektronix alternate measurement technique could be used at the baseband level. If we interchange S/N measurement with C/N and assign equivalent amplifier cells for the noise present on the pyramid, we can see how a good local signal with a high S/N is affected with respect to a signal received by an earth station of marginal design performance.

In Figure 2 our first 16 amplifiers equate to a 48 dB S/N or C/N. If we shade these boxes in and add the distribution system we see that the first amplifier of the distribution network is really the 17th box and will perform as such with respect to noise. If we send this signal by AML microwave to a second headend, even with a good C/N performance of 54, which equals four of our distribution amplifiers, we now have effectively equaled 20 amplifiers before we get to our first distribution amplifier. Compare this to our locally originated signal that sees the first amplifier as truly the first amplifier, and the results are obvious.

In Figure 3 a more typical level of satellite performance and microwave network is shown. Amplifiers 1 through 47 would equal the noise produced by a satellite receiving system with a 43.26 dB S/N performance. Amplifiers 48 through 64 would be added to equal the 48 dB C/N of the AM microwave link. Under these conditions, at the first amplifier, the satellite signal looks like it has already passed through 64 amplifiers, which would be equal to a 42 dB C/N, while a local signal sees the first amplifier as truly the first amplifier.

Improving noise in the early stages in networking and distribution is very important. The use of the pyramid to help understand noise accumulation gives visual perspective to what is happening. Substituting the equivalent number of amplifiers to the transportation network's noise level helps show where we stand and what we can expect our noise component to be as signal passes through all stages of networking and distribution. ■

Why everyone should know CPR

By Bob Luff
Group Vice President of Technology, Jones Intercable

'I think I'm....heart attack," were the faint words barely heard from a fellow attendee sitting in the front row of the Construction Practices session at the Society of Cable Television Engineers' Conference and Cable-Tec Expo. What happened during the 15-minute catastrophe is a blemish on the whole industry.

The following events are as true as I can remember them and are recounted here not to embarrass anyone (myself included), but to show how apathetic and ill-prepared our industry has become about fellow employee medical emergency preparedness. I hope this account will inspire a desperately needed industrywide focus on employee cardiopulmonary resuscitation (CPR) and first aid training.

'I think I'm...heart attack'

After those faint words for help, everyone just continued on with what they were doing. Maybe it was initial disbelief. Or maybe some did not hear the heart attack victim's whispered call for help—although I was sitting several rows back and heard his words quite clearly. From the back he looked about mid-30s and was still sitting upright in his chair, but now with one arm slightly raised to seek attention from his unresponsive classmates.

"I think I'm having a heart attack," he again weakly whispered. Everyone still remained in their places, I suppose still in a state of disbelief. But as an intense hush rolled across the room, the mood began to quickly pass from disbelief to belief. Yet no one came to his aid.

The problem was, no one in the room had enough CPR or even basic first aid training to confidently know what to do in an apparent heart attack situation.

Of all groups, one would expect our construction crews and supervisors to be the industry's most trained and experienced employees in basic first aid. Even if there were doubts or concerns as to just what aid to administer, there was no excuse whatsoever for not spontaneously taking care of the most primitive basics—sending for medical help and making the patient comfortable.

The session moderator was the first to hesitantly move toward the stricken attendee. The moderator asked, as I recall, "I beg your pardon?" And once more, the victim said in a shallow voice, "I think I'm having a heart attack."

At this point, a few of us left our seats and cautiously approached the victim. But, none of us did anything constructive; we all just stood around the panicked victim in a circle for several more minutes, internally debating about what to do and wishing someone had enough first aid training to do something.

A major problem, to us, which should be mentioned, was that the victim was still conscious, sitting upright, and able to talk. In hindsight, he was in no shape to direct us through his crisis, but that is what we were expecting since he could speak. We may have been responsive if the victim had turned blue and slumped forward, unconscious. But it was not, as I recall, until the victim himself answered "yes" to our question of sending for help that someone left the room to do so.

Until this point in time, what was actually done to aid the patient for perhaps as much as five minutes of this potentially life and death situation, was *nothing*. The first minute or two was spent looking at each other waiting for *someone else* to do something. The remaining time was spent chatting with the victim.

Uncertainty in even the basics

Once aid finally had been sent for, we seemed to be more willing to provide at least some useful assistance. Although many errors were committed, someone suggested that he should lay down flat, which he did with questionable assistance from us. Then discussions broke out as to whether his head or feet should be elevated or whether he should remain flat. No one knew the answer, so we left him flat. His head seemed uncomfortable, so we did roll up a tablecloth into a makeshift pillow. About this point, we thought it might be a good idea to loosen his tie and collar button.

He said his heart was "beating a mile a minute." I placed my hand on his chest and upon feeling the frightening pulse and intensity, I jerked my hand away and exclaimed, "My God." This obviously further upset the patient. Needless to say in hindsight, I do not know how I could have been so insensitive. The patient complained of being cold, so we used several more tablecloths to make a blanket to cover him from the neck down.

Help finally arrives

The person sent to seek help went to the SCTE registration area where Steve Cox, SCTE's new executive director, was on duty. Steve immediately called the front desk and gave them the details including the location of the victim. Steve then rushed to aid us.

Steve had had extensive medical training in the service, and his control and confidence of the situation was as much a relief to the patient as it was to all of us in the room. He immediately assured the patient that help was on the way, and to just relax. He checked the patient's vital signs, asked various pertinent questions, again reassured him that it did not look serious to him, and told him to try to remain as relaxed as possible. Steve then made minor adjustments to our makeshift pillow, and sponged off the patient's perspiring forehead with a dampened cloth napkin.

A few minutes later, the hotel security police arrived and it was obvious that they too were well trained in CPR and first aid. I think all of us were feeling very bad that we had done so little initially for the patient, due to our lack of proper training.

The security police were able to relay precise patient conditions to a rescue squad with their hand-held two-way radios. And, in just a few more minutes, they arrived with stretchers, oxygen and all the other needed items.

While everyone else, including the victim, was doing their job flawlessly, I'm afraid we were still bungling around. You see, the rescue squad rushed the patient to the hospital and none of us even offered to go with him.

I did learn that the patient lived through the heart attack—and us.

I do not know how well I have been able to capture the intense feeling of frustration I felt, helplessly standing by during this life and death situation of a fellow human being. It was an experience I would not wish on anyone. ■

Reprinted from "Communications Technology" magazine, July 1984.

Decibels (Part 6)

By Ron Hranac
Jones Intercable Inc.

RF signal levels in a cable system are easily expressed as voltage or power. Because Ohm's Law states that I = E/R (where I = current, E = voltage and R = resistance), those levels also can be expressed as current. Like voltage and power, the numbers used to represent RF current in a cable system are rather small. Here, too, the decibel can be used to simplify the mathematics of cable television.

The following table provides dBmV to milliampere conversions from −20 dBmV to +20 dBmV, when the impedance is 75 ohms. The formulas from which this table was derived appear below. Examples of their use are on the next page.

dBmV	milliamperes	dBmV	milliamperes
−20	.001333	0	.013333
−19	.001496	+ 1	.014960
−18	.001679	+ 2	.016786
−17	.001883	+ 3	.018834
−16	.002113	+ 4	.021132
−15	.002371	+ 5	.023710
−14	.002660	+ 6	.026603
−13	.002985	+ 7	.029850
−12	.003349	+ 8	.033492
−11	.003758	+ 9	.037578
−10	.004216	+10	.042164
− 9	.004731	+11	.047308
− 8	.005308	+12	.053081
− 7	.005956	+13	.059558
− 6	.006682	+14	.066825
− 5	.007498	+15	.074979
− 4	.008413	+16	.084128
− 3	.009439	+17	.094393
− 2	.010591	+18	.105910
− 1	.011883	+19	.118833
		+20	.133333

To convert millivolts to milliamperes, use the formula

$$I(mA) = mV/75$$

To convert milliamperes to millivolts, use the formula

$$E(mV) = mA \times 75$$

Problem
What current will a 5 millivolt RF signal produce in a 75 ohm impedance CATV distribution cable?

Solution
Use the formula

$$I(mA) = mV/75 = 5/75 = 0.066667 \text{ mA}$$

Problem
Convert +48 dBmV to amperes, assuming a 75 ohm impedance.

Solution
First, convert +48 dBmV to millivolts (see the August 1988 "Installer's Tech Book").

$$mV = 10^{\frac{dBmV}{20}}$$

$$= 10^{\frac{48}{20}}$$

$$= 10^{2.4}$$

$$= 251.19 \text{ mV}$$

Next, convert 251.19 millivolts to milliamperes with the formula

$$I(mA) = mV/75 = 251.19/75 = 3.35 \text{ mA}$$

Since 1 milliampere equals 0.001 ampere, you must divide milliamperes by 1,000 to determine the answer in amperes:

$$3.35 \text{ mA}/1{,}000 = 0.00335 \text{ ampere}$$

Problem
What level in dBmV will a 0.001 milliampere RF signal produce across 75 ohms?

Solution
First, convert 0.001 milliamperes to millivolts with the formula

$$E(mV) = mA \times 75 = 0.001 \times 75 = 0.075 \text{ mV}$$

Next, convert 0.075 millivolts to dBmV (see the August 1988 "Installer's Tech Book").

$$dBmV = 20\log_{10}(mV) = 20\log_{10}(0.075) = 20(-1.124939) = -22.499 \text{ dBmV}$$

Leakage detectors speed service calls

By Steve Kerrigan
Senior Technician, Community Cablevision Co.

Cumulative leakage index (CLI) testing will affect the workload (and paperwork) of cable operations nationwide. When adherence to the Federal Communications Commission-imposed CLI begins July 1, 1990, it will be too late to start on leakage detection. *Now* is the time to correct leaks and run a tight system.

CLI is only a factor to quantify leakage. Already, there are regulations on the books stating that we must monitor and keep leakage in check to operate frequencies in the aeronautical bands (108-137 and 225-400 MHz). With the new CLI regulations, cable operators must enter leakage detection and repair information in a log book. For field personnel, this added paperwork is just something more we must do.

However, one of the less negative aspects of CLI is that we must now (or very soon) carry leakage detection receivers. Since many picture impairments are caused by signal ingress, the detector will speed the process of locating problems. Employing the detector can reduce the time spent solving problems on service calls and outages. As well, two tasks can be completed for the same repair—trouble call solved and a leak recorded.

There are several types of detectors on the market. Some are mounted on a vehicle, some are portable but bulky. Still others can be used in the truck, with DC and external antennas, and quickly detached for carrying on the tech's belt. The detectors that emit a high-pitched squeal rising in pitch as you near the leak are easy to operate as they guide you to the fault.

Just by keeping the detector constantly turned on, a leak often can be found and the problem eliminated before arriving at the customer's house. Cracked, broken or corroded sheaths and/or loose connectors are some examples of high-intensity leaks that reduce picture quality. In older systems, some of the original connectors are frequenty a problem because of their design.

Because buried or damaged underground vaults often result in damaged cable, we have found buried vaults with detectors. Of course, there must be a strong leak to find a buried vault. On service calls for low signal, if the sheath is damaged, the cable will usually leak badly.

Recently, we had an outage on one feeder leg passing down a greenbelt. The problem was quickly isolated to the run between two taps. We noticed freshly set metal fenceposts. The detector squealed loudly when we passed one of the posts. The homeowner acknowledged that the cable went out when the posts were being set. We dug up the offending post and repaired the damage. Not only did the detector quickly find the problem, but we did not need to use more time-consuming troubleshooting techniques.

"Service calls and installations are the best time to check for leaks in the home."

By using detectors inside the home, problems can be found quickly and small leaks corrected. By tightening loose fittings, in many cases the leak can be repaired before the customer even notices picture impairment. With an A/B switch and other hardware in the install, there is ample chance for several loose fittings, creating leaks. Some flaws in the home also can be found. Pre-wires damaged in construction sometimes leak, as do relocates around carpet tack strips. Carpet tacks and staples can pierce the cable, causing leaks and bad pictures.

Sometimes customers attempt their own cable connections in the home. If a leak that emanates from a customer's home is found during routine patrol, gaining admittance to the home may be a problem. Especially with a guilty conscience, a sub most likely won't want to allow a tech inside. So, service calls and installations are the best time to check for leaks in the home.

Improper hookups to A/B switches, illegal outlets and homemade relocates are other causes of leaks in the home. Customers often make wrong and/or poor connections at the TV or splitter. Also, changing from 75 ohm to 300 ohm cable, with or without a balancing transformer, can cause a leak. Homemade splices without connectors will leak, cause low signal and ghosting—all of which are easily discovered without detectors. Connections using bad technical practices and poor mechanical integrity will usually leak.

Finally, don't think of CLI as one more regulation that must be dealt with. Our goal is to provide quality pictures to our subscribers. Use the leakage detector as another tool in troubleshooting, in addition to volt ohmmeters, signal strength meters and brains, to get the job done swiftly. ■

NaCom confirms training commitment

By Byron Leech
President, National Cable Television Institute

In an industry that daily receives word of major new alliances being formed, multimillion-dollar contracts being inked and technical breakthroughs being brought forth, another new contract signing is often lost in the shuffle. But many times in these forgotten stories the future of the industry is being foretold.

That is the case with the announcement last month of a contract signing between NaCom, a leading construction and installation company, and National Cable Television Institute. The agreement calls for NaCom to make available to hundreds of its employees nationwide NCTI's full range of technical training correspondence courses, including Installer, Installer Technician, Service Technician, System Technician, Advanced Technician, CATV System Overview and Broadband RF Technician. While providing a means for employees to increase their technical knowledge and professionalism is hardly earth-shaking news, in this case there is a very important story behind the story.

Early in its existence, NaCom reduced its corporate philosophy to writing to give guidance to its employees and customers. While this act in itself is unfortunately rare, there is more to the story. Alongside tenets such as: "Our people are our most important asset," "We are committed to identify and satisfy the needs of our customers and our prospective customers; with honesty and integrity" and "Our performance standards exceed industry standards and are unwavering" is this credo: "Training and continuing education of our employees strengthens our company and enables us to serve our customers better."

Byron Leech, president of NCTI, and NaCom President Larry Linhart complete the contract reinforcing NaCom's commitment to technical training.

To further clarify its commitment to a well-trained, professional work force, the company amplified its corporate philosophy by issuing a written commitment to quality and customer service. The first point in this commitment statement reads: "We believe quality of workmanship is improved through education."

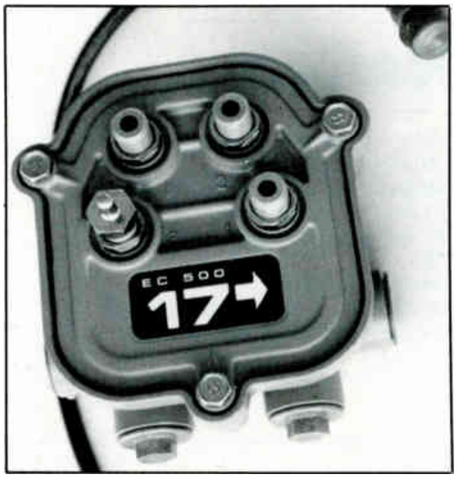
While it is easy for a company to say this, it is often hard to do something about it. NaCom's agreement with NCTI proves its commitment is much more than just lip service and that it is once again willing to take an industry-leading posture.

Since its inception in 1968, NCTI courses have trained over 27,000 industry professionals. The company is exclusively devoted to technical training in the cable television industry. Currently, over 4,000 students representing 2,600 systems and multiple system operators (MSOs) are enrolled in NCTI programs. The company serves 24 of the top 25 MSOs.

NaCom's commitment exemplifies the industry's growing awareness that training saves money. The investment in well-prepared, professional employees decreases the number of employees needed to do the same work, increases the quality of the work done, increases customer satisfaction and decreases churn. MSOs are realizing this more and more. NaCom is evidence that installation and construction contracting companies are coming to the same conclusion. In fact, NCTI's student enrollments are up more than 30 percent this year and the number of industry companies coming to NCTI continues to grow.

If you would like to discuss how training can save your operation money, call me or Jerry Neese at (303) 761-8554, or write to us at National Cable Television Institute, P.O. Box 27277, Denver, Colo. 80227. ■

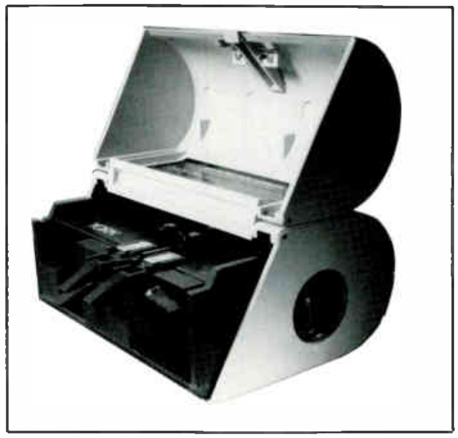
Business Directory



Connector protector

The End Cap Protector from Insulation Systems is an air-shrinkable, waterproof device that prevents moisture from getting into connectors when disconnecting cable service. They are made of PVC material, pre-expanded and sealed in a foil package. Once installed on the connector, sealing occurs automatically and provides 100 percent uniform covering and environmental seal, according to the company.

For further details, contact Insulation Systems, 461 Nelo St., Santa Clara, Calif. 95050, (408) 986-8444; or circle #138 on the reader service card.



Fiber cleaver

The FK11 fiber cleaver from York Technology uses an electronically tuned, ultrasonic vibrating diamond blade that carries out up to 20,00 cleaves. The unit can be adjusted for a range of diameters for both single- and multimode fiber with cleaves typically under 0.5 degrees. According to the company, the use of this blade reduces fiber damage due to compressive stresses from anvil use and eliminates contamination of the cleaved end.

For additional information, contact York Technology, 210 N. Glenoaks Blvd., Suite C, Burbank, Calif. 91502, (818) 955-8927; or circle #133 on the reader service card.

F connector

Augat/LRC Electronics' Snap-N-Seal F connector is triple sealed and requires no crimping. According to the company, 360° compression on the cable jacket ensures a complete radial seal, eliminating moisture migration path and problems encountered with rubber boots due to inconsistency of port lengths on mating equipment.

For more information, contact LRC Electronics, 901 South Ave., Box 111, Horseheads, N.Y. 14845, (607) 739-3844; or circle #135 on the reader service card.

U.S. Postal Service
STATEMENT OF OWNERSHIP, MANAGEMENT AND CIRCULATION
Required by 39 U.S.C. 3685)

1A. TITLE OF PUBLICATION: IT- Installer Technician
1B. PUBLICATION NO: 0 1 0 4 1 2 5 3
2. DATE OF FILING: 9-29-88
3. FREQUENCY OF ISSUE: MONTHLY
3A. NO. OF ISSUES PUBLISHED ANNUALLY: 12
3B. ANNUAL SUBSCRIPTION PRICE: $-0-
4. COMPLETE MAILING ADDRESS OF KNOWN OFFICE OF PUBLICATION: 12200 E Briarwood Ave. Suite 250, Englewood COlorado 80112
5. COMPLETE MAILING ADDRESS OF THE HEADQUARTERS OF GENERAL BUSINESS OFFICES OF THE PUBLISHER: 12200 E Briarwood Ave. Suite 250, Englewood, Colorado 80112
6. FULL NAMES AND COMPLETE MAILING ADDRESS OF PUBLISHER, EDITOR, AND MANAGING EDITOR
PUBLISHER: Paul R. Levine - 12200 E Briarwood Ave Suite 250, Englewood CO 80112
EDITOR: Toni I Barnett- 12200 E Briarwood Ave Suite 250, Englewood CO 80112
MANAGING EDITOR: Rikki J Lee- 12200 E Briarwood Ave Suite 250, Englewood CO 80112
7. OWNER

FULL NAME	COMPLETE MAILING ADDRESS
CPI-Paul R Levine	12200 E Briarwood Ave Suite 250 Englewood CO
United Cable Television	[illegible]

8. KNOWN BONDHOLDERS, MORTGAGEES, AND OTHER SECURITY HOLDERS OWNING OR HOLDING 1 PERCENT OR MORE OF TOTAL AMOUNT OF BONDS, MORTGAGES OR OTHER SECURITIES

FULL NAME	COMPLETE MAILING ADDRESS

9. FOR COMPLETION BY NONPROFIT ORGANIZATIONS AUTHORIZED TO MAIL AT SPECIAL RATES
☐ (1) HAS NOT CHANGED DURING PRECEDING 12 MONTHS ☐ (2) HAS CHANGED DURING PRECEDING 12 MONTHS

10. EXTENT AND NATURE OF CIRCULATION	AVERAGE NO. COPIES EACH ISSUE DURING PRECEDING 12 MONTHS	ACTUAL NO. COPIES OF SINGLE ISSUE PUBLISHED NEAREST TO FILING DATE
A. TOTAL NO. COPIES (Net Press Run)	9,400	10,000
B. PAID AND/OR REQUESTED CIRCULATION 1. Sales through dealers and carriers, street vendors and counter sales		
2. Mail Subscription (Paid and/or requested)	9,000	9,185
C. TOTAL PAID AND/OR REQUESTED CIRCULATION (Sum of 10B1 and 10B2)	9,000	9,185
D. FREE DISTRIBUTION BY MAIL, CARRIER OR OTHER MEANS SAMPLES, COMPLIMENTARY, AND OTHER FREE COPIES	300	615
E. TOTAL DISTRIBUTION (Sum of C and D)	9,300	9,800
F. COPIES NOT DISTRIBUTED 1. Office use, left over, unaccounted, spoiled after printing	100	200
2. Return from News Agents	—	
G. TOTAL (Sum of E, F1 and 2—should equal net press run shown in A)	9,400	10,000

11. I certify that the statements made by me above are correct and complete. SIGNATURE AND TITLE OF EDITOR, PUBLISHER, BUSINESS MANAGER, OR OWNER: Paul R. Levine Publisher

PS Form 3526, Dec. 1985 (See instruction on reverse)

Brochure

A brochure about Manta Ray utility anchors is now available from Foresight Products. This brochure contains complete installation instructions illustrated in color and photos and descriptions of the equipment needed to install the anchors. Also included are illustrated descriptions of methods of anchoring poles in extremely hard soils, methods for temporary guying of utility poles and complete specifications of the entire anchor line.

For further information, contact Foresight Products, 6430 E. 49th Dr., Commerce City, Colo. 80037, (800) 325-5360; or circle #132 on the reader service card.

You and the SCTE

(Continued from page 11)

Gateway Chapter
Contact: Darrell Diel, (314) 576-4446
Golden Gate Chapter
Contact: Tom Elliott, (408) 727-3900
Great Lakes Chapter
Contact: Daniel Leith, (313) 549-8288
Greater Chicago Chapter
Contact: William Gutknecht, (312) 690-3500
Heart of America Chapter
Contact: Wendell Woody, (816) 474-4289
Hudson Valley Chapter
Contact: Wayne Davis, (518) 587-7993; or Bob Price, (518) 382-8000
Iowa Heartland Chapter
Contact: Dan Passick, (515) 266-2979
Miss/Lou Chapter
Contact: Rick Jubeck, (601) 992-3377
New England Chapter
Contact: Bill Riley, (617) 472-1231
North Central Texas Chapter
Contact: Vern Kahler, (817) 265-7766
North Country Chapter
Contact: Douglas Ceballos, (612) 522-5200
North Jersey Chapter
Contact: Art Muschler, (201) 672-1397
Ohio Valley Chapter
Contact: Robert Heim, (419) 627-0800
Oklahoma Chapter
Contact: Gary Beikman, (405) 842-2405
Old Dominion Chapter
Contact: Margaret Harvey, (703) 238-3400
Piedmont Chapter
Contact: James Kuhns, (704) 873-3280
Razorback Chapter
Contact: Jim Dickerson, (501) 777-4684
Rocky Mountain Chapter
Contact: Steve Johnson, (303) 799-1200
Tip-O-Tex Chapter
Contact: Arnold Cisneros, (512) 425-7880
West Texas Chapter
Contact: Jerry Whitehead, (915) 655-8911
Central California Meeting Group
Contact: Andrew Valles, (209) 453-7791; or Dick Jackson, (209) 384-2626
Chaparral Meeting Group
Contact: Michael Gormally, (505) 761-6200
Chesapeake Meeting Group
Contact: Thomas Gorman, (301) 252-1012
Dairyland Meeting Group
Contact: Jeff Spence, (414) 738-3180
Dixie Meeting Group
Contact: Greg Harden, (205) 582-6333
Inland Empire Meeting Group
Contact: Michael Lajko, (208) 263-4070
Michiana Meeting Group
Contact: Thomas White, (219) 259-8015
Midlands Cable Training Association
Contact: John Page, (712) 323-0420
Mt. Rainier Meeting Group
Contact: Bill Donaldson, (206) 742-5811
Palmetto Meeting Group
Contact: Rick Barnett, (803) 747-1403
Southeast Texas Meeting Group
Contact: Harold Null Jr., (713) 645-3738
Southern California Meeting Group
Contact: Tom Colegrove, (805) 251-8054
Tennessee Meeting Group
Contact: Joe Acker, (205) 932-7264
Upstate New York Meeting Group
Contact: Ed Pickett, (716) 325-1111
Utah Meeting Group
Contact: Roger Peterson, (801) 486-3036.
Wyoming Meeting Group
Contact: Jim Niswender, (307) 324-2286 ■

Calendar

November

Nov. 9-11: Magnavox CATV training seminar, Boston. Contact Amy Costello, (800) 448-5171.

Nov. 10: SCTE Upstate New York Meeting Group technical seminar on video and audio signals and systems, Burgundy Basin Inn, Rochester, N.Y. Contact Ed Pickett, (716) 325-1111.

Nov. 13-14: SCTE Old Dominion Chapter technical seminar, Holiday Inn, Richmond, Va. Contact Margaret Harvey, (703) 248-3400.

Nov. 14-16: SCTE Technology for Technicians seminar, Luxbury Hotel, Charlotte, N.C. Contact (215) 363-6888.

Nov. 14-17: Siecor Corp. technical seminar on fiber-optic installation and splicing for LANs, building and campus applications, Hickory, N.C. Contact (704) 327-5539.

Nov. 14-18: Hughes Microwave technical training seminar on channelized transmitters, Torrance, Calif. Contact (213) 517-6244.

Nov. 15: SCTE Chesapeake Meeting Group technical seminar and BCT/E testing on Categories I, II, III and IV, Holiday Inn, Columbia, Md. Contact Thomas Gorman, (301) 252-1012.

Nov. 15-16: Trellis Communications fiber-optics seminar, Key Bridge Marriott, Arlington, Va. Contact Richard Cerny, (603) 898-3434.

Nov. 15-17: Magnavox CATV training seminar, Boston. Contact Amy Costello, (800) 448-5171.

Nov. 15-17: C-COR Electronics technical seminar, New Orleans. Contact Shelley Parker, (800) 233-2267.

Nov. 16: SCTE North Central Texas Chapter technical seminar on fiber optics. Contact Vern Kahler, (817) 265-7766.

Nov. 16: SCTE Mt. Rainier Meeting Group technical seminar and BCT/E testing, Martha Lake Community Center, Seattle. Contact Russ Eldore, (206) 251-6760.

Nov. 16: SCTE Piedmont Chapter technical seminar. Contact James Kuhns, (704) 873-3280.

Nov. 16: SCTE Razorback Chapter technical seminar on CLI, Days Inn, Little Rock, Ark. Contact Jim Dickerson, (501) 777-4684.

Nov. 16-18: National Satellite Programming Network's Private Cable Show, Sheraton Denver Tech Center, Denver. Contact Nancy Toman, (713) 342-9655.

Nov. 21-23: Magnavox CATV training seminar, Syracuse, N.Y. Contact Amy Costello, (800) 448-5171.

Nov. 28-30: Siecor Corp. technical seminar on fiber-optic overview for management and supervisory personnel in LANs, building and campus applications, Hickory, N.C. Contact (704) 327-5539.

Nov. 29: SCTE Satellite Tele-Seminar Program, "SCTE Installer Certification Program workshop," 12-1 p.m. ET on Transponder 7 of Satcom F3R. Contact (215) 363-6888.

Nov. 29-30: Trellis Communications fiber-optics seminar, Holiday Inn, Las Vegas, Nev. Contact Richard Cerny, (603) 898-3434.

December

Dec. 6: SCTE Interface Practices Committee meeting, Hilton Hotel, Anaheim, Calif. Contact Tom Elliot, (303) 721-5349; or Joe Lemaire, (415) 361-5792.

Dec. 7: SCTE Greater Chicago Chapter technical seminar on CLI. Contact William Gutknecht, (312) 690-3500.

Dec. 7: SCTE Delaware Valley Chapter technical seminar on system preventive maintenance, Williamson Restaurant, Horsham, Pa. Contact Diana Riley, (717) 764-1436.

Dec. 7-8: Trellis Communications fiber-optics seminar, Bay Harbor Inn, Tampa, Fla. Contact Richard Cerny, (603) 898-3434.

Dec. 7-9: Western Show, Convention Center, Anaheim, Calif. Contact (415) 428-2225.

Dec. 10: SCTE Rocky Mountain Chapter technical seminar on video and audio. Contact Steve Johnson, (303) 799-1200.

Dec. 13: SCTE Chattahoochee Chapter technical seminar, a tour of AT&T's fiber manufacturing plant. Contact Dick Amell, (404) 394-8837.

Dec. 14: SCTE Oklahoma Chapter technical seminar. Contact Herman Holland, (405) 353-2250.

Dec. 27: SCTE Satellite Tele-Seminar Program, a BCT/E review course on Category III, 12-1 p.m. ET on Transponder 7 of Satcom F3R.

Upcoming

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

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

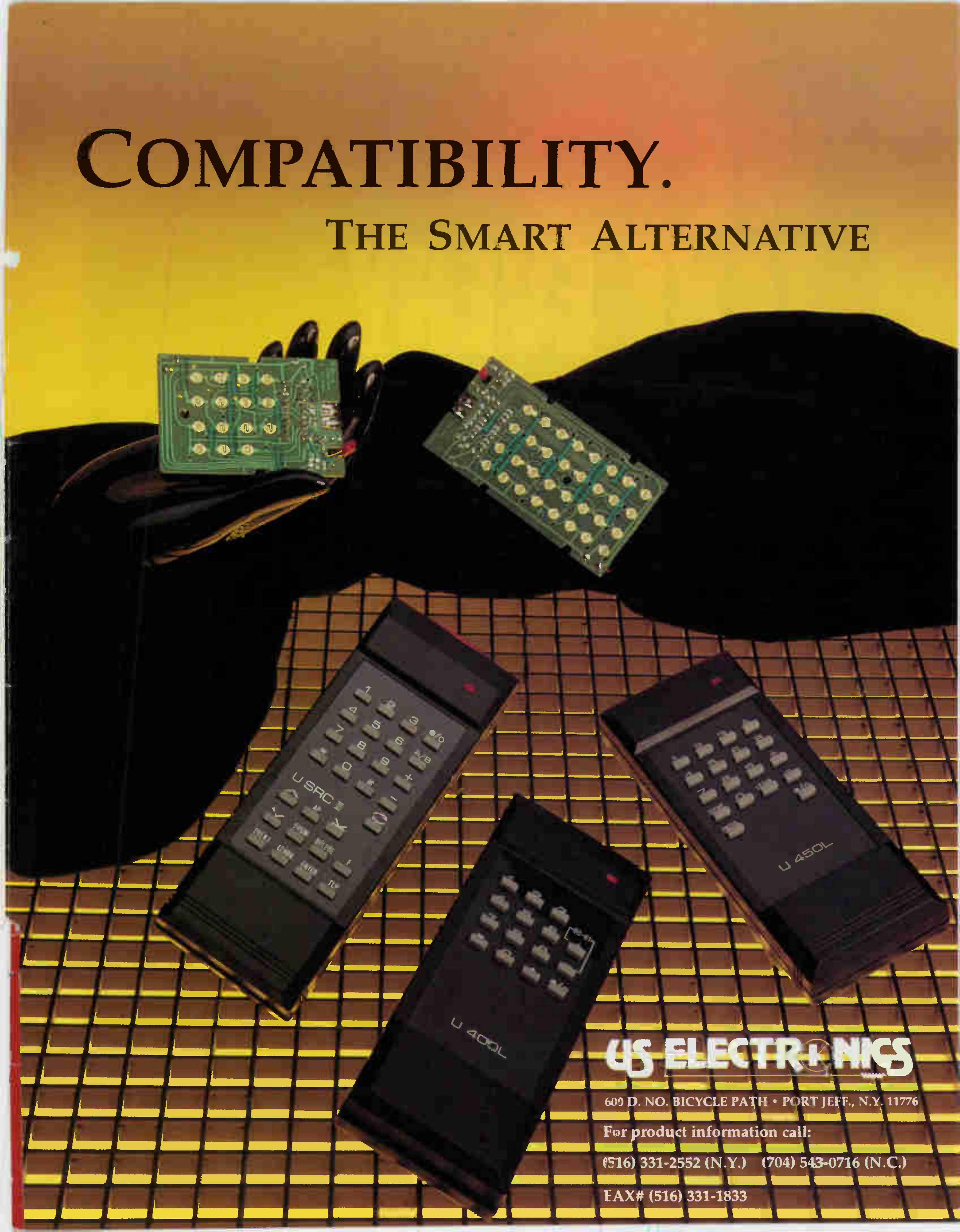
May 21-24: NCTA Show, Convention Center, Dallas.

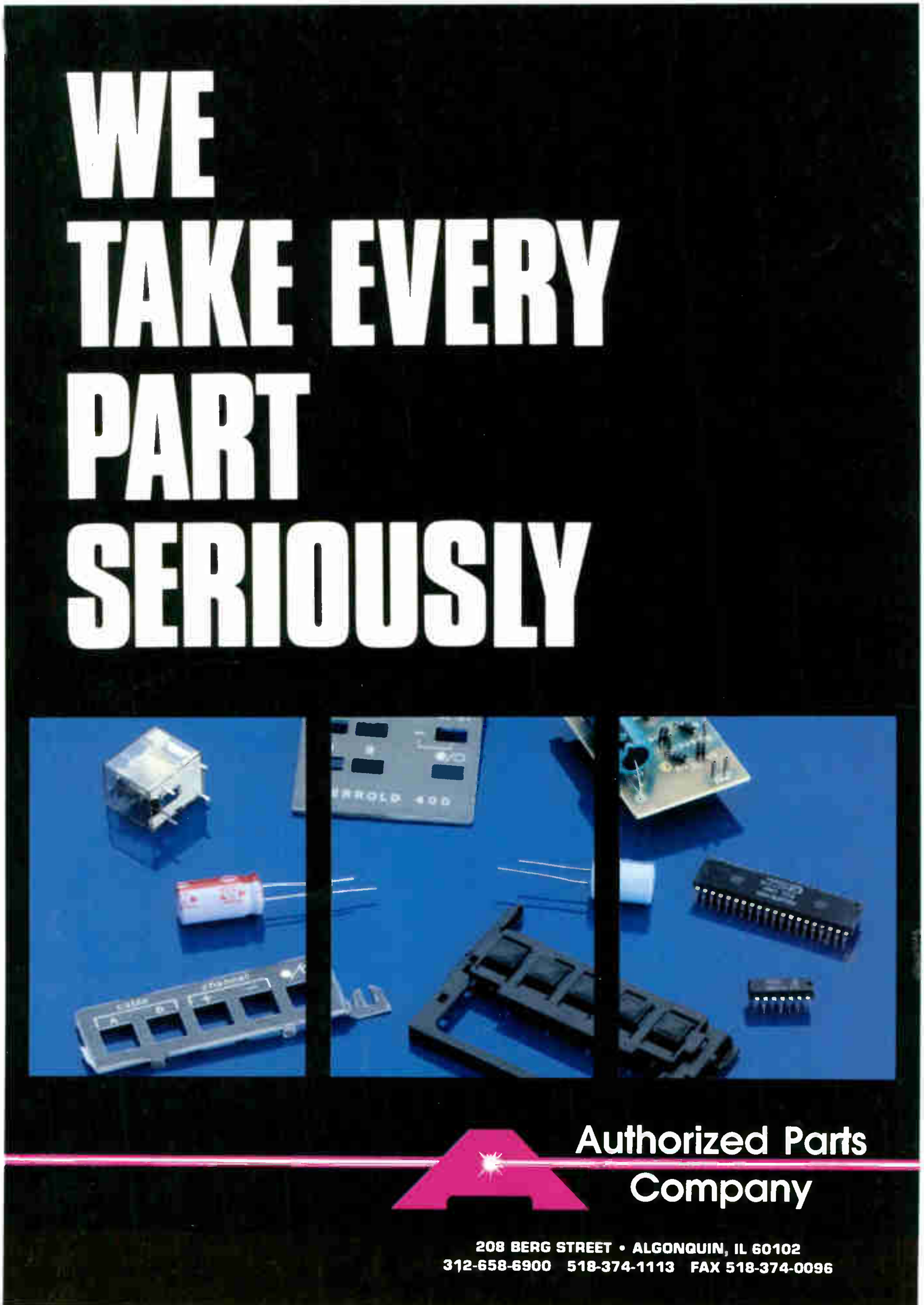
June 15-18: Cable-Tec Expo '89, Orange County Convention Center, Orlando, Fla.

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

Sept. 19-21: Great Lakes Show, Columbus, Ohio.

Ad Index


COMPATIBILITY.
THE SMART ALTERNATIVE
U 400L
U 450L
US ELECTRONICS
609 D. NO. BICYCLE PATH • PORT JEFF., N.Y. 11776
For product information call:
(516) 331-2552 (N.Y.) (704) 543-0716 (N.C.)
FAX# (516) 331-1833


WE
TAKE EVERY
PART
SERIOUSLY
Authorized Parts
Company
208 BERG STREET • ALGONQUIN, IL 60102
312-658-6900 518-374-1113 FAX 518-374-0096